Aviation Week & Space Technology

75 Cents

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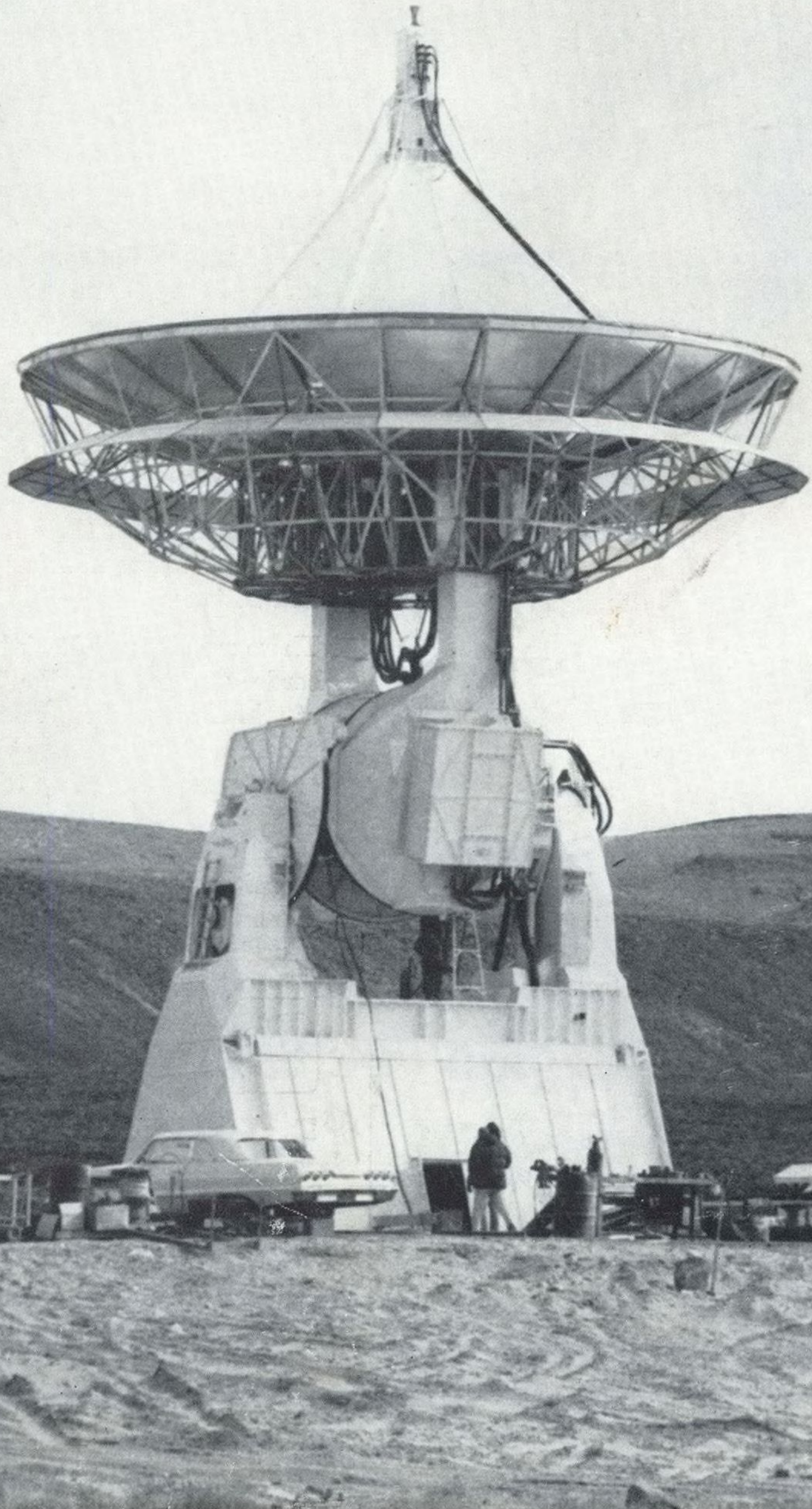
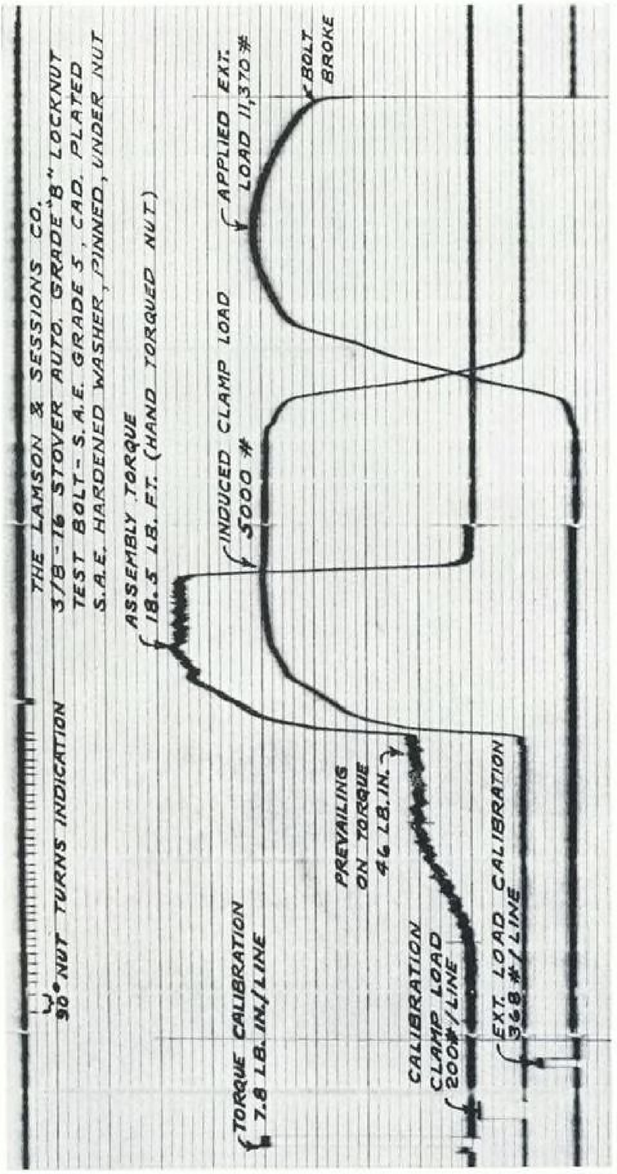
January 7, 1963

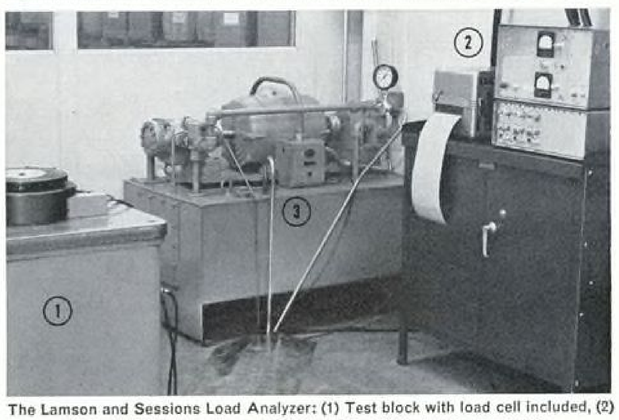
SPECIAL REPORT:

Lockheed C-130 STOL Version

Philco 40-ft. X-Y Tracking Antenna







The Lamson and Sessions Load Analyzer: (1) Test block with load cell included, (2) Honeywell Model 906 Visicorder and 119 Amplifier, (3) Hydraulic pump unit.

The Honeywell Visicorder watches a bolt do the twist

When measuring the dynamic effects of torque and load on a bolt fastener, Lamson and Sessions found that fast rise-time was the most essential characteristic of the measuring instrument.

The high frequency response of the Visicorder Oscillograph (DC to 5000 cps) thus made it the choice for measuring these sudden loads applied by an impact wrench.

The Lamson and Sessions studies have charted the complex relationships of joint components under load. Some of these relationships are: fastener strength; relaxation properties; optimum clamping load for a given size and strength of fastener; bearing areas adequate to prevent embedding; the number, size, and strength of fasteners consistent with the greatest strength, lightest weight, and lowest cost; and proper assembly techniques. Visicorder recordings have provided the knowledge of these factors necessary to point the way to new fastener specifications and designs.

There are six models of the Honeywell Visicorder Oscillograph. You'll find at least one of them designed to meet your specific test program requirements. Visicorders offer recording capacity of up to 36 data channels. Paper speeds vary from .1 inch per hour to 160 inches per second, depending upon the model you select. Thus, a Visicorder can be chosen which will present your data on the time base most meaningful to your test.

For full specifications on all Visicorder Oscillographs, write Minneapolis-Honeywell, Heiland Division, Denver 10, Colorado. Or phone 303-794-4311.

DATA HANDLING SYSTEMS

Honeywell

HONEYWELL INTERNATIONAL Sales and Service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

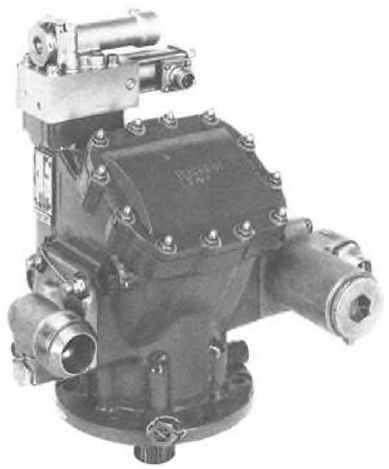
Capability Means Product Improvement

ORIGINAL DESIGN REQUIREMENT
560 hrs.
(Time Between Overhauls)

PRESENT CAPABILITY
3000 hrs.
(Time Between Overhauls)

Backed by 3,500,000 Hours of Turbine Powered Airline Operation

Pump overhaul life capability has jumped to 3000 hours on airlines operating Boeing 707s and 720s or Convair 880s and 990s. At the time commercial jetliners entered service, this pump's 560 hour overhaul life was the best available. Now—Vickers planned product improvement program has produced a nearly 450% improvement in "time between overhauls" in the same package—again the best in its field.



One phase of this planned program concentrated on improving bearing life. It included: 54,231 test hours on jets operated by eight major domestic and foreign airlines, 23,126 hours of pump endurance testing, and 310,440 hours of accelerated bearing testing—a total of 387,797 hours. New bearings developed play a big part in longer life between overhauls and higher reliability.

To maintain leadership in fluid power systems for aerospace applications, requires close liaison with airlines, airframe manufacturers and engine builders. Through the knowledge gained from application engineers and service technicians, specialized schools and company-sponsored conferences, Vickers maintains a continuing flow of new and improved products for changing aerospace requirements.

MORE DATA AVAILABLE—Write for Bulletin A5283 "Harnessing Fluids for Airborne Uses" to: Vickers Incorporated, P.O. Box 302, Troy, Michigan.

VICKERS
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1546

No one has ever combined high resolution *and* long wear in a telemetry tape...

until now.

In Soundcraft's new HRM Telemetry Tape, outstanding short wavelength sensitivity and long wear are combined to give you flawless high data rate recording. Since long term wearability has been previously found only in heavy duty computer tapes, the achievement of this quality in HRM represents a major advance in the state of the art. In tests on conventional telemetry transports, it has been run 600,000 times without evidence of any signal deterioration. The specially developed oxide coating operates through an extremely wide temperature, humidity and speed range without head fouling or deposit build-up on tape transports. Equals or exceeds requirements of MIL-T-21029-A. Exclusive use of DuPont's polyester *"Mylar"* base contributes to strength and reliability. Complete information on request. REEVES **SOUNDCRAFT** CORP.

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AEROSPACE CALENDAR

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

Jan. 15-16—Supersonic Transport Navigation Conference, Ann Arbor, Mich. Co-sponsors: Institute of Navigation; University of Michigan.

Jan. 15-17—Ninth Annual Meeting, American Astronautical Society, Statler Hilton Hotel, Los Angeles, Calif.

Jan. 21-22—Annual Meeting, Assn. of Local Transport Airlines, National Aviation Club, Washington, D.C.

Jan. 21-23—31st Annual Meeting (including Wright Brothers Lecture), Institute of the Aerospace Sciences, Hotel Astor, New York, N.Y. Honors Night Dinner, Jan. 22.

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

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

Jan. 24—Sixth Convertible Aircraft Congress, Franklin Institute, Philadelphia. Sponsor: Convertible Aircraft Pioneers.

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

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

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

(Continued on page 7)

AVIATION WEEK and Space Technology

January 7, 1963

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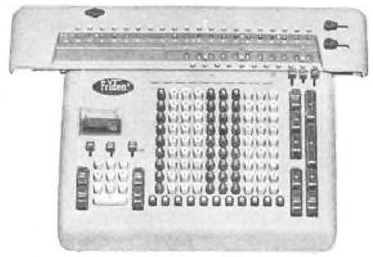
x^2

square a number...

$\sqrt{x}$

extract a square root,



on the Friden SRQ–automatically!

The Friden SRQ is the only desk calculator in the world that provides both automatic *squaring* of numbers, plus automatic *extraction* of square roots.

To square a number, simply enter it on the keyboard and touch one key. The answer instantly appears in the upper dials.

You can also square a number, *add or subtract it* from a running total, all in the same operation.

To extract a square root, simply enter the radicand on the keyboard and touch one key. The square root instantly appears in the *lower* dials.

Only the Friden Model SRQ offers these unique features on an easy-to-use, fully-automatic, desk calculator. Two *other* new Friden Calculators, the Model SBQ and the Model STQ, offer you automatic squaring, along with a whole array of other automatic features. Every engineer and statistician should have one.

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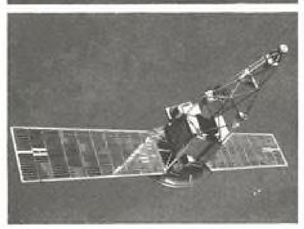
SPACE STRUCTURES



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ADVANCED METAL PRODUCTS

The solution to many space age problems lies within

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From advanced astronics to the fabrication of space age metals, Ryan is prepared to assist government and industry in studies, design, development, production, and the field support of *complete* operational systems and equipment.

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AEROSPACE CALENDAR

(*Continued from page 5*)

Feb. 1—Fundamental Phenomena in the Material Sciences Symposium, Hotel Sheraton Plaza, Boston, Mass. Sponsor: Ilikon Corp.

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

Feb. 5-7—Advances in Metalworking Seminar, American Society of Tool and Manufacturing Engineers, Park Sheraton Hotel, New York, N. Y.

Feb. 6-7—59th Meeting, National Aerospace Standards Committee of the Aerospace Industries Assn., Ambassador Hotel, Los Angeles, Calif.

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

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

Feb. 15-Apr. 14—International Aeronautics and Space Fair, Congresses and Competitions, Ibirapuera Park, Sao Paulo, Brazil. Sponsor: Santos Dumont Foundation.

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

Feb. 21-22—Western Region Conference, American Society for Quality Control, Flamingo Hotel, Las Vegas, Nev.

Mar. 3-7—Seventh Annual Hydraulics, Gas Turbine, Aviation and Space Meeting, American Society of Mechanical Engineers, Statler Hilton Hotel, Los Angeles, Calif.

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

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

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

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

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

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

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

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

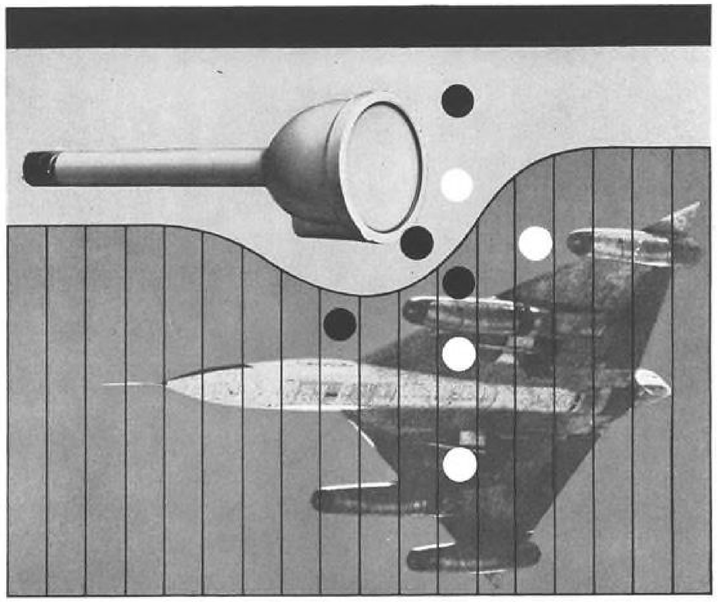
Apr. 2-5—Spring Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

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

(*Continued on page 9*)

MICROPIX® multi-purpose cathode ray tubes, used in high-resolution applications, are part of the extensive line of Litton display devices and microwave tubes. San Carlos, California. In Europe, Box 110, Zurich 50, Switzerland.

LITTON INDUSTRIES
ELECTRON TUBE DIVISION



PROBLEMATICAL RECREATIONS 152

Between Kroflite and Beeline are five other towns. The seven towns are an integral number of miles from each other along a straight road. The towns are so spaced that if one knows the number of miles a person has traveled between any two towns he can determine the particular towns uniquely. What is the minimum distance between Kroflite and Beeline to make this possible?

— Contributed

If you've had at least five years' experience in digital data processing systems, let Mr. William T. Short at our Data Systems Division know about you. Systems Engineers are needed to direct these areas of activity: tactical data systems, active tracking, radar/computer interface, digital communications, and mixed mode navigation systems. You would determine systems integration problems, formulate solutions in terms of required systems parameters, work with and/or direct designers in implementation.

ANSWER TO LAST WEEK'S PROBLEM: The missing number is 31. The terms of the sequence are the representations of 16 to various bases starting with base 16 and proceeding consecutively to base 2.

An Equal Opportunity Employer

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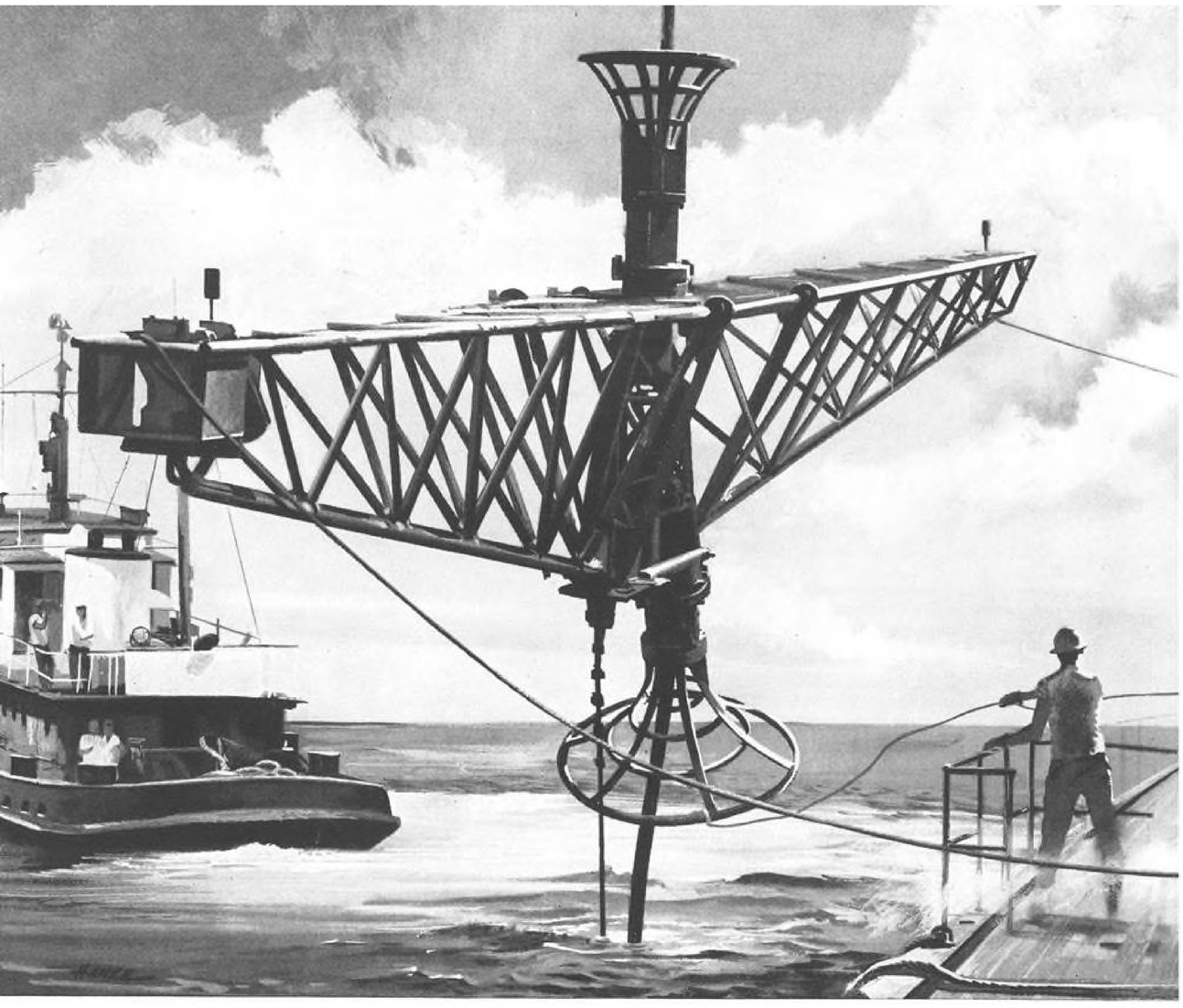
Data Systems Division
Canoga Park, California



Putting ears in the ocean

Unique underseas sound laboratory built by Lockheed helps U.S. Navy measure submarine noise.

The sea is saturated with sounds—the motion of the waves, the rumble of ships and the babel of marine life. Sifting out single sounds—such as the noise of a distant submarine—may be as difficult as hearing a pebble tossed into a puddle during a thunderstorm.

The U. S. Navy has embarked upon a high-priority underwater test facility known as the Atlantic Underwater Test and Evaluation Center (AUTEC). This undertaking may well achieve importance tantamount to the nation's achievements in space.

Lockheed Electronics Company was chosen by the Navy as team manager to direct the design and installation of the first operational range of this vast program.

Inventive Designers of Lockheed engineered and developed a bottom-moored acoustic array, involving a sensitive hydrophone system for the surveillance, detection and measurement of undersea sounds.

Practical Packagers of Lockheed housed the system to operate efficiently under the enormous pressure and other adverse conditions encountered underseas.

Engineering Follow-through teams of Lockheed directed the installation of the hydrophone array in deep water—and completed test and checkout of the system to assure optimum operation in that environment.

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

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

LOCKHEED ELECTRONICS COMPANY

PLAINFIELD, NEW JERSEY **A Division of Lockheed Aircraft Corporation**

AEROSPACE CALENDAR

(*Continued from page 7*)

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

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

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

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

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

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

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

Apr. 24-26—Seventh Region Technical Conference, IRE, San Diego, Calif.

Apr. 29-May 2—22nd Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton-Jefferson Hotel, St. Louis, Mo.

Apr. 29-May 3—Annual Conference, Society of Photographic Scientists and Engineers, Ambassador Hotel, Atlantic City, N. J. Cosponsor: Army Research Office.

May 1-3—19th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

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

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

May 6-8—Aerospace Reliability and Maintainability Meeting, Institute of the Aerospace Sciences, Washington, D. C.

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

May 13-15—National Aerospace Electronics Conference, IRE, Dayton, Ohio.

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

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

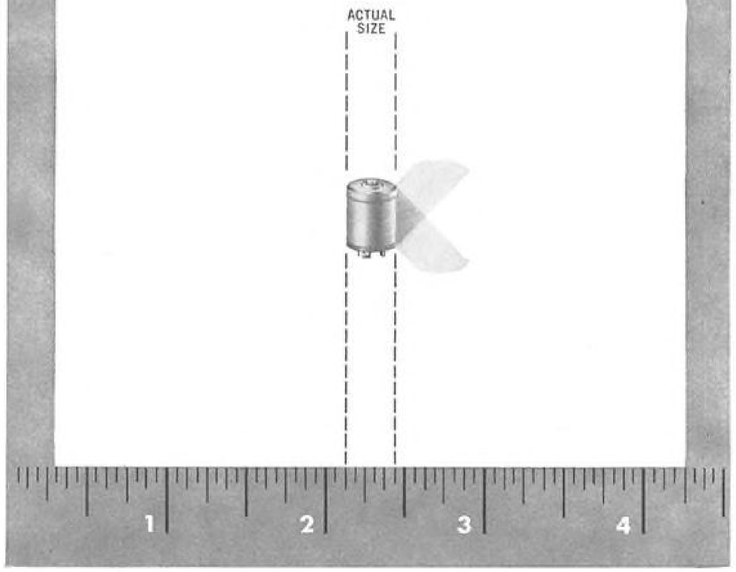
May 20-22—National Telemetering Conference, Hilton Hotel, Albuquerque, N. M.

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

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

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

KLIXON®
PRECISION CONTROLS



Still . . . the smallest hermetically-sealed snap-acting precision switch ever made!

KLIXON® AT1-1

Three years ago, we introduced the KLIXON AT1-1 as the first sub-miniature, snap-acting switch with a true hermetic seal.

Since then, no other switch has approached its small size and light weight . . . has matched its high shock and vibration resistance . . . has achieved a flux-free welded seal.

That's why AT1-1 series switches have been used in space probes, spacecraft, ASW equipment, aircraft valves, rocket engine valves, pressure switches, radar equipment, ECM systems, fusing and arming systems and launching equipment.

Another reason for the wide use of AT1-1 switches is the KLIXON packaging team. These specialists design and build single and multi-pole packages . . . simple and complex . . . with toggles, pushbuttons, levers, connectors, etc., to meet demanding requirements. For complete information write for bulletin PRSW-11.

AT1-1 Switches are available with a variety of mounting devices such as: AT3-1 AT2-1

SPECIFICATIONS

Hermetically sealed	according to MIL-S-8805A Enclosure design E Class A
Actuation force	20 oz maximum
Pretravel	0.006" maximum
Movement differential	0.003" maximum
Overtravel	0.003" minimum
Ambient temperature range	—65°F to 275°F
Current capacity	3 amp resistive at 28 V-dc
Vibration resistance	over 65G
Shock resistance	200G without snap-over 1000G without damage
Weight	1 gram maximum

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A CORPORATE DIVISION OF

TEXAS INSTRUMENTS
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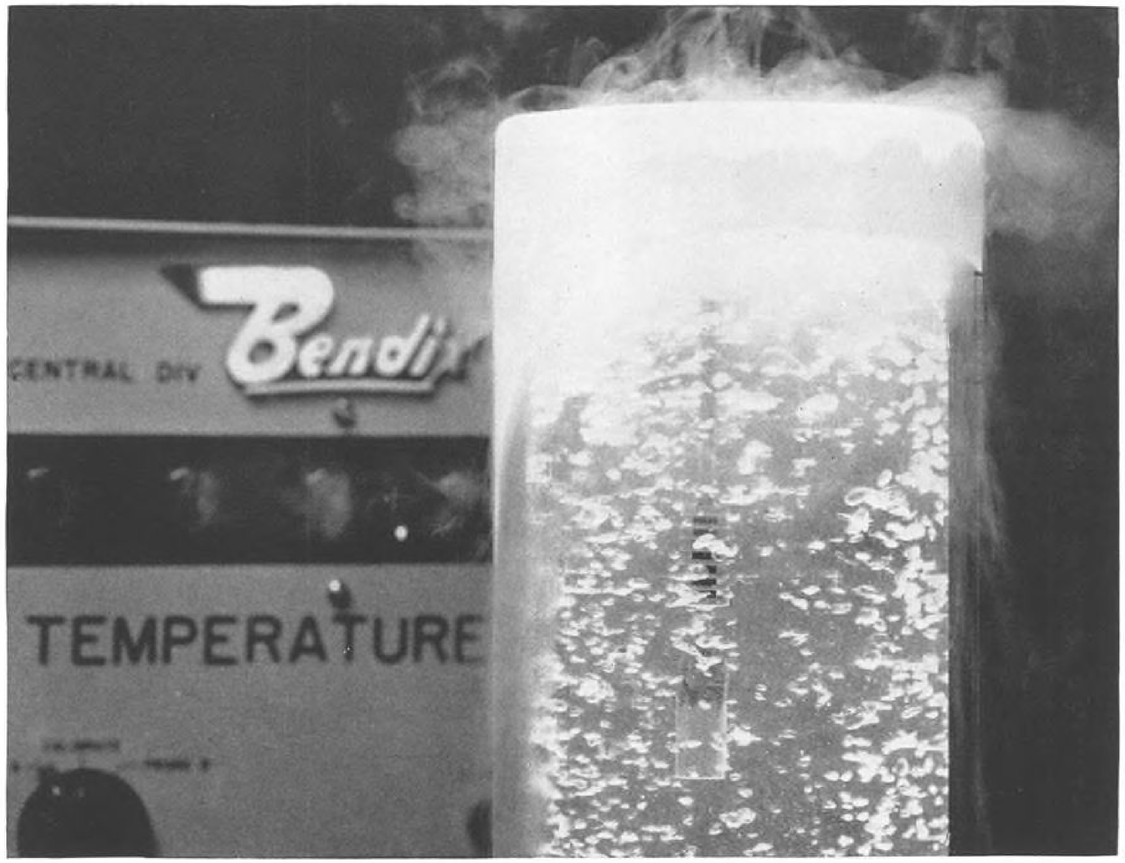
We are heavily involved in exotic instrumentation.



A case in point is cryogenics.

In modern, fully equipped cryogenic development laboratories, a unique combination of Bendix experience is available to help meet your cryogenic instrumentation requirements. Our experience includes 11 years—liquid hydrogen, 23 years—liquid oxygen, and 42 years—precision instrumentation.

Perhaps one of your requirements is the precise measurement of temperature between 20°K and 400°K with digital readout. We can meet this and other cryogenic instrumentation requirements.

In addition to cryogenics, we are also active in the development of life support systems (both aircraft and manned missiles), propellant measurement and control, precision special-purpose electronics.

Tell us what you are working on. Tell us what you need. Let us help you. Write us in Davenport, Iowa, Dept. A.P.R.

Pioneer-Central Division

THE Bendix CORPORATION

From Washington—

A CLARIFICATION

that can significantly affect your future visits to the world's most important city

Few remember the original meaning of a noble word that will be dramatically clarified and redefined with the opening of The Madison in Washington, D. C., this month.

That word is "hotel". French in origin, "hotel" made its first written appearance in 1644. The literal meaning was "a town mansion", and that is what the early European hotels were: town mansions of wealthy, country-based families, privately maintained for their own uses during the brilliant Court seasons. To this day, many impressive private residences in Paris are called "hotels".

In The Madison, the word "hotel" will be restored to its original dignity and meaning.

A Long-Felt Need

The need for a luxury hotel in the great European tradition, catering to Washington's most highly placed and discerning visitors has long been recognized by a group of local businessmen, which I have the honor of heading.

We have felt that in the process of increasing their efficiency as business enterprises, the better hotels have lost much of the highly personalized flavor that distinguishes the great European hotels, and that was so importantly a part of the traditional hospitality of "Old" Washington. We believe that management by teletype from a distant management center cannot effectively satisfy the individual requirements of the individual guest, nor make him feel that he is occupying his "own" Washington town mansion.

The Madison, privately and locally owned and individually managed, is the result of our mutual determination to correct this situation and to place at the disposal of Washington's distinguished guests, an elegant "town mansion" worthy of their patronage. To this end we have pledged generously of our resources.

The Madison Atmosphere

While The Madison will be one of the world's most luxurious hotels, its atmosphere will be one of *restrained elegance*. Its opulence will be unobtrusive; there will be no glitter of chrome nor blare of unwelcome music, and there will be no garish uniforms to offend either the beholder or the wearer.

The quiet refinement and exquisite taste of The Madison's Federal period decor will be reminiscent of the gracious, unhurried correctness of living that James Madison and his wife "Dolley" brought to Washington from their stately Virginia home, Montpelier.

The Madison Service

Individual tastes and preferences of guests will be served in the European manner by a multi-lingual staff; with courtesy, dignity, quiet competence and the attentive deference that is the due of "the lord of the manor."

The right of The Madison guest to privacy will be rigidly respected. No guest accommodation will be within sight or hearing of any delivery or service area. Rooms and suites will be shielded with the most effective sound insulation known to modern building science.

And a firm policy of *"No Conventions, No Tour Groups"* will be maintained both to protect the serenity of The Madison way of life against untoward invasion, and to assure an adequate supply of accommodations to regular patrons in all seasons.

The service of food and drink in The Madison will be in the great and lavish European tradition. It is our aim to make *The Montpelier Restaurant,* off the main lobby, a mecca for connoisseurs of Continental formal dining and the adjacent *Montpelier Lounge* the most elegant gathering place for Washington gentlemen and their ladies. *The Retreat,* a bit of transplanted Old England, will be sacred to males; *La Provence,* a bright and gay dining room authentically French provincial in decor, will serve, informally, delicious meals at modest prices, and the flagstone terraced, protected sidewalk cafe will be known, appropriately, as *Coin de Paris*—in truth, "a corner of Paris."

A Pledge

It is our determination to maintain, in The Madison, the highest standards observed in the most meticulous private homes, so that you and our other perceptive guests will accept The Madison as *your own Washington town mansion,* and know that in it, you are indeed "the lord of the manor."

Marshall B. Coyne
President

THE MADISON — *Washington's Correct Address*

NOTE: Our Managing Director has prepared a special indoctrination booklet for The Madison staff members. In this, the basic philosophy and the facilities of The Madison are detailed. If you would like a copy of this interesting, behind the scenes booklet, we shall be happy to forward one to you. Please address your request (preferably on your letterhead) to: Hans Sternik, Managing Director, The Madison, Fifteenth and M Streets, N.W., Washington 5, D. C.

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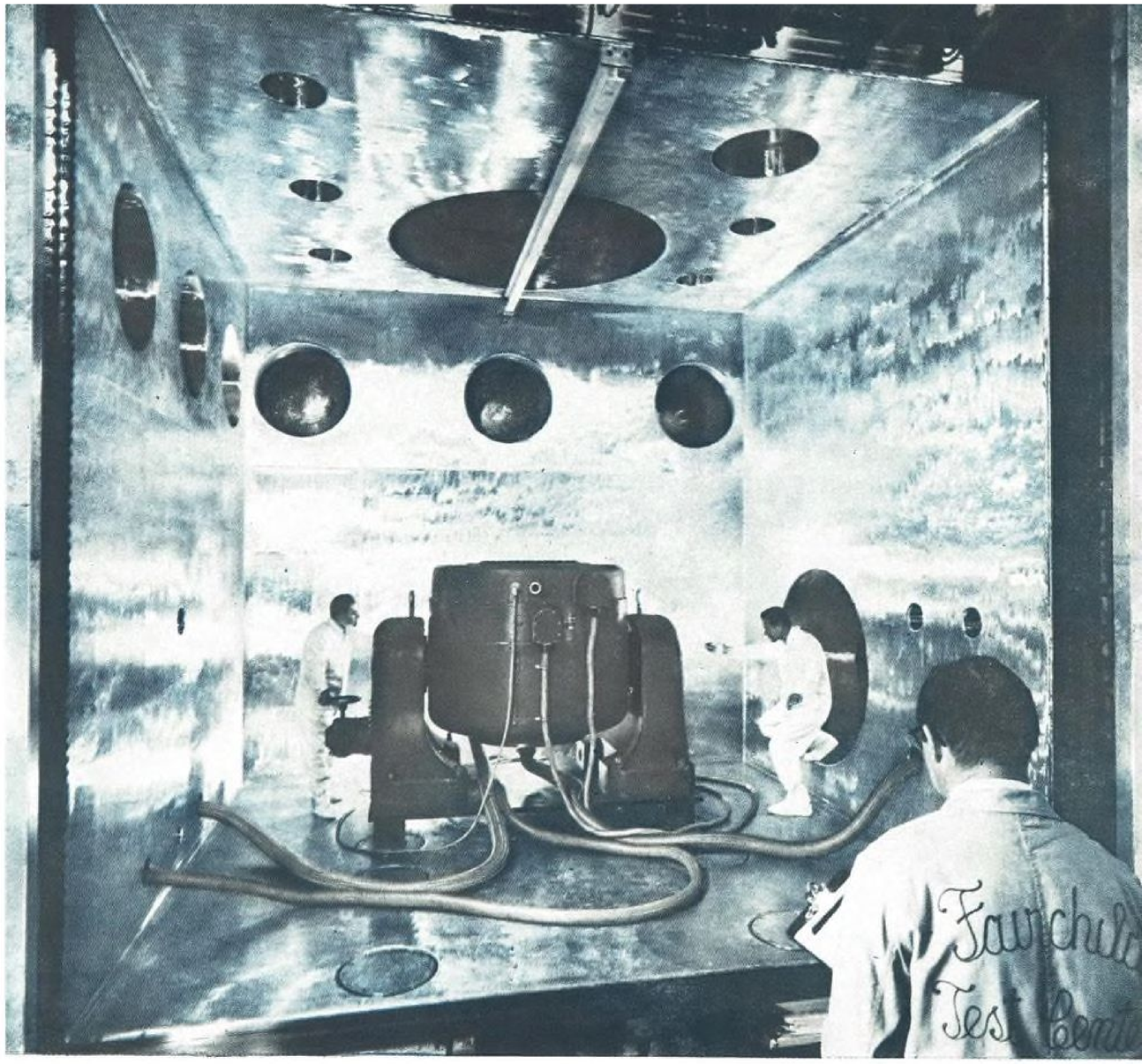

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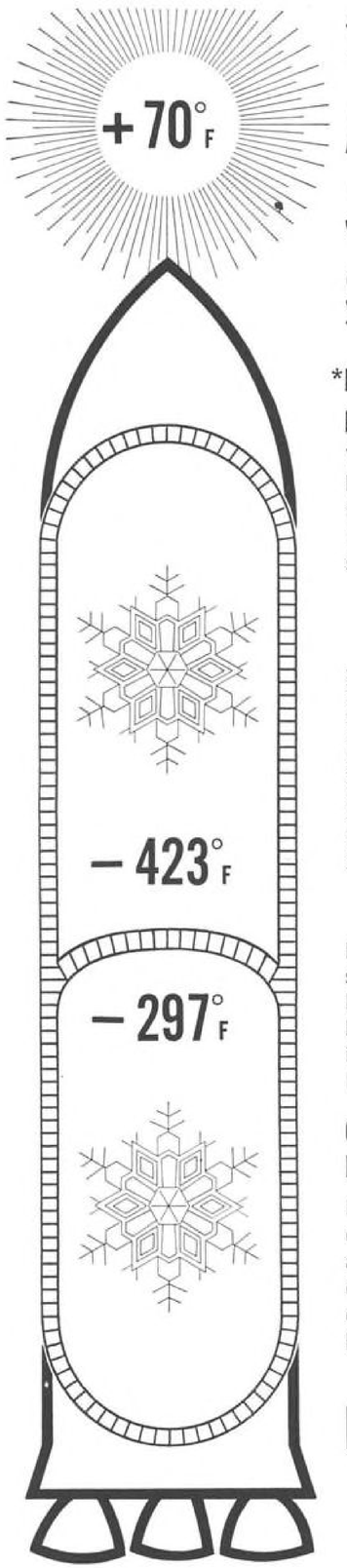

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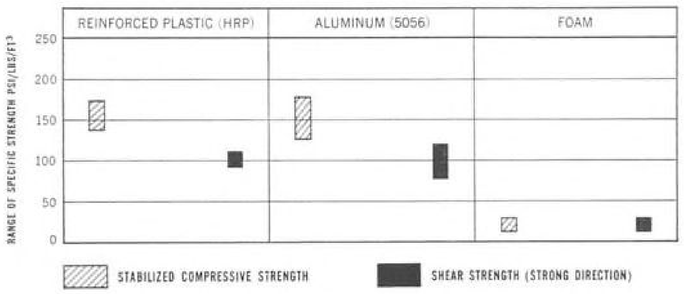

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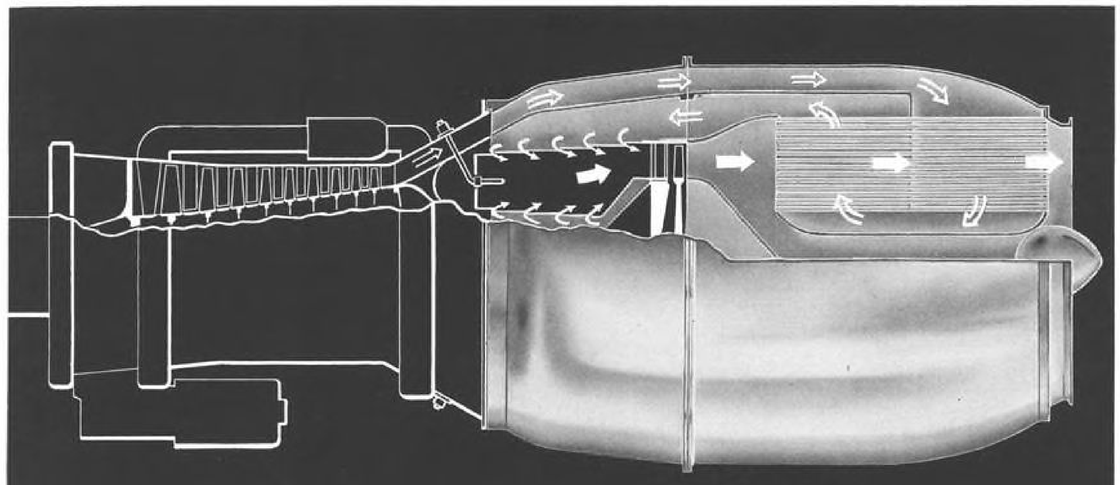

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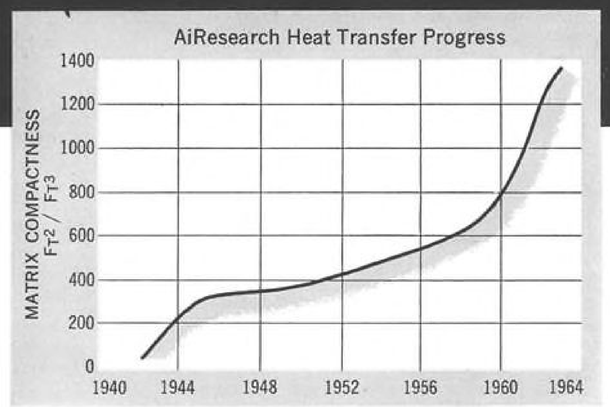

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They shall beat their swords into plowshares and their spears into pruning hooks. Nation shall not lift up sword against nation. Neither shall they learn war any more.

— ISAIAH

Lockheed is very proud of its F-104 Starfighter. At a recent U. S. Air Force Fighter Weapons Meet at Nellis AFB, Nev., an F-104 (C model) outflew, outgunned, and outbombed all 13 of its competitors.

Lockheed has given us permission to disclose that the F-104 carries a 19.25mm hemisphere of KODAK IRTRAN 2 Optical Material on the flat face of which we deposit by a unique method a 4mm x 4mm film of lead sulfide to which leads are attached. This kind of infrared sensor we call a KODAK EKTRON Detector, Type Q-5, Modified. The hemisphere has been made also out of another high-index infrared-transmitting material, strontium titanate. Replacement of this by IRTRAN 2 material seems to make the time constant of the detector—which is about 250 μsec at 25°C—more stable over long periods with less effect from storage conditions. Also, the dark resistance stays put better. Therefore the s/n drifts less. Incidentally, signal and noise levels are both high, which lessens the demands on the associated circuitry. (NEP, however, is less than 6.7 x 10^{-11} watts for 600°C radiation chopped at 2500 cycles/sec over a 1 cycle/sec bandwidth.)

We mention high index. We are rather pleased at having it in the record that some years ago we suggested to the brethren that the same principle that makes an oil-immersion microscope objective resolve more detail than the best dry objective could also be worked for another purpose in the infrared game. Putting the detector film on the high-index hemisphere flat boosts the signal by 3.4×.

Safe as the F-104 makes us feel as we sit before our hearths, we'd feel even safer if we had more sales outlets for these buttons than just one make of airplane. We sure would like it if it turned out, in line with the prophet's beautiful allusion to old iron, that an entirely different use were found in addition for Type Q-5 detectors. Eastman Kodak Company, Special Products Division, Rochester 4, N. Y. can help you think about that.

Electric sugar, $5 per lb.

A mighty industry breaks down the sugar molecule in the interests of conviviality. Use of the sugar molecule as a base for further building is little practiced, except by us. (We do it in the northeast corner of a state which respects the venerable craft that works the other way.)

And what is achieved thereby?

A high dielectric constant, a large increase in the capacitance of an electrical condenser compared with when there is nothing between the plates.

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dissipation factor (25°C, 60 cycles)	0.010	0.17-2.7	< 0.1
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Request an 8-ounce sample of Cyanoethyl Sucrose and a data sheet from Eastman Chemical Products, Inc., Kingsport, Tenn. (Subsidiary of Eastman Kodak Company).

The film in the bottle

For a while now we have been tossing around the term "modulation transfer characteristic" with reference to photographic emulsions. We suspect that a few uncharitable souls in the gallery have snickered at such high-flown language issuing from people who brew one of the principal ingredients for their product from hides and old bones.

Let the snickers cease. With a modulated electron beam playing directly on this humble outcome of the efforts of cowboys and silver miners, stronger reasons begin to unfold for speaking of modulation transfer characteristics. The modulation, indeed, seems to get itself transferred better by skipping the phosphor and lens. In fact, the monkey now rides on the electronics to generate as much as the photography can take.

We peddle no hardware for this and can therefore talk freely with would-be hardware peddlers and their prospective customers. We wish to tell them we have looked into it deeply enough to know

- that conventional medium-speed film such as you used to take along on camping trips before you switched to color can, when recording with electrons, resolve detail considerably smaller than 5μ;
- that we can make a film for which the modulation transfer level remains above 50% out to 355 cycles/mm, which corresponds to nearly 65 megacycles in TV 16mm format;
- that a high-resolution film (far too slow to consider for the light available from a phosphor screen), when exposed to an electron beam of low current at little more than half the accelerating potential customary in c-r tubes, gives far more resolution and far less graininess than can be expected of the medium or fast films that the phosphor screens need;
- that freedom from the graininess and other imperfections of the phosphor screens themselves is beautiful;
- that no harsh remarks should be uttered about the lenses that image phosphor screens on film because, until some practical equipment appears on the market for the new direct-electron technique, a lot of people will want to write to Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y. for details and prices on what we believe to be the sharpest lenses for the purpose in the world.

For further information on the new technique, write Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y.

If you like, we can send you a pocket reference book that may help you and us achieve mutually beneficial contact through the bewildering variety of other products we make. Address Eastman Kodak Company, Dept. 8, Rochester 4, N. Y. It is a tiny bit out of date, but that can't be helped. (Everybody dies a little each day.)

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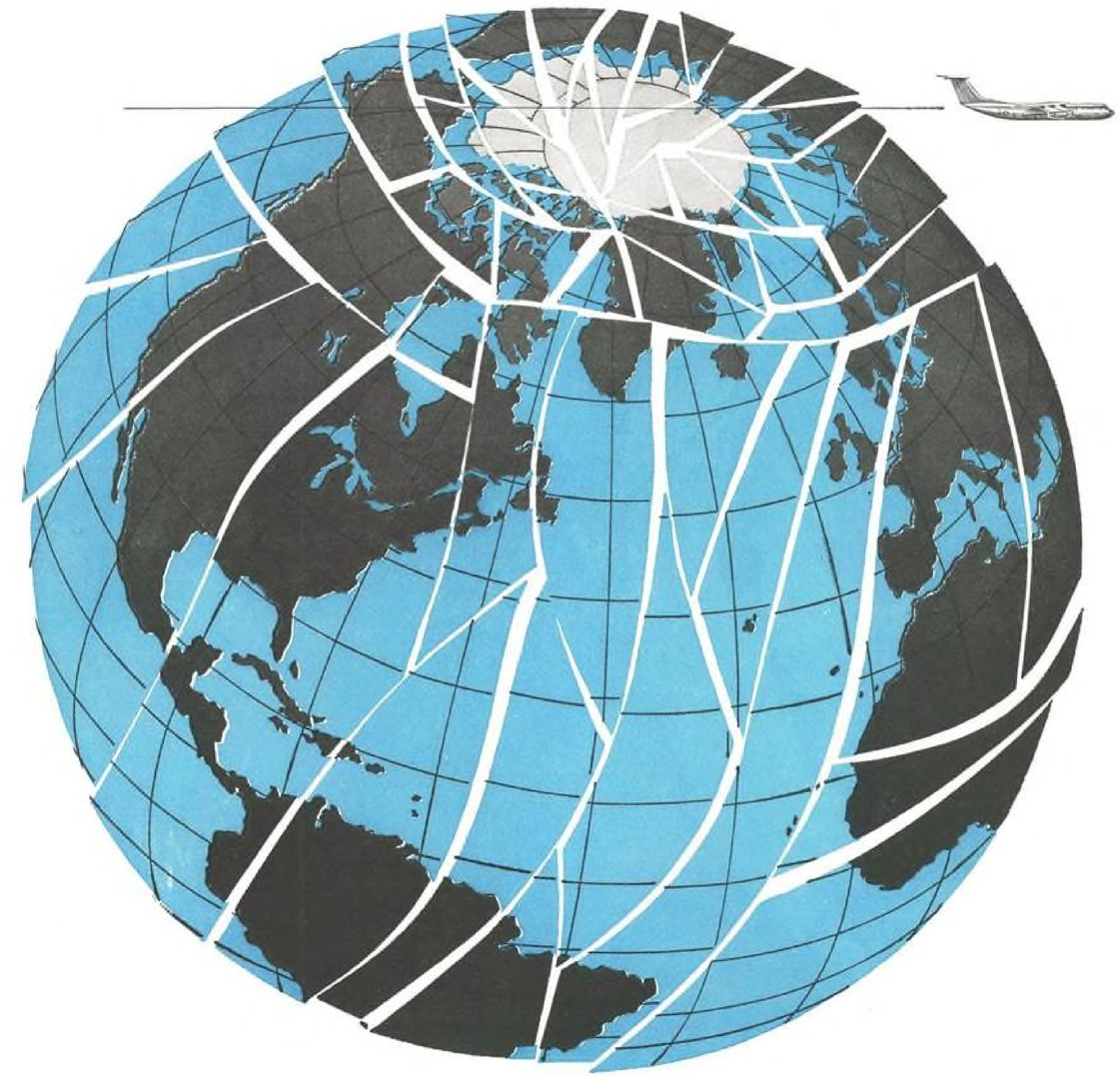

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Number 1

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January 7, 1963

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COVER: Capability for overhead tracking is stressed in the use of X-Y, or double elevation, mount for Philco Corp.'s 40-ft. antenna for the National Aeronautics and Space Administration. More common azimuth-elevation mounts are designed to meet military requirements for low-ang'e tracking. The three-channel monopulse all-solid state receiving system is designed for reception up to 10 gigacycles. Developed by Philco's Western Development Laboratories for use in the Relay communications satellite program, the antenna is sited in the Mojave Desert near Barstow, Calif. Orbital data will be sent by teletype from Goddard Space Flight Center at Washington and fed into Philco-provided digital handling equipment for automatic aiming. The mount provides full hemispheric coverage except for about 5 deg. above the horizon 25 deg. each side of the X axis.

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Looking Ahead

The year ahead promises to be lively in the aerospace business, with an extra large dash of political spice added to the recipe of galloping technology mixed with financing and management problems that have become standard industry fare in recent years.

Fundamental to all aerospace activity in 1963 is the simple fact that this will be the period when the basic foundations will be laid for the 1964 presidential election campaign. Everything that happens during the next 12 months in Washington will be measured toward that goal. Thus we have the odd spectacle of an Administration pushing higher expenditures for space and defense on one hand, and giving top priority to tax cuts in its legislative program. The game here is not to see who will really get a tax cut, but to see who gets the onus of not letting the voters have the tax cut they so eagerly seek, and who gets the credit for trying to give it to them while still not losing any cash from the federal treasury. This is why things may not always be what they seem during 1963.

The Kennedy Administration at mid-term is facing a financial and political reckoning all along the New Frontier on the happy programs and bright phrases with which it was inaugurated. In the aerospace field, it will have to decide early this year just how fast we are going to race to the moon, just how broad a scientific exploration of space we will make and how strong a defense force we will build for the future.

The most critical year of its transition from infancy to adolescence is facing the national space program (see p. 26). A more realistic view of the costs for the manned lunar landing program is now possible than at the time President Kennedy made his bold commitment in this area. Of course these costs are rising fast as the program progresses. They dictate either a large increase in the over-all space budget, a larger share of the space funds earmarked for manned flight, or retarding the technical pace to fit budget strictures. Congress, which has given wholehearted and unquestioning support to the space program during the past two years, is growing more critical and less enthusiastic over the rising space budget and the character of its program. NASA leaders will find the climate on Capitol Hill considerably chillier than last year and their already well-demonstrated legislative agility will be put to its severest test. They will get less support this year, too, from the great series of space achievements that held the public spotlight during 1962, from the Mercury astronaut flights to Telstar. The solid space achievements of 1963 will be made in the more private atmosphere of the laboratories, experimental machine shops and environmental test rigs as the first proof of technical feasibility is translated into reliable operational systems. This far more important work is less likely to impress either congressmen or the American public than the initial feasibility demonstrations, and may create a false impression of a technical lull unless some lucid and candid explanations are forthcoming by NASA.

There is certain to be serious questioning not only of the rising level of space expenditures, but also of the character of the NASA program with its current 75% emphasis on manned space flight. There is growing pressure for more emphasis on space science and a broader orientation than the Apollo program apparently offers. This pressure will increase in direct proportion to the NASA budget squeeze as competition for the available dollar gets tougher among programs. Perennial debate over the military role in space will probably sharpen this year as the validity of increasing space expenditures without more definite relation to military applications is questioned by the changing character of congressional space leadership.

The Fiscal 1964 defense budget presents the same old problem of trying to squeeze all of the requirements to maintain adequate modern forces in being, plus the research and development necessary for new weapon systems, into what every administration hopefully believes will be a stable budget level. In the waning years of the Eisenhower Administration, the defense budget was stabilized at about $41 billion. In the first years of the Kennedy Administration, the talk was of stabilizing the defense budget at $50 billion for a five-year period. But already the $50-billion level has sadly slipped into history in the face of inflation, unanticipated international rows and expanding requirements and commitments.

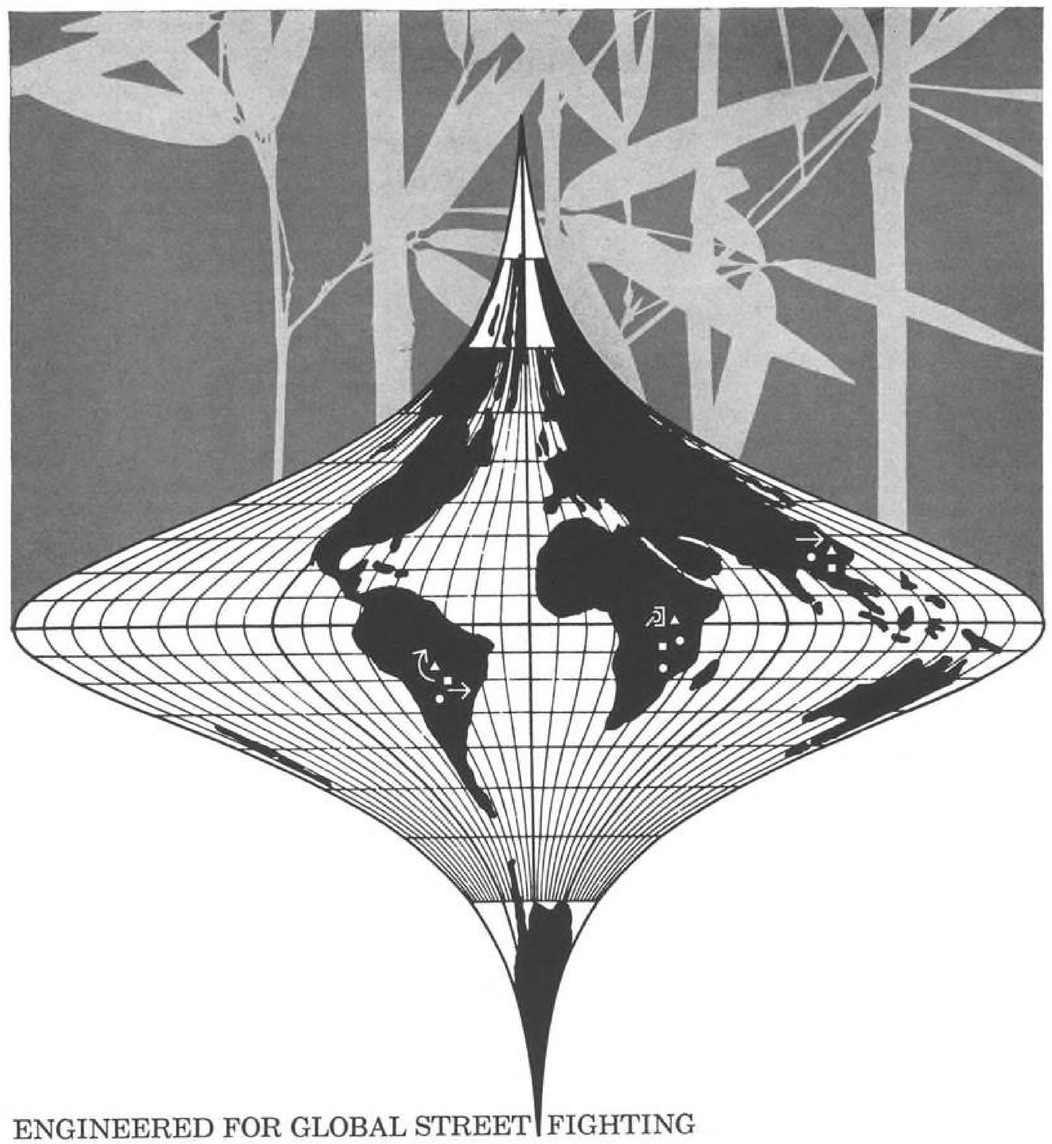
As always, when executive officials are faced with this dilemma, they seek the solution in chopping weapon system programs. When all the furor over Skybolt settles (see p. 29), it will be apparent that this was primarily a fiscal decision designed to lop $2 billion from the next few budgets when the weapon costs would have ballooned from the relatively small current development tab to a substantial production bill. All of the learned talk over technical difficulties was simply obfuscation.

The Kennedy Administration fell heir to a strategically significant deterrent in the B-52 bomber fleet equipped with Hound Dog missiles, and the Atlas, Titan, Minuteman and Polaris ballistic missile programs. For the immediate future it is betting heavily on Minuteman and Polaris to bolster the deterrent and the McDonnell F-4B tactical fighter and Lockheed C-141 jet transport to strengthen limited war capability.

New weapon system programs beyond this area are facing a stiff scrutiny for budgetary reasons. This examination is also bolstered by an Administration conviction that the world has reached a plateau of technical development in weapon systems and it is now possible to enjoy a "technical breathing spell" that allows for leisurely contemplation of any new development lines. This feeling also eases the budget pangs that result from hard pressing the state of the art, as in the ICBM program.

This feeling of a "technical breathing spell" is a recurrent symptom of complacent ignorance. It was a policy of many nations in the period just before their inundation by less intelligent barbarians who were not sufficiently sophisticated to perceive this phenomenon. It has always proved to be an illusion, but it is more than a little appalling to find it gaining such wide acceptance only five years after Sputnik should have wiped away these cobwebs for this generation.

—Robert Hotz



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George Keck, executive vice president-general manager, United Air Lines, and **Andrew M. DeVoursney,** executive vice president-economic planning.

Dr. Luis W. Alvarez, of the University of California Radiation Laboratory, elected a director of Allied Research Associates, Inc., Concord, Mass.

Maj. Gen. Albert Boyd (USAF, ret.) has resigned as vice president of Westinghouse Electric Corp.

K. O. W. Crooks, vice president, general manager and director of Rolls-Royce of Canada, Ltd., Montreal, succeeding **James Wood** who returns to England to take a senior position with Rolls-Royce, Ltd.

Gen. Frederic H. Smith, Jr., (USAF, ret.), vice president and executive assistant to the president of Republic Aviation Corp., Farmingdale, N. Y.

Donald M. Wilder, vice president-Europe for the F-104 program for Lockheed-California Co., with headquarters in Koblenz, Germany.

Dr. James C. Fletcher, vice president-advanced systems of Aerojet-General Corp., Azusa, Calif. Dr. Fletcher continues as chairman of Space-General Corp., a subsidiary.

Gen. Clyde D. Eddleman (USA, ret.), a vice president, Universal Match Corp., St. Louis, Mo.

H. Lane Dudley, president, Control Science Corp., Alexandria, Va.

Malcolm D. Ross has announced the formation of Space/Defense Corp., Birmingham, Mich., and the appointment of the following officers: **Norman Lee Barr, M. D.,** board chairman and director of research; **Mr. Ross,** president and general manager; **Bruce W. Pine,** vice president and director of technical operations; **Donald L. Foster,** secretary-treasurer and head of the Engineering Department.

Edward L. Klein, president and chief executive officer of Mepco, Inc., Morristown, N. J.

Dr. William M. Duke, general manager-defense operations for International Telephone and Telegraph Corp.; he continues as president of ITT Federal Laboratories, Nutley, N. J. Also: **George A. Banino,** executive vice president of ITT Federal Laboratories; he continues as division president of ITT Kellogg Communications Systems.

Col. Harold V. Ellingson, commander of the Aerospace Medical Division's School of Aerospace Medicine, Brooks AFB, Tex., succeeding **Col. Paul A. Campbell,** retired.

Honors and Elections

J. D. Pearson, chief executive and deputy chairman of Rolls-Royce, Ltd., has been awarded a Doctorate of Engineering by Germany's Brunswick University "in recognition of his outstanding technical and scientific merits."

Robert H. Jerome, of Douglas Missiles and Space Division, has been elected president of the Aerospace Electrical Society for 1963.

(Continued on page 106)

INDUSTRY OBSERVER

► Thermoelastic problems of aerospace plane concepts will be investigated in a program of theoretical and experimental research planned by Air Force's Aeronautical Systems Division. Among subjects for study: effects of fuel slosh on structure; buffeting loads at high angles of attack, and fuselage-wing divergence.

► **Problems of graphite erosion in nozzles of Polaris fleet ballistic missiles are bothering Navy technical personnel. Higher-density graphite is being suggested as a primary solution to minimize the problem.**

► Three-parachute recovery system is used on Russian spacecraft of the Vostok class. Small chute is used for stabilization. Second, larger chute is deployed by barometric device and brakes the capsule. At altitudes above 10,000 ft., the third and largest parachute opens. At this point the cosmonaut removes his oxygen equipment and abandons the spacecraft, using his personal parachute.

► **Industry study effort for an over-all analysis of human engineering provisions related to spacecraft maintenance and repair is expected to be initiated soon by National Aeronautics and Space Administration. Results of the study probably will be compiled as a handbook.**

► Proposals for advancing nozzle design and thrust-vector control by using hot-gas injection with solid-propellant motors were submitted last week to Edwards AFB's large rocket motor research laboratory. Industry proposals in competition for these applied research studies are now being evaluated by the Edwards group.

► **First of two prototypes of the Swedish Saab 105 twin-jet trainer now under construction is scheduled to begin flight tests early in July. Both prototypes are being built with production tooling. If the aircraft meets performance specifications, Royal Swedish Air Force has assured Saab it will buy a minimum of 130 trainers.**

► Army Missile Command is projecting a study for high-resolution airborne radar techniques. Industry proposals were submitted last week to Army's Signal Support Agency, Ft. Monmouth, N. J., for evaluation.

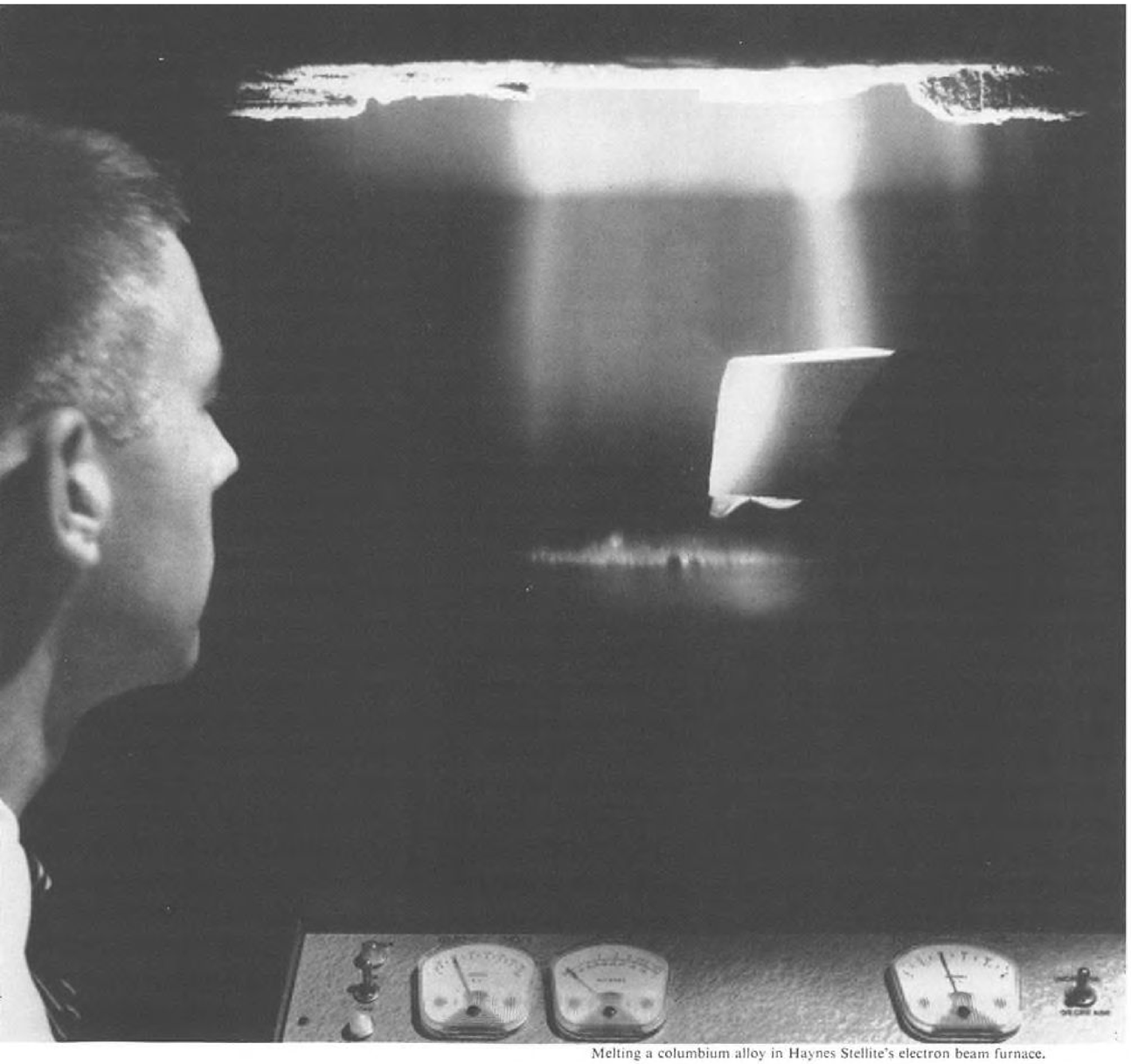
► **National Weather Research Center has revived a Navy proposal to develop a simple, direct-readout weather satellite and currently is performing analytical studies on the system. Concept has been called DREWS, for Direct Readout Equatorial Weather Satellite, and DROS, for Direct Readout Satellite.**

► Protective coatings for expandable vehicles re-entering from space will be investigated in a research program expected to be initiated by Air Force's Aeronautical Systems Division. Industry proposals were submitted in mid-December and now are being evaluated.

► **Proposals for an information management system for Aerospace Medical Research Laboratories will be evaluated by Air Force Systems Command's Aeronautical Systems Division. Technical aspects of system were submitted by industry bidders last week. Details on costs are due next week.**

► Simplification of funding estimation is the key purpose of a new plan expected to be initiated by National Aeronautics and Space Administration. Plan will coordinate mission requirements for solid-propellant rocket motors used by various NASA research and development centers.

► **Evaluation procedures for materials suitable for uncooled rocket nozzles and gas control systems of rocket motors using high-energy liquid or solid propellants were submitted last week by industry to Air Force's Aeronautical Systems Division.**



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Washington Roundup

Nuclear Space Problems

U.S. policy on the development of nuclear energy for space vehicles and missiles reaches a crucial juncture this year and the probability is that the Kennedy Administration and Congress will be pulling in opposite directions.

Issues will range from President Kennedy's planned reorganization of the Atomic Energy Commission into a department, rather than an independent agency, to the question of whether Air Force should be allowed to develop a nuclear-powered, supersonic low-altitude missile (Slam).

Influential congressmen already have criticized the Administration for placing too little emphasis on nuclear rockets (see p. 26) and Snap auxiliary power systems. This attack will intensify, with the loudest protests coming from nuclear-oriented lawmakers from California and New Mexico.

The crux, in the Kennedy Administration's view, is whether nuclear technology is far enough advanced to warrant commitment to full-scale spending. The Administration, influenced by its White House and Defense Dept. scientific advisers, feels it is not, in most cases. Yet there is a political limit to the number of times the Executive Branch can refuse to spend money appropriated by an aroused Congress. Therefore, more stretchouts—rather than outright cancellations—are expected in the nuclear power field. This is likely to be the Administration's approach toward Slam, Nerva and Snap-50/Spur.

After months of wrangling, Defense Dept. and AEC finally have established the program office for Snap-50/Spur under USAF Col. Elwood M. Douthett. The power unit will be designed to generate 300 to 1,000 kw. and have a weight of 10 to 20 lb./kw. Air Force estimates Snap-50/Spur will fly within 6 to 10 years and cost about $250 million up to the first flight test. Air Force-AEC funding responsibility for the project still is being discussed.

Soviet Air Strategy

Air-launched missiles have become the basic form of weapon for Russian aircraft, Soviet Chief Marshal of Aviation Konstantin Vershinin said in a review of the role of aviation in modern war. Despite the fact that the "decisive role" in a future war belongs to long-range, ground-based missiles, it is the cornerstone of Soviet military doctrine that victory will come only through interconnected use of all branches of the services, Vershinin said. The Soviet air force chief also said no single operation of any size in a future war is thinkable without the participation of a large number of different forms and branches of aviation.

Vershinin said the rocket-carrying aircraft has come to replace the bomber and can strike not only stationary but moving land and sea targets from a long range. He also said the ceiling of supersonic aircraft has increased to 98,000 ft. and more.

Primary reason for the extensive advanced ballistic re-entry systems (ABRES) flight program (AW Dec. 10, p. 27), which is to begin this month, is that tests of decoys and other penetration aids so far have produced very disappointing results in their attempts to confuse defensive systems (see p. 34).

Longer Mercury Flight

Possibility still exists for a three-day or two-day manned Mercury flight to fill the gap between the current Mercury program and the first Gemini flight. NASA has asked McDonnell to see what life support equipment could be added to the capsule, and has asked General Dynamics to study Atlas orbital trajectories using a variety of weights.

Cost overruns on the controversial USAF-North American RS-70 reconnaissance-strike aircraft have prompted Defense Secretary Robert McNamara to caution Air Force to clamp down on spending.

Air Force headquarters is becoming disenchanted with the performance of Mitre Corp., technical advisers to its Electronic Systems Division, and is considering a cutback in funding for the non-profit corporation. Some of the work formerly done by Mitre would be given to USAF organizations such as the Rome Air Development Center.

'Poor Cousins' Review

First thing Chairman George P. Miller of the House space committee wants to explore after NASA budget hearings are completed is what the agency is doing in aircraft research. Rep. Miller feels "it's time that we go into it. . . . The glamour girl daughter [space] has been getting all the spotlight. . . . Let's take a look at some of these poor cousins who are our bread and butter business." He also wants to investigate what the U.S. is doing in hovercraft and hydrofoils, compared with other nations.

Space Communications Corp. has been selected as the name for the communications satellite corporation being formed by 13 men named by the President. At their last meeting the incorporators also eliminated USAF Gen. Lauris Norstad as a prospective chief executive officer, in view of his statement that he was not interested (AW Dec. 24, p. 19).

—Washington Staff

Space Program Faces Severest Challenge

Sen. Kerr's death, growing doubts in Congress on lunar landing signal hard fight for NASA funds.

By George C. Wilson

Washington—National space program faces its severest challenge in the 88th Congress which convenes this week in an atmosphere of second thoughts about spending billions to land a man on the moon.

National Aeronautics and Space Administration, with well-founded trepidation, will ask the lawmakers for $5.7 billion in Fiscal 1964. About 73% of that total would go toward landing a man on the moon in 1968.

This dominant emphasis on the manned lunar landing will make it harder than ever for NASA leaders to persuade Congress that their space program is far more than a race with Russia to the moon. Somehow they must find a way to sell their theme that space spending, regardless of whether the U.S. beats Russia to the moon, is an investment which will pay dividends to the national economy. NASA officials consider this their most important public relations job in 1963, both inside and outside the government.

Congress, inspired by the dramatic flights of the U.S. astronauts and worried by the successes of the Russian cosmonauts, went along with President Kennedy last year and voted most of the money sought for space. But this year will be different.

For one thing, the Kennedy Administration is starting off the year by asking for a tax cut at the very time its Fiscal 1963 budget is $7.8 billion in the red. This combination will inspire Rep. Clarence Cannon (D.-Mo.), chairman of the powerful House Appropriations Committee, to bear down harder on NASA budget requests. Rep. Cannon, who believes the space effort is a "crash program" which will waste billions, was the main reason the House Appropriations Committee cut $143 million from NASA's original Fiscal 1963 budget request of $3.8 billion.

Also, NASA Administrator James E. Webb has lost some of his effectiveness in Congress since last year. He disillusioned several high-ranking members of the House Science and Astronautics Committee when he did not fight harder for restoration of the NASA budget cuts, and he lost his most powerful supporter in the Senate when Chairman Robert S. Kerr of the Senate Aeronautical and Space Sciences Committee died here Jan. 1.

Chairman George P. Miller (D.-Calif.) of the House space committee has supported Webb in the past, but now is disturbed about reports of a money gap in the manned space flight program. Rep. Miller said that neither Webb nor anyone else at NASA told him the manned space flight program needed more money. "I want to find out if this is true," Rep. Miller said. "If it's not, I want to find out where the pressures are coming from."

AVIATION WEEK & SPACE TECHNOLOGY, (Nov. 12, p. 27) first reported that NASA was running short of funds in this fiscal year. Webb minimized this at the time and prevailed over other space officials in arguing that NASA should not ask Congress for supplemental funds for Fiscal 1963 (AW Nov. 19, p. 26). Webb is expected to tell the House that shortages in the manned space flight account were made up through reprograming of NASA money. This cannot help but look to many congressmen as proof that the space program is not as urgent as portrayed.

Rep. Miller said there is no doubt in his mind "that we'll have more trouble" this year than last in getting NASA the money it wants. He hopes, however, that such space achievements as the Mariner 2 flyby of Venus (see p. 31) will give the space program in 1963 something of the glamor it enjoyed in 1962. Rep. Miller steered the NASA Fiscal 1963 authorization bill to a unanimous vote in the House last year.

Besides the question of whether NASA deserves all the money it will request for Fiscal 1964, the space agency will be subjected to demands that it change its program's emphasis. Space agency officials themselves feel the biggest push in Congress will be for more emphasis on nuclear power, especially if Sen. Clinton P. Anderson (D.-N.M.) realizes his ambition to become Senate space committee chairman.

Chairman Chet Holifield (D.-Calif.) of the Joint Congressional Atomic Energy Committee signaled what is ahead for NASA when he said last week:

"I cannot help but wonder about the sincerity of our entire space effort in view of the trends which I see in our current program. It appears increasingly that our goal is gravitating toward a one-shot manned mission to the moon. This effort is centered around the development of chemical rockets whose limitations, compared to nuclear propulsion, are severe . . . The leader in space cannot be so lacking in vision as to fail to appreciate the need for nuclear power."

Others in the House like Reps. Thomas G. Morris (D.-N.M.), a member of both the atomic energy and space committees; Melvin Price (D.-Ill.) and Craig Hosmer (R.-Calif.) of the atomic energy committee, and Alphonze E. Bell, Jr. (R.-Calif.) of the space committee share Rep. Holifield's view and can challenge NASA's nuclear effort.

Sen. Anderson is the leading force in Congress for wider use of nuclear energy. He currently is chairman of the Senate Interior and Insular Affairs Committee, but would like to exchange that position for the leadership of the Senate space committee. He has an excellent chance of getting it when the Democrats in Congress organize this week.

Sen. Kerr ran the Senate space committee almost single-handedly and held very few hearings. He worked closely behind the scenes with Webb, who formerly was one of his executives at the Kerr-McGee Oil Industries, Inc., but discouraged other committee members from exploring space issues in public hearings.

Under Sen. Anderson, the Senate space committee would probably become more active. Other members also would have more opportunity to explore such subjects as the military's space mission. But no matter who becomes new chairman, NASA will find the going slower in the Senate and House.

New Satellite Proposals

Washington—Proposals for a 4,000-lb. satellite with more than 2,000 sq. ft. of surface area are being solicited by the National Aeronautics and Space Administration. It will be designed to extend the study of meteoroids and micrometeoroids.

The satellite will be a secondary payload on the eighth and ninth Saturn test vehicles, which will be two stages—a finned Chrysler S-1 booster and a Douglas S-4 second stage. Satellite probably will be erectable or inflatable to provide a large surface area with a variety of skin thicknesses.

Marshall Space Flight Center will manage the project. The satellite will be programed into the same orbit as Gemini and Apollo manned earth-orbiters and will have a one-year lifetime.

Saturn 8 is scheduled for launch in about a year, and Saturn 9 will follow by three months.

Army Has Lost 12 Helicopters in Vietnam

Washington—Communist guerrilla forces had destroyed 12 U. S. Army helicopters up to late last week in the two-year-old Vietnamese civil war, Army sources said. The total included one Bell HU-1 destroyed last week in the bitterest fighting to date in the Plain of Reeds, 50 mi. south of Saigon.

Despite reports from Vietnam of much heavier helicopter losses, Col. R. H. Schulz, deputy chief of Army aviation, told Aviation Week & Space Technology that battle losses have totaled only 12, and the annual replacement rate of 12 helicopters a year "has not changed." Three U. S. troops were killed in the action which started Dec. 28, and four Vertol H-21 helicopters were damaged. Col. Schulz said the H-21s are repairable.

Reports from the battle scene said that at least eight helicopters were destroyed and six damaged in the action last week, indicating that the effectiveness of helicopters in Vietnam had decreased because the guerrillas had found a tactic to destroy them—barrage of armor-piercing ammunition fired from small arms as the helicopters come in for a touchdown.

However, Col. Schulz said the Army is more concerned about helicopters being kept out of service due to inadequate maintenance than through enemy action. Another Army aviation officer said the helicopter "was made for Vietnam" and has been a most effective system there. He pointed out that the communist Viet Cong forces cannot locate the helicopters until they are at the target because the helicopters fly low.

Vietnamese terrain at the battle scene was described as wet flatland, rolling gradually to a tree line.

U.S. Will Restrict Technical Aid As European Competition Grows

By Cecil Brownlow

Bonn—American technological aid geared towards West European space projects will become increasingly difficult to obtain.

With one eye on the gold flow and another on the growing competitive position of European firms in the international aerospace market, the U.S. government is emphasizing in talks with European officials that the days of abundant, no-strings-attached technological aid are matters of the past.

This position was outlined to the responsible government agencies of France, Germany and Great Britain during a recent European tour by Arnold W. Frutkin, director of the National Aeronautics and Space Administration's Office of International Programs.

Essentially, Frutkin said, NASA will look at all requests for technological aid in the space field on a "what's in it for us" basis. This attitude will be extended to cover requests by U.S. firms for government approval to discuss their respective space technology capabilities with interested European governments and/or companies.

The "what's in it for us" approach also will include the stipulation in at least most of the aid agreements that the U.S. must share in any knowledge obtained from the resultant European programs.

A similar stand has been applied on an on-and-off basis over the past year to requests for the purchase of airframe and engine technology from U.S. firms for incorporation into European projects with design capabilities comparable to existing American hardware that could be purchased directly on an off-the-shelf basis. The latter, of course, would bring substantially more dollars into the U.S. but, at the same time, tend to limit the scope and growth of European companies.

Frutkin—in Europe primarily to discuss proposals for American aid to the European Launch Development Organization (ELDO) management agency for development of an integrated, multination space booster system—emphasized that the U.S. will not consider any purely national requests for technological assistance. Such requests, he said, must be channeled through, and approved by, ELDO headquarters in Paris.

The same yardstick is expected to be applied to aid requests from member nations of the complementary European Space Research Organization (ESRO) which has responsibility for multi-nation development of satellite payloads to ride aboard the ELDO boosters. Headquarters for ESRO, whose formal organization is still awaiting parliamentary approval from the governments of the nations involved, also will be in Paris.

Under such an approach, for example, West Germany must gain approval from its British and French partners in ELDO before NASA will consider its hopes for U.S. assistance in the development of an advanced hydrogen fluoride-propelled rocket for use as a potential third stage in the three-stage European booster system.

German officials regard the development of an advanced system as a step towards the country's re-emergence in the field of rocketry and as the actual payoff from any funds allocated to the ELDO booster program. To meet its commitments for 1965 delivery of the initial third-stage booster units to ELDO, however, the German government has agreed that the first units off the line will use a conventional unsymmetrical dimethyl hydrazine propulsion system which the country's chemical industry can develop with little or no outside aid.

Meanwhile, the government has begun to realign itself organizationally to prepare for its move towards a role in the space era.

In the general cabinet shakeup of Chancellor Konrad Adenauer's government last month, the Ministry for Atomic Energy was quietly renamed the Ministry for Scientific Research to more accurately reflect its changing role. Of the three major divisions within the ministry, one will be devoted to civil space projects, including Germany's involvement in ESRO and ELDO plus a purely national program.

Under the system, military space projects will remain under the aegis of the Defense Ministry, while any approaches towards development of a communications satellite—either on a national or multi-nation basis—will come under the jurisdiction of the Ministry of Post and Telecommunications which has an extensive research center of its own at Darmstadt.

Most of the space development work called for by the Ministry for Scientific Research will be parceled out to industry and private research centers through a recently organized, non-profit organization headquartered here and known as the Society for Space Research. The funneling of contractual and operational procedures through the technically private society will free the ministry from many of the standard government restrictions on expenditures and other matters that could restrict the limit of the programs involved as well as the capability of attracting top personnel to the program.

The ministry's space expenditures thus far have been limited—for 1962, about $2.5 million was made available. This year, however, as the ELDO and ESRO commitments begin to be felt, ministry officials hope the amount can be boosted to approximately $25 million, with the total growing proportionately over the following years.

High-Altitude Helicopter Is Rated As India's Only Vital Air Need

By Katherine Johnsen

Washington—Extremely high-altitude helicopter for ground support and evaluation is the only aircraft given a high priority in a program now being evolved by India, the U.S. and Great Britain for a long-term strengthening of India's military power.

Proposals for the buildup of an Indian supersonic jet fighter and fighter-bomber capability and the development of a major aircraft and electronics industry in India, advocated by some Indian officials (AW Nov. 26, p. 30; Dec. 17, p. 88), have been completely ruled out, according to Administration spokesmen.

The only possibility for a change in this position, these spokesmen say, would be an unexpected buildup of Communist China's airpower by Russia. The Indian air force is still balking, but the position against any significant increase in Indian tactical bomber forces has been generally concurred in by Indian government, the U.S. and U.K.

Indian and Chinese tactical forces are now evaluated as a standoff. They are considered approximately equal in quality. In quantity, the Chinese have about double the number. This numerical advantage is believed to be canceled out by India's more favorable tactical position. Administration spokesmen say China is severely limited in the number of fighters and bombers it could maintain and launch from Tibet.

Russia's Mi-4 Hound is the only helicopter with the desired high-altitude capability that is now operating with the Indian forces. India has approximately 25 Hounds, which have an estimated gross weight of over 12,000 lb. and an estimated service ceiling of at least 12,000 ft.

India has two Sikorsky S-62s, which lost out to the Hound in a stiff international competition two years ago.

U.S. officials say the decision in favor of the Hound over the Sikorsky S-62 was "purely political." The high altitude performance of both types is considered marginal at this time. The requirement is for a helicopter with at least the payload capacity of the Hound or S-62—12 to 15 men or cargo of comparable weight—but which can land and takeoff at altitudes up to 20,000 ft. and cruise through altitudes up to 22,000 ft. Neither the Hound nor S-62 can handle significant payloads at these altitudes, U.S. officials said.

Russia's programed delivery of 12 supersonic MiG-21 jets to India is considered of more political than military significance in official U.S. circles—as an indicator of Russian policy in the Indo-Chinese conflict. Russia has neither reneged nor delivered the aircraft scheduled for delivery in December.

The latest development was a report to the U.S. that Russia indicated last week to the Indian government that delivery would be made "on something less than a half dozen" MiG-21s. At the time of the first major Chinese thrust against India late in October, India had orders outstanding with Russia for 24 MiG-21s, plus an agreement for Russian support for production of 40 more MiG-21s by India's own Hindustan Aircraft, Ltd.

India's policy is to evade confronting Russia with any showdown situation and hope for a USSR neutralist course, according to U.S. interpretation. The U.S. and Great Britain are in accord with this policy. Administration spokesmen noted that India refrained from seeking a vote of censure for aggression by China in the United Nations Security Council. This reportedly was done at request of the Russian government, which would be ideologically—even if unwillingly—bound to support China. Russia so far has not responded to Communist Chinese requests for MiG-21s (AW Nov. 19, p. 38).

Top U.S. officials consider the odds heavily weighted against a Chinese escalation of the conflict into air warfare.

One top U.S. official pictured India's MiG order as an example of the policy of ousted Defense Minister Krishna Menon "of having a few flashy showpieces in front of an improperly and inadequately trained and equipped military establishment."

In addition to a need for high-altitude helicopters, India's airpower requirements are evaluated by India-U.S.-British teams in this manner:

• **A substantial program** of equipment and parts supplies to keep the aircraft in India's existing tactical airlift and ground support forces operational for sustained periods. This is considered the most important first step.

• **Gradual standardization** and modernization. This is viewed as the next step to take. India is now operating a hodgepodge of British, French, Russian, and U.S. aircraft. In modernization, airlift will have the highest priority. As an emergency step, the U.S. Army has already given up its production line priorities for two Canadian de Havilland Caribous for supply to India. India has asked for Lockheed C-130s. In size, India's airlift and ground support aircraft forces—as well as its tactical fighter bomber force—are considered as generally adequate.

• **Air defense plans** for India are undetermined. A special U.S. team left last week for an evaluation of the requirement—in aircraft, rockets, missiles, or radar. The U.S. disposition now appears to be that any attempt to develop a comprehensive system would be a waste of money, since no system would be fool-proof. There is some U.S. support for a token defense system for its limited military value and its psychological value.

A short-range program of aid to India—directed at reinforcing the military for losses already sustained in conflict—was concurred in by the U.S. and Great Britain at the pre-Christmas meeting of President Kennedy and Prime Minister Macmillan in Nassau. It will total between $100 and $120 million, financed 50-50 by the U.S. and Great Britain. Half of the dollar value will be for ammunition and explosives, and the other half for small arms and small arms production machinery.

Deliveries of these highest priority items will run until next fall, it is estimated. It is hoped that between now and then, agreement on Kashmir will have been reached between India and Pakistan. U.S. and British financing of any long-range military program hinges on this settlement.

U.S. has established a 100-man military mission in India, headed by Army Brig. Gen. John E. Kelly, to coordinate with the Indian government and a similar British mission in the field.

Guidelines on which the long-range Indian military program is being based:

• **Overriding requirement** is for a change in tactics. It is pointed out that, although Indian recruits are first-class fighters, they are trained for World War 2-type engagements, for fighting on roads, and from fixed positions. They have no understanding in Korean war-type fighting and fighting in rough and wild country. This was recognized publicly by Prime Minister Nehru with his comment: "We do not know how to fight in the mountains, but we shall learn." This inadequacy in training—as well as the surprise element—resulted in shoving Indian losses under Chinese onslaughts to the scale of losses in the Normandy landings in World War 2, U.S. officials said.

• **India's preparation** must be for a long-term capability to meet periodic Chinese onslaughts. U.S. officials estimate that Communist China aims to establish itself as the great military power of the India-Asia sector of the world, as a counter to its own failures and India's success on the economic front.

• **Small arms and ammunition** needed by India eventually can be produced within the country without a significant setback in its developing economy.

Little Hope Seen for Skybolt's Survival

Washington—Defense Dept. order for "immediate action to terminate all production in connection with the Skybolt program" has practically eliminated any chance for reversal of the Administration's decision through congressional pressure.

Defense Dept. moved swiftly to present the new Congress with an accomplished fact after President Kennedy and British Prime Minister Harold Macmillan announced at Nassau Dec. 21 that the British would accept the Polaris IRBM as a substitute for Skybolt air-launched missiles (AW Dec. 24, p. 20). On Dec. 31, Defense Dept. announced the termination order and said the Air Force would submit Jan. 7 "a detailed plan for the early and orderly phase-out of the Skybolt. . . ."

Three major Skybolt contractors immediately stopped or drastically cut back on production. The Douglas Aircraft Co., prime contractor for Skybolt, said 1,200 of its Missile and Space Division employes working on Skybolt were laid off last week. About 900 of them worked in the Los Angeles area. About 2,800 more Douglas employes are to be laid off within 30 days.

Nortronics Division of the Northrop Corp. said 2,000 employes who work on production of the guidance package for Skybolt would be dismissed within a few days and said the figure might climb to 3,000.

Aerojet-General Corp., which manufactures the solid propellant motors for the two-stage Skybolt, said its 340 employes working on the project would shift to other work. About 95 of the 340 were involved in production.

General Electric, also a major contractor, said it received work termination orders from Douglas which could affect 700 employes in Philadelphia and 200 in Burlington, Vt., who are working on Skybolt re-entry vehicle development or fabrication, and about 1,400 persons at its Utica, N.Y., Light Military Electronics Dept. where components for the re-entry vehicle are built.

Air Force supporters of Skybolt are preparing arguments on behalf of the Boeing B-52-launched nuclear weapon. They will not volunteer support, but their extensive arguments will be brought out in congressional hearings by advocates of the manned bomber—Senate Armed Forces Committee Chairman Richard B. Russell (D.-Ga.) and Sen. Stuart Symington (D.-Mo.).

No matter how favorable the testimony is to Skybolt, it is not expected to reverse the Administration's decision. By the time hearings are held late this month or early next month, all Skybolt production lines probably will have been shut down and the last of the production force dismissed or shifted to other projects. Defense Secretary Robert S. McNamara used a similar technique last year when he quietly reorganized the Army and then told Congress about the move later.

Test objectives of the sixth flight on Dec. 22 were to check loading, launching, firing, staging and guidance. These objectives included full-duration firing of the second stage for forward thrust.

Hitting a target was not a mission objective. However, in an announcement following the flight, the Air Force said Skybolt "impacted in the target area" more than 800 mi. downrange. Actually, the second stage and instrumented nose cone disintegrated on re-entry. Calculations based on tracking data indicated they would have impacted more than 800 mi. downrange if they had survived re-entry.

Some hours after the Air Force announcement, Roswell Gilpatric, deputy secretary of defense, made a formal statement which the department said was prompted by press complaints that USAF's announcement was misleading.

"Today's single test," said Gilpatric,

Air Force, Pentagon Duel on Skybolt Test Data

Washington—President Kennedy's anger over the information Air Force released about its successful Skybolt test Dec. 22 has touched off another debate within the Pentagon on how news should be managed.

The controversy pits Arthur Sylvester, assistant secretary of defense for public affairs, and his office against Air Force officials who feel they are being denied the chance to tell their side of the story to the public. The issue may break into the open when Congress begins probing the Skybolt program and Kennedy Administration information policies.

Sylvester took issue with the language in the Air Force Skybolt release and feels the Air Force should have cleared it with him. Air Force officials concede the wording could have been improved, but maintain Sylvester and other civilian Defense Dept. officials were notified ahead of time that the Skybolt test results would be released in the field but made no move to demand special handling.

On Dec. 22, Air Force said in a press release from Patrick AFB that the Skybolt had "impacted in the target area hundreds of miles down range" and called the test successful. On Dec. 28, a Defense Dept., spokesman said the Skybolt had no re-entry nose cone and "burned up in the air. And all that you know is that if it had gone, and if there had been a nose cone, and if there had been a lot of other things on it, then maybe it would have landed some place."

Defense Dept. public affairs officials said Air Force was required to clear the release with Defense Dept. under the Aug. 27 directive to information officers because of the "unusual" news interest of the Skybolt test. But the Air Force claimed that the directive's requirement cited by Sylvester's office is subject to interpretation, and that Sylvester was notified a full day in advance that Air Force officials near the test area would release the information.

The Aug. 27 directive authorizes field officials to release information with certain exceptions. The exception cited by Defense Dept. in the Skybolt controversy requires Defense Dept. clearance for "those launches whose primary unclassified test objectives might attract unusual news media attention." Since the Dec. 22 test objectives were little different than those in earlier Skybolt tests, Air Force officials contend no special information clearance was required under the directive.

The office of public affairs was notified that there was going to be a Skybolt test, but said it did not know that Patrick was going to release more than routine information about it without first clearing it with Defense Dept.

The public affairs office said it assumed the release would be submitted for clearance under the "unusual" news interest requirement.

Under Secretary of the Air Force Joseph V. Charyk and Deputy Defense Secretary Roswell L. Gilpatric both considered cancelling or postponing the Dec. 22 test because of the Nassau meeting of President Kennedy and British Prime Minister Macmillan on Skybolt, but then decided against it. Air Force itself, three days earlier, had planned to postpone the test for fear of disrupting the Nassau conference.

President Kennedy spent a good part of the conference time at Nassau trying to convince Macmillan that there were too many technical difficulties to warrant further development of Skybolt. At this crucial juncture the Air Force announced its first success in six Skybolt tests.

Telstar 1 Revives

Fault in Telstar 1 communication satellite's command receiver cleared Jan. 3 and Bell Telephone Laboratories engineers succeeded in relaying test patterns through the satellite. An attempt to transmit live television from U.S. to Europe was scheduled to follow.

Telstar's command circuit stopped operating Nov. 23 after more than four months' operation (AW Dec. 3, p. 31). Malfunction was attributed to damage caused by high-energy electron radiation.

Prior to Telstar's return to operation, American Telephone & Telegraph Co. had announced plans to launch Telstar 2 this spring, with additional shielding to protect solar cells and command circuitry from radiation. A spokesman said the rejuvenation of Telstar 1 will not change these plans.

"did not conclusively demonstrate the capacity of the missile to achieve the target accuracy for which the Skybolt was designed. Program decisions cannot be based upon the success or failure of early tests."

Skybolt project officials said that telemetry on burning times and tracking data indicated that, had the missile been carrying either of its operational re-entry vehicles, and had the flight been programed for thrust termination and separation of the re-entry vehicle, the vehicle would have impacted within 1.0 to 1.7 mi. of a pre-planned target.

The Nortronics stellar-inertial guidance system was understood to have worked perfectly, as it did on the fifth flight. The system was given a rough fix when the B-52H carrying the Skybolt left Eglin AFB, from which all Skybolt missions are staged.

The Nassau communique said: "The U. S. will make available on a continuing basis Polaris missiles (less warheads) for British submarines. The U. S. will also study the feasibility of making available certain support facilities for such submarines. The U. K. will construct the submarines in which these weapons will be placed and they will also provide the nuclear warheads for the Polaris missiles."

Although emphasis in the joint statement was on multi-lateral or NATO control of Polaris missiles supplied to Britain, the U. S. did agree to independent control and use of Polaris by the British. Both British and American government officials involved in the Nassau conference said they could not conceive of any situation in which the British would want to make independent use of the Polaris.

Meanwhile, Peter Thorneycroft, British minister of defense, promised an interim nuclear weapon delivery system would be developed (AW Dec. 24, p. 21) to fill the gap caused by the cancellations of Skybolt. He said production of Vulcan Mark 2 bombers would be completed according to plan and steps would be taken to "strengthen the capacity of the British-manufactured deterrent" until the Polaris becomes available in 1970.

Air Commodore Sir Arthur Harvey, chairman of the Conservative Party's defense committee, has contended that the current 150-mi. range of Avro Blue Steel air-to-ground standoff bomb, could be stretched to 800 mi. with the addition of ramjet engines.

Sir Arthur is in the U. S. on a Skybolt fact-finding mission.

British defense officials now feel that because of the immediate need for an interim weapon, it is more likely to be an improved Blue Steel Mark 1 rather than a totally new weapon or Blue Steel Mark 2.

U.S. also offered Polaris to the French, who did not reply until last week. President De Gaulle said his message to President Kennedy contained neither an acceptance nor refusal of the offer, which is still under study by the French.

De Gaulle made it clear that France intends to develop its own independent nuclear deterrent capability.

Some Skybolt proponents, resigned to cancellation of the missile as an air-to-ground weapon, are urging alternate uses. The Air Force said Douglas is studying possible use of Skybolt as an anti-satellite missile. Skybolt also has been proposed as a relatively cheap launch vehicle for light orbital payloads.

Boeing Labor Stand Criticized by Board

Washington—Special board last week advised the President that establishment of a union shop at Boeing Co. is justified and severely criticized the company's management for its inflexible opposition.

The board, headed by Saul Wallen, was appointed by the President two days before the Sept. 15 expiration of Boeing's labor contract with the International Assn. of Machinists.

Efforts by the board and the National Mediation and Conciliation Service to mediate the dispute have been a complete failure. The union shop issue has been the block to any progress in negotiation.

"If we had been given the powers of arbitrators, we would not hesitate to make an award granting the union shop under the circumstances of this case," the board's report to the President stated. "We find no merit in the company's argument that such a provision is unfair or prejudicial to the interest of any party."

The board noted that its task was to make a recommendation "likely to lead to a settlement." In view of this, the board made this specific recommendation:

"The company reconsider its position on union security and that the parties negotiate some additional provision for union security over and above the present maintenance of membership clause."

The board declared that "the Boeing company's rather cynical argument that the union is an 'enemy', bent on mortal combat with the company, is . . . not only factually unsound but also goes a long way toward explaining why this dispute has been so difficult to settle. We are convinced that if the Boeing management would reconsider its basic approach to the relationship, it would find the union more than willing to meet it halfway."

The board commented that the precise formula for settlement of union security is "of secondary importance," and added:

"What is important is for the company to step forward with some contribution to a settlement and abandon its stubborn insistence that its views on union security must take total precedence over the views, not only of the union, but also of this board and for that matter of the great majority of large American industrial corporations. The Boeing management has no monopoly on either patriotism or wisdom, and some tangible recognition of that fact would be very much in order at this point."

The board noted in an advisory poll conducted for it by the National Labor Relations Board approximately 74% of Boeing workers supported a union shop. The board criticized the "free loader" concept under which a minority of workers, without paying union dues, would enjoy the same benefits as dues-paying union members.

Boeing's opposition to compulsory unionism, the board said, has a "hollow ring," in view of the fact that the company has agreed to the union shop with the Teamsters' union and with the Firemen and Oilers Union.

Solar Satellite Plans

Washington—U. S. will launch a series of solar satellites, called Piqsy, during 1964 as part of the effort to monitor the sun's activity during its period of least activity.

Initials of the satellite stand for Probe for the International Quiet Sun Year. The program will be managed by National Aeronautics and Space Administration's Ames Research Center. This is the first satellite flight program to be assigned to Ames.

Venus May Have Slow Retrograde Rotation

By Barry Miller

Stanford, Calif.—Concept of Venus as a slowly rotating planet, apparently devoid of a magnetic field comparable to that of the earth and free of intense, extensive neighboring fields of charged particles is beginning to emerge from preliminary analyses of data returned by Mariner 2 spacecraft and from Venus radar bounce experiments conducted recently by the Goldstone tracking station.

Early and incomplete results of interplanetary and planetary encounter experiments carried aboard the 447-lb. National Aeronautics and Space Administration/Jet Propulsion Laboratory spacecraft on its historic flight (AW Dec. 24, p. 16) past the cloud-shrouded planet were reported here on Dec. 28 at Stanford University during the second Western National Meeting of the American Geophysical Union.

Results of the microwave and infrared radiometer experiments which are expected to be the most significant of Mariner's long journey to Venus—possibly indicating the temperature of the planet, breaks in its cloud cover, the presence of water vapor and carbon dioxide in the planet's thick atmosphere—were not made public at this time. The decision to withhold comment on the radiometer results was not influenced by "politics", or instructions from NASA, according to Dr. Conway W. Snyder, a JPL Mariner experimenter and chairman of the session. This decision, Snyder said, was made by the experimenters themselves who hadn't had time to analyze the data.

At the conclusion of a press conference held earlier in the day, another JPL scientist told AVIATION WEEK & SPACE TECHNOLOGY that he and his colleagues had been instructed by the director (presumably Dr. William H. Pickering, director of JPL) to confine comment on the radiometer experiments to a simple restatement of an earlier NASA announcement that the payload made three complete radiometer scans of the planet.

Rotation Direction

One of the more striking notions about Venus revealed in recent radar bounce experiments conducted with a 10-kw. transmitter of JPL's Goldstone site indicates that the planet may be rotating on its axis in a direction opposite from that of the earth and that its period of rotation is very slow, perhaps as slow as a single rotation every 250 earth days.

This conclusion, according to Dr. Richard M. Goldstein of JPL, is based on the assumption that the Venusian axis of rotation is normal to the plane of the planet's orbit about the sun. The Mariner experiments are not expected to yield any evidence about the planet's rotation axis.

The apparent rate of rotation of the planet was determined from the effects of Doppler shift upon coded signals, transmitted from Goldstone and returned from the Venusian surface during the 2½-month experimental period ending Dec. 17. From changes in the rate of rotation observed over this interval, estimates were made of the direction of rotation.

In another technique, the fuzzy and indistinct echoes of a CW signal beamed at the planet were studied and rotation direction estimated from sequential observations of rate of rotation as Venus approached and then moved away from the earth. These results, according to JPL, tend to confirm the slow retrograde rotation deduced from the first technique.

Visual astronomical observations of Venusian cloud formations have indicated that the planet rotates slowly. If the surface temperature of Venus is very high, then the subsurface temperatures may be high enough to maintain the presumed silicate core of the planet in a fluid state. The viscodynamic forces arising from this condition would slow the rotation over a long period of time.

Rotational Capture

In addition, the sun's gravitation, which is stronger at the orbit of Venus than at the earth's orbit, may be involved in a partial rotational capture of Venus. This phenomenon is exhibited in the planet Mercury, which, under the influence of the sun's gravity, has been slowed to one rotation per revolution, thus presenting the same side to the sun at all times. The moon has been similarly affected by the earth.

Mariner results included:

• **Magnetic field**—There was no evidence of distinctly Venusian magnetic field along Mariner's trajectory, which at its closest point was about 25,000 mi. from the center of the planet. Mariner's magnetometer, which was operated throughout most of the trip to and past the planet, did not indicate a rise in the average value of the magnetic field above the interplanetary value and observed fluctuations were smaller near the planet than in the 24- to 48-hr. period preceding planetary encounter.

JPL cautions that this does not preclude the existence of a magnetic field which, if it were weak, would be confined to regions close to the planet by the solar wind, found in another Mariner experiment to be continuously blowing. But observations are consistent with the possibility that Venus has no field. By putting an upper limit on the dipole magnetic moment of the planet, based on Mariner measurements, its distance from the planet, and a geomagnetic analogy, the magnetometer experimenters conclude that the magnetic dipole moment of Venus, if it is normal to the sun-Venus line, is less than 5 to 10% of the earth's magnetic dipole moment.

If the Venusian magnetic structure is the same as that of the earth, the surface field is less than 5 to 10% of the earth's field at the surface. If the Venus magnetic structure is complicated, the surface field could be larger than the earth's field in spots even though the field strength was not of sufficient magnitude to be observed along Mariner's trajectory.

Previous Observation

Previous observation of the planets and the moon suggest that planets and their natural satellites which rotate less rapidly than earth have smaller magnetic fields, a suggestion consistent with recent theories about the source of the fields.

Magnetometer sensors on Mariner are housed in a metal cannister, which is six inches long and three inches in diameter. The cannister is located just below the Mariner omnidirectional antenna in order to isolate it from any magnetic-field producing instrumentation on the spacecraft.

The cannister contains three mutually-orthogonal magnetic cores, one for each principal axis. The cores are constructed much like some transformers, with two windings of copper wire. The primary winding is excited by an oscillator and the secondary is connected to an amplifier. In the absence of a magnetic field, the wave-form of the current induced in the secondary winding is symmetrical, but under the influence of a magnetic field the symmetry of the wave is altered and a component with amplitude proportional to the field intensity is produced.

Mariner continues to transmit data on the magnetic field between the sun and Venus. The spacecraft passed perihelion at 12:11 a.m. EST on Dec. 28, at which time it was 65,505,935 mi. from the sun.

The magnetometer experimental results were reported by Dr. Edward J. Smith, JPL, for the group of experimenters including P. J. Coleman, UCLA; Prof. Leverett Davis, Jr., Caltech; and Dr. Chas. P. Sonett, Ames

Van Allen Hits Nuclear Blast Report

Presidential Scientific Advisory Committee's handling of information relating to the July 9 Project Starfish high-altitude nuclear blast has drawn criticism from two scientists who participated in the test.

Dr. James A. Van Allen, physics professor at the State University of Iowa and discoverer of the earth's radiation belts, said that the committee created an international false impression by the premature publishing of a report which erroneously stated that the artificial radiation belts established by the blast were much more intense and longer-lived than had been anticipated—and the report has never officially been retracted.

Van Allen's criticism was voiced during his discussion of Project Starfish at the recent meeting of the American Assn. for the Advancement of Science in Philadelphia. It stems from the fact that the committee classified his pre-blast predictions and then ignored the results obtained from the Injun and Explorer 14 satellites, which, he said, were in close agreement with the predictions.

Van Allen repeated his prediction that the decay rate of the artificial belts would leave them virtually undetectable by next summer (AW Nov. 19, 1962, p. 26).

The committee, headed by Dr. Jerome B. Wiesner, based its report on data obtained from Telstar. Van Allen told Aviation Week & Space Technology that the committee's wrong conclusion resulted from a "naive misinterpretation" of the data, rather than any error in the data. Telstar probably was measuring the earth's natural radiation belt, and "the committee essentially garbled the whole business," he said, and told the world that "we didn't know what we were doing."

Moreover, the report was released without warning several days before the Sept. 10-11 conference at Goddard Space Flight Center, which was scheduled to resolve conflicting opinions on results of the blast.

Van Allen attributed the committee's action to pressure from governmental circles for the rapid release of scientific findings. In the several times that he has been before it, he said that he felt "intimidated" by the "frenzied atmosphere."

"The committee possesses an air of authoritativeness inappropriate to sound judgment," he said, but stressed the fact that he spoke only in relation to this particular incident and did not wish his remarks to be construed as a sweeping condemnation of the committee's performance in all areas.

Dr. James W. Warwick, a radio astronomer at the University of Colorado, shared the platform. He agreed with Van Allen's charges, and said that when he tried to deliver the results of his radio measurements of the artificial belts, which were consistent with Van Allen's conclusions, he felt as if he were "crying in the wilderness."

The artificial radiation belts, he said, interfered with radio astronomy only at observatories at very low latitudes, contrary to previously-expressed fears that radio astronomy would be universally affected over a long period of time.

Van Allen added that the President's committee had erred in going beyond the intended scope of its advisory capacity when it permitted itself to "decide what the scientific facts were." In order to circumvent a similar occurence in any future tests of this kind, he suggested that an ad hoc committee from the National Academy of Science be created. This committee would announce forthcoming tests, publish the theoretical predictions and carefully analyze the resultant data before releasing any results.

Research Center. The magnetometer was made by Marshall Laboratories.

• **Energetic Particles**—An Anton 213 Geiger counter on Mariner detected only a single charged particle per second at the closest approach to Venus, compared with the several thousand per second counting rate the same device is known to indicate 20,000 mi. from earth. The observed encounter rate did not differ from the interplanetary rate observed by Mariner during November.

Low Intensity

This indicates that the magnetic field which would trap particles does not extend as far as the Mariner trajectory, a point confirmed by the magnetometer. The low intensity and extent of the field, according to JPL, is believed due to the planet's slow rotation rate.

An ionization chamber measured a rate of ionization of 670 ion pairs per cubic centimeter per atmosphere of air throughout the flight and a Geiger counter indicated a cosmic ray flux of about three particles per square centimeter per second over the flight path, information which is expected to add to knowledge about the solar radiation.

Reports on these experiments were made by Dr. Hugh R. Anderson, JPL, and Lewis A. Frank from State University of Iowa. Their colleagues on the two experiments, respectively, are Dr. H. V. Neher, Caltech, and Dr. James A. Van Allen, Iowa.

• **Solar plasma**—Solar plasma, or solar wind—streams of hot ionized gases apparently emanating from the inner corona of the sun—was observed by a Mariner experiment over long periods of time and results described by Dr. Conway W. Snyder for Mrs. Marcia Neugebauer, also of JPL, and himself.

The solar wind appears to be blowing continually and has sufficient energy to drag or push aside magnetic fields. Energy of the individual gas atoms in the wind is low, but they are so dense compared with cosmic ray particles that the total energy content of the plasma is greater than cosmic rays and fluctuations in the plasma can produce noticeable effects on earth.

From the findings of an electrostatic analyzer which measured particles over ten energy levels, the velocity of the solar wind was found to be less than 250 mi./sec. During relatively quiet intervals, its temperature is about 200,000K and particle density is around 10 to 20 per cubic inch.

The wind does kick up. Solar disturbances, or so-called solar flares, eject clouds of plasma, the temperature, density and velocity of which may exceed those observed in more quiescent periods, making it appear that solar wind is blowing harder than usual. Examples of these less common occurrences were observed by Mariner. Highest measured wind current was 0.4 nanoamperes.

• **Venusian mass**—Accurate estimate of the mass of Venus, 0.81485 times that of earth, with a probable error of 0.015%, was made by preliminary analysis of spacecraft trajectory data obtained during Mariner flight, according to John D. Anderson and George Null of JPL.

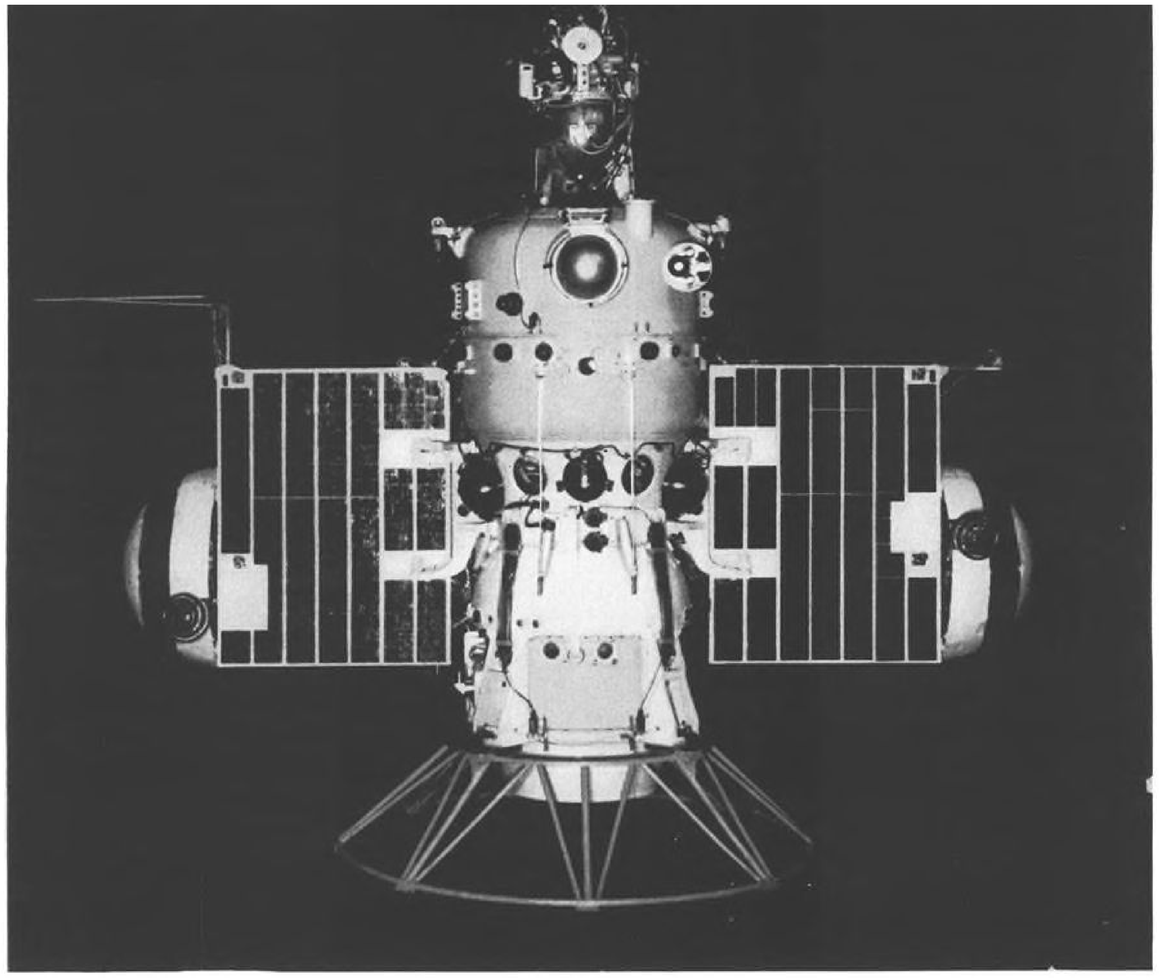
Basis for the estimate was a comparison of a Goldstone-transmitted signal with a spacecraft-translated frequency, transponded signal from which spacecraft velocity with respect to the earth was derived. A change in this velocity due to the gravitational field of Venus provided the basis for calculating mass, much as astronomers have determined mass of other solar bodies.

• **Cosmic dust**—Mariner's micrometeoroid dust detector indicated one unqualified encounter with a cosmic particle and there were other possible encounters, W. M. Alexander, Goddard Space Flight Center, reported to the gathering.

New Cosmos Satellite Orbited by Russians

Moscow—Soviet Union launched the 12th satellite in the Cosmos Series Dec. 22. The Russian news agency Tass late last week said all systems were functioning normally.

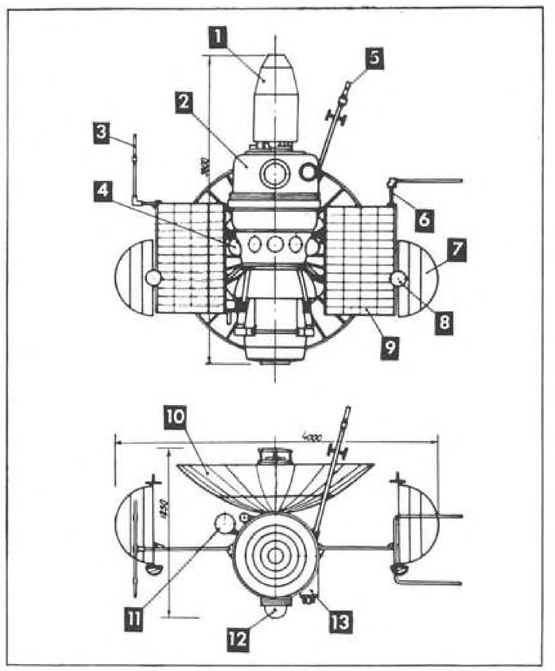
Cosmos 12 has an orbit ranging from 251.1 mi. to 130.8 mi., with a period of 90.45 min. Inclination is 65 deg. Cosmos 12 is transmitting on a frequency of 19.995 mc., according to Tass.



Soviet Mars Probe Design Details Shown

Soviet interplanetary probe Mars 1 appears roughly similar to U. S. satellites and space probes, with solar panels extending on either side of a central body, above. Schematic view, right, shows (1) correcting engine (uncovered in photo), (2) orbital compartment, (3) and (6) omnidirectional antenna, (4) orientation system container, (5) magnetometer shaft, (7) thermal regulation system radiators, (8) low-gain directional antenna, (9) solar battery panels, (10) high-gain directional antenna, (11) spectro-reflectrometer, (12) precise star and solar orientation data unit and (13) constant solar orientation data unit. Soviets say that according to current data, the space probe was located at direct elevation 6 deg. 27 min.; declination 39 deg. 52 min. and was a distance of 24,227,000 km. from earth on Jan. 2.

Soviet probe was launched Nov. 2 (AW Nov. 5, p. 43) and is expected to pass Mars about mid-May.



Hard Point ICBM Defense Effort Pushed

By Philip J. Klass

Washington—Program to investigate the technical feasibility of a relatively simple, low-cost ICBM defense system, specifically designed to protect hardened underground missile sites and vital command centers, is getting increased Defense Dept. emphasis.

The hard point defense concept envisions an anti-ICBM missile system which—unlike Nike Zeus—is readily adaptable to hardening, including its detection radars. The interceptor missiles would have extremely high acceleration and maneuverability, but only relatively short range. Intercept might occur at altitudes of 10-20 mi., perhaps even lower.

The concept is not a direct competitor to Army's Nike Zeus, which is designed to provide area defense against ICBM attack. Nor should it be confused with Army's Sprint program, currently in the study phase, in which the use of similar high acceleration missiles as a low-altitude supplement to the longer-range Zeus is being considered (AW Dec. 17, p. 26.; Dec. 3, p. 23).

Army Ballistic Missile Agency is contracting for some of the hard point exploratory developments in behalf of the Advance Research Projects Agency (ARPA), which is conducting the effort under its Project Defender program.

The new concept reflects a better understanding of ICBM defense needs and potentialities gained from work carried out in the Project Defender and the Nike Zeus programs. Where formerly ICBM defense was thought of as a single problem regardless of the target to be defended, it is now recognized that the requirements for a hardened target differ in significant respects from a soft urban area. These differences may permit the use of a less costly, less complex defense.

A hardened missile site or underground command center, designed to withstand both blast and fallout effects, can only be knocked out by essentially a direct hit.

Thus, an enemy missile aimed at a hardened site must funnel through a relatively narrow corridor, regardless of its launch point.

In contrast, an area-type ICBM defense system must protect a vastly larger approach corridor. A near-miss can be nearly as destructive as a direct hit, and fallout from a far-miss may be nearly as deadly as a near-miss. Because of this extreme vulnerability, interception of an enemy missile must occur at extremely high altitudes before the warhead detonates, and where the blast and fallout from the interceptor missile will not do major damage to the target it is protecting.

If interception occurs at extremely high altitude, before denser layers of the atmosphere have had time to slow the lighter decoys to a speed less than that of the more massive warhead, discrimination between the warhead and the decoys requires complex radars and computers, as in the Zeus system.

A hard point defense system, in theory, could use a relatively simple radar and computer, relying upon atmospheric filtering to make the initial sort between decoys and warheads. Finally, only those warheads on a trajectory that will bring them to impact very close to a missile silo or control center need be intercepted; the remainder can be ignored. The hard point defense interceptor missiles may use extremely simple guidance, such as an infrared homing device, or they might be unguided and used in a barrage-type attack.

In current exploratory developments for the hard point defense concept, emphasis is on basic techniques. There is no system development program at this point. Of the roughly $115 million budgeted in Fiscal 1963 for Project Defender, a very appreciable portion is being used to support the hard point defense concept directly, or indirectly through re-entry and nuclear-blast effects measurements that are also applicable to other systems. Funding for Fiscal 1964 is expected to be comparable.

Even if the concept is proved technically feasible, it will not necessarily move into system development and implementation.

Cost of implementation must be compared with alternatives, such as building additional hardened, but undefended, ICBM sites. Current cost of a Minuteman, its silo and pro-rata share of control system cost is slightly more than $4 million per missile. If the cost of a hard point defense per missile exceeds this figure, Defense officials may decide instead to build and install more Minuteman missiles. For this reason, simplicity and low cost are being emphasized in the hard point defense studies.

There are special situations where no such trade-offs can be made. These would include the President's command center and those of the Strategic Air Command and the North American Air Defense Command. If the concept proves technically feasible, these vital command centers would be the first to be equipped with the defense, probably with more firepower than used at a missile site.

Project Defender includes a number of other feasibility investigations, including Arpat (ARPA Terminal), which is under contract to Raytheon. It is considered "a vehicle for evaluating a lot of important techniques, some of which might be applicable to hard point defense," according to Dr. J. P. Ruina, director of ARPA. Ruina compares the function of the Arpat program to the role of the X-15 and Dyna-Soar (X-20) vehicles.

The ARPA program to measure characteristics of different types and shapes of re-entry bodies, so that techniques may be developed for distinguishing between warheads and decoys, has provided extremely valuable data during the past year. Where formerly there was largely speculation and theory, today there is the beginning of a body of scientific knowledge on re-entry physics, according to Dr. Charles Herzfeld, director of Project Defender.

This data is valuable not only in the ICBM defense discrimination problem, but because it enables the U.S. to design less vulnerable ICBM warheads. Although the U.S. has obtained important data on what types of discrimination techniques are most useful under different conditions, Ruina stresses that present knowledge still is modest and he expects the re-entry measurement program to continue.

Current measurement tests in the Atlantic and Pacific missile ranges soon will be supplemented by a new facility being installed at the White Sands Proving Ground. The latter will be equipped with the latest type of radar, Amrad (ARPA Measurements Radar), built by Raytheon under the direction of Lincoln Laboratory.

Zeus Intercept

One of two Nike Zeus anti-missile missiles fired in salvo recently from Kwajalein Island in the Pacific intercepted successfully a re-entry target vehicle launched by an Atlas ICBM from Vandenberg AFB, Calif.

This was the first target vehicle to be accompanied by decoys. Tracking equipment indicated that the intercept of the target was within the lethal range of a Nike Zeus operational warhead.

Second of the Nike Zeus missiles was destroyed automatically after launch because of technical defect.

In the series of Nike Zeus/Atlas target vehicle interception trials, Army specifies the time of the ICBM launch, trajectories, radar cross-section of target vehicle, and target vehicle penetration aids to be used and point of deployment in space (AW Feb. 5, p. 32).

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ON A WING AND TWO PRAYERS

LEACH HERITAGE OF THE AIR—23

The two young men faced almost certain death. The inside of their Whitworth plane was a fiery oven. They themselves had stopped German bullets. And six Fokker tri-planes hovered like vultures over their dying plane.

Two thousand feet below was No-Man's Land, just three kilometers from Albert, France. Eight undropped bombs and more than a thousand rounds of ammunition lay inches away from the licking flames.

For 2nd Lieutenant Alan McLeod and his machine gunner, Lt. A. W. Hammond, the war would surely soon be over.

Both men were part of No. 2 Squadron of the Royal Flying Corps based at Hesdigneul. The heavy Armstrong-Whitworth (Ack-W) they were flying was only meant for day and night bombing, photography, and artillery spotting. But the 18-year-old McLeod handled it like a scout plane.

On this morning of March 27, 1918, McLeod and Hammond set out on a bombing mission to Bray-sur-Somme. The Germans had launched a strong offensive in the area. And a call went out to the RFC for help.

Eight bomb-laden Ack-W's took off together for Bray, 15 miles behind the German lines. But the fog was thick in this part of the world. McLeod soon lost sight of the other bombers. And after 25 minutes of searching through cotton candy, he turned west and landed at one of his own airfields.

After lunch, McLeod and Hammond took off for another try. Approaching Bray, they saw a big German battery in action. They were just about to make a bombing run when a Fokker tri-plane appeared below them 200 yards away. Hammond fired three short bursts and the German flipped over and fell fatally to the ground.

Hardly had the Fokker fallen, when seven other tri-planes came down on the Ack-W from a break in the clouds. McLeod ducked, dove and danced in the air while Hammond hammered away with his single Lewis gun. A Fokker got too close. Hammond hit it right in the middle. It broke in two, belched flame and fell.

But six-to-one odds in a dog fight are not the best. And the worst happened.

Lieutenant Hans Kirschstein, 22-year-old German ace, maneuvered his Fokker under the Ack-W. With one machine gun burst he hit McLeod, Hammond and the Ack-W's fuel tank. This was it. Burn up in the sky or die on the ground 2000 feet below. What other choice was there?

To live. That's what McLeod had in mind. So when the floor of his cockpit fell away, he climbed out on the lower left wing, reached in and grabbed the joy stick, and sideslipped the plane, forcing the flames away.

His machine gunner was having his troubles, too. Hammond's seat had fallen away with the cockpit flooring. Favoring his wounded arm, he lifted himself onto the fuselage. From that high-wire position he miraculously shot down another German who thought he'd come in for a better look at the dying bird.

Kirschstein cursed the daring of these young men fighting for their lives. He dove at them again, putting more bullets into men and machine. Now Hammond's gun jammed. Kirschstein flew away, sure that neither pilot nor gunner could possibly survive.

But he was wrong. Just before the Ack-W was about to plow into a shell hole, McLeod flattened out the dive and climbed to the top wing. At impact, both he and Hammond were thrown clear of the wreck. As eight bombs and round after round blew up, McLeod dragged his unconscious gunner through No-Man's Land. Then, just short of the British lines, he was downed by a German bullet. But British Tommies crept out and brought the two unconscious airmen back to the safety of the trenches. That night, they were hospitalized behind the lines.

For his part in the brave battle above Bray, Hammond received a Bar to his Military Cross. He recovered, minus a leg. Three weeks before his 19th birthday, McLeod was awarded the Victoria Cross. He recovered, too, and returned to his home in Canada. Then, on November 6, 1918, he was stricken with influenza. The boy-man who had cheated death months before over a small French town, died quietly in bed.

We owe a lot to those pilots of World War I.

Indeed we do. It was young men like McLeod who gave the aviation industry the important boost it needed. And it's companies like Leach, who've helped keep that industry growing.

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Yes. Relays are an important factor in complex power and control circuits. Since 1919, Leach has supplied them to virtually every major aircraft. For instance, this balanced armature relay was developed by Leach to withstand the high shock and vibration requirements of today's sophisticated aircraft.

It's in use on all the "Century Series" aircraft, military bombers like the B-58, and on all commercial jet transports including the newest 727.

What else is Leach doing in the aerospace industry?

We're busy in many areas. Data recording, for one. Here is a miniature tape recorder that gathers data during 750 G's shock and performs perfectly during underground, on-the-ground, or in-the-air testing.

Where are you located?

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News Digest

Topaze, solid-fueled rocket being developed by the French for use as a satellite launcher by 1965 began its test program late last month. Developed by several French companies, notably Nord and Sud Aviation, Topaze is planned as the second stage of a three-stage Diamant missile.

Eurocontrol accord, setting up a high-altitude air traffic control for a large portion of Western Europe, has been ratified by parliaments of all member nations and is expected to begin operation soon.

Aero Grand Commander, which can seat up to 11, including pilot in high-density version, and features fuselage 6 ft. longer than Aero Commander 680F, is in flight test at Bethany, Okla. Standard version will be priced at $133,500, and initial deliveries are scheduled for April. Powerplants are 380-hp. Lycoming IGSO-540s.

Cessna 172 four-place, single-engine business aircraft, will be built in France by Reims Aviation, under an agreement signed by the two companies recently. Production will begin later this year. Cessna owns 49% of the stock in the French company. Balance is largely held by Nord Aviation.

Unsuccessful first test of an Air Force ion-propulsion engine, boosted into its space trajectory by a Blue Scout rocket from Pt. Arguello, Calif., recently, resulted from partial failure of battery power for the ion engine in the nose cone package. Developed by Electro-Optical Systems, Pasadena, Calif., the ion-propulsion system is designed to produce a fraction of a pound of thrust.

Space agency has ordered three executive Gulfstream turboprop transports from Grumman. One aircraft will be based at NASA's Langley Research Center for headquarters use, and the others will be at Marshall Space Flight Center and Manned Spacecraft Center. NASA will return to the Air Force three C-47s and one T-29 which the agency had on bailment for administrative transport.

Pratt & Whitney has been awarded a $1.8-million initial contract to produce throttleable RL-10 hydrogen engines with multiple re-start capability for possible use as a lunar braking engine. Specifications call for a throttling range of 12.5% to 100% of the 15,000-lb. RL-10 thrust. Initial contract takes the program through performance flight rating testing.

GLOBE-CIRCLING ROUTE STRUCTURE that would result from a Pan Am-TWA merger would involve 80,000 mi. and 169 cities. Overseas points now served by TWA exclusive from Pan Am are Geneva, Zurich, Milan, Madrid, Athens, Tel Aviv, Cairo, Dhahram and Bombay.

Uncertainty Shrouds Pan American-TWA Merger Effort

New York—Merger proposal by Pan American World Airways and Trans World Airlines (AW Dec. 24, p. 29) comes at a time when an uncertain attitude toward mergers exists among government regulatory agencies.

Atmosphere is reflected by the Justice Dept. and a Civil Aeronautics Board examiner both disapproving the proposed merger of Eastern Air Lines and American Airlines, both reasoning that the merger would not appreciably reduce excess competition. However, officials of Eastern and American airlines, like those of Pan American and TWA, are both expressing confidence that their respective mergers will ultimately be approved.

Pan American officials stress that there is no ground for comparing its merger with TWA and that sought by Eastern and American. The Pan American-TWA merger involves the nation's interest in international transportation, they say, and is a means of correcting an imbalance of monetary exchange created by heavy competition from foreign flag carriers.

Sympathy for this view is expressed by Rep. Emanuel Celler of New York, who said the Pan American-TWA and American-Eastern mergers "should not be considered in the same light."

Celler, chairman of the House-Antitrust Committee and frequent opponent of anything near a monopoly, said he favors a "benevolent" view toward the Pan American-TWA proposal.

"This doesn't mean I'm for it," Celler told AVIATION WEEK & SPACE TECHNOLOGY. "But since it involves international airlines, it should be viewed differently from the American-Eastern merger."

Celler cited Europe's Air Union as a merger of equipment, facilities and profits, a move he said would increase the international flag carrier competition against TWA and Pan American.

"It is a cartel beyond question," Celler said of Air Union, stressing that it must be seriously considered by everyone involved in deciding the Pan American-TWA merger.

He concurred that consideration must also be given the domestic airline situation, since the merged airline would have a competitive advantage for that traffic bound from the interior U.S. to overseas points.

Reaction from Howard R. Hughes, who owns 78.2% of TWA's stock, was noncommittal. His attorney, Chester C. Davis, said that it was too early for a formal comment, but that if the voting trustees controlling Hughes' stock failed to protect the interest properly, they would be accountable to the principal stockholder.

Sources in both TWA and Pan American said that efforts were made prior to filing to acquaint Hughes with the program. However, they said that Hughes' representatives expressed little interest.

Some parties close to both airlines are interpreting this apparent indifference as an indication that Hughes will fight the merger, possibly through a court injunction. Even though the

rights of the trusteeship controlling Hughes' TWA holdings extend to voting his stock in a merger. Hughes could still plead to the courts that his interest in the airline is threatened.

Merger's impact on domestic airline business could be substantial, as TWA serves approximately 73 U.S. cities. Much of the international travel from interior points is now carried to the country's gateways by TWA's competitors, mainly United, American and Eastern.

American annually feeds approximately $4,200,000 of interline business to Pan American, and receives about $8,000,000. Eastern provides Pan American $4,500,000 in outbound traffic and receives $8,000,000 from inbound travelers. Eastern's exchange with TWA, both domestic and international, totals $8,000,000 outbound and the same amount inbound. United feeds approximately $10,600,000 in business to Pan American and receives $5,800,000-$6,000,000. With TWA, it trades about $23,000,000 both ways.

The Pan American-TWA merger would enable the combined airline to establish schedule patterns in the U.S. ideally suited for one-carrier service all over the world, a feature that competitors realize could seriously reduce the amount of business received from the two international carriers. And carriers stress that interline sales as a class are often the single largest annual source of passenger revenues.

System Organization

"Each airline merger should be judged on its own merits," an American spokesman said. "But the proposal is almost certain to raise the question of how U.S. international systems should be organized, and what the relationship should be between domestic and international airline systems.

"The related question of whether TWA's domestic operations should be disposed of separate from its international operations is likely to arise."

American's comment appeared to raise the question of whether domestic carriers would still continue to feed domestic traffic to the international Pan Am World system or attempt to gain new sources of traffic by dealing with foreign airlines.

Foreign carriers are making no formal statements on the merger. But there is no question of their concern over the prospect of a single U.S. international airline with the full weight of this country's government behind it.

Isolating Hughes was the motivating aim in setting up the complex organizational structure for the merger. From it came the idea of converting Pan American World Airways into a holding company, which would control 11,346,063 shares of the total 18,020,218 shares of stock in the operating company—Pan Am World Airlines.

Proposal calls for a share-for-share exchange of stock in Pan Am—the new operating company—for currently outstanding stock in TWA. Then 1.7 shares of Pan Am for each share of TWA stock taken in would be placed in the holding company. The 1.7 figure favors the TWA stockholder since the market price of Pan Am's stock is approximately double that of TWA stock.

Significant for Hughes is the fact that TWA stockholders have no control over the majority interest held by the holding company, since their stock would be wholly in the operating company. The 18,020,218 combined shares also represents an increase of about 34% over the present outstanding stock total of both airlines, and reduces Hughes' percentage in the merged airline to 29%.

This might be sufficient for Hughes to elect representation on the board of directors of the operating company. But gaining control of the board is unlikely, since the holding company, through its majority stock interest, will elect at least 15 of the 26 members.

A tax liability would be assumed with the holding company operation, since the dividends it receives on stock in the operating company is taxable. However, Pan American considers this preferable to permitting Hughes a stronger interest, which he would have through a straight merger of the airlines. Provision is made in the merger agreement for abolishing the holding company if it becomes practical to do so.

Another stock agreement Pan American obtained in its negotiations with TWA, and one apparently designed to further equate the exchange of stock, is the issuance to the holding company of 150,000 new shares of $100 par 6% cumulative convertible preferred stock. These shares would be callable after five years at $110 and accrued dividends, and would be convertible into the common stock of the operating company.

Pan American, in becoming the holding company, would also retain $6,500,000 in cash as a guarantee of continued dividend payments until wrinkles are smoothed out of the new airline. It will also keep its interest in the new Pan Am building in New York, 463,988 shares of National Airlines stock with a market value of about $9,400,000, and $2,417,000 in blocked Cuban pesos.

Prior to the merger, Pan American would call in $46,970,000 in subordinated debentures, paying them off with cash that one official said Pan American "has in its pocket." TWA's $100 million in outstanding debentures, issued to gain additional funds, would be transferred to the new operating company. No interest payments on the TWA debentures were made in 1961 or 1962, but the interest is cumulative.

Both carriers would continue to operate for at least three years under their present names and corporate symbols to "capitalize on the good will accruing to each." The new identity of Pan Am World Airlines would then be attached to aircraft and facilities.

New York Stock Exchange has agreed to a dual listing for the merged operation. Pan American's current board code of PM would be retained for the holding company, and a new code adopted for the operating company. This is necessitated by TWA stockholder interest being all in the operating company, and Pan Am's in the holding company.

Comparative balance sheet figures for Pan American and TWA underscore the reasons for TWA's interest in the merger. As of Oct. 31 last year, Pan American's stockholder equity totalled $147 million, of which $67 million was made up of retained earnings accumulated over the years. TWA's stockholder equity of $80 million was slightly better than half the Pan American figure, but included only $1,880,000 in retained earnings as a result of recurring deficits.

One of the major criterions of borrowing power is the ratio of stockholder equity to debt, that is, the ratio of money invested in the company by stockholders and retained out of earnings in relation to money borrowed from banks or institutions.

Borrowing Power

Deficits are eroding TWA's equity and consequently its borrowing power to buy the equipment it needs to compete in major markets at a time when the airline needs new equipment—especially a small, short haul jet transport of the BAC 111 or Caravelle class—to generate revenues and improve earnings.

In former years, Howard Hughes has been willing to pump new equity capital into TWA. But the advent of the trusteeship has eliminated this source for at least the near future.

TWA might be able to break the financial vicious circle by its own efforts, but increasingly intense competition domestically and internationally has apparently convinced the airline's top management that consolidation with Pan American's greater capital resources is a more palatable solution.

Whether consolidation would provide any broad scale immediate savings is a debated question, except in one area. Combining and streamlining of the advertising budgets alone of the two carriers would provide an immediate saving on the order of $10 million.

No plan for the distribution of jobs among Pan American's 22,886 and TWA's 20,940 employes has yet been drawn. But the merger agreement does specify that none of TWA's non-management force in the U.S. will be released, since it is needed for operation of the domestic routes. TWA management employes would be retained on the basis of merit, determined by a special committee comprised equally of TWA and Pan American representatives.

Special termination allowances would be made for officers.

Foreign based nationals in non-management positions would, if released as result of the merger, receive termination allowances greater than that required by their local law. Special consideration must be given in this area because foreign laws are especially protective toward nationals employed by U.S. carriers. Such employes often cannot be laid off even when the airlines are shut down by strike.

New labor contracts would have to be negotiated in several instances if the merger results. The Air Line Pilots Assn. contracts with both Pan American and TWA specify that in event of a merger, the flight operations of both carriers would remain separate until a new agreement is signed.

The mechanics and related crafts on each airline are represented by different unions. TWA's clerks and agents have no union affiliation, while those in Pan American are represented by the Brotherhood of Railway Clerks.

General feeling of disappointment is evident among TWA's management personnel over the merger move. Even though this group realizes that merger is a logical remedy of numerous problems, many within it express regret at TWA's losing its long-established identity. Idea is also widespread that TWA management will suffer most in the employe position readjustment.

Effort is being made within TWA to stress that the merger is just that, and not an absorption of TWA by Pan American.

"TWA personnel will have increased room for the exercise of their talents and know-how," Charles C. Tillinghast, Jr., president of TWA, said at a recent dinner for management personnel. "If consummated, the merger will be a true consolidation of two great airlines and not simply an absorption of one company by another."

Floyd D. Hall, senior vice president and system general manager, carried the "wag the dog" theme further in his remarks to the same group.

"We have been case-hardened by many years of tough sledding," Hall said. "When you look at the comparative ages of the officers of Pan Am and TWA, we average a good ten years younger.

"With the guarantees that have been written into the agreement, and the youth and vigor of our management, we are the ones who are most likely to shape and guide the future of the merged airline," Hall continued. "I say this without detracting in any way from the capabilities of the Pan Am people. They are a very able crowd. But youth and vigor—and vital statistics—are on our side."

Traffic Data From Aeroflot Chief Indicates Severe Excess Capacity

Moscow—Aeroflot chief Yevgeny Loginov has disclosed that the Russian airline monopoly carried between 120,000 and 150,000 passengers daily during peak traffic periods last summer.

The statement provides further evidence that Aeroflot has seat capacity far in excess of its normal requirements. A rate of 150,000 passengers daily would equal nearly 55 million passengers annually.

Aeroflot's 1962 goal was 29-30 million passengers, and Loginov said the Soviet line had handled "more than 27 million passengers" by mid-December. Target for 1963 is 35 million passengers.

Ton-miles flown during 1963 are expected to increase 33.5% over last year.

Speaking before a Moscow press conference that was open to foreign as well as Russian journalists, Colonel-General Loginov also declared that.

- **"The time is not far off"** when the four-jet, 182-passenger Ilyushin Il-62 will go into "transcontinental" service. (In the past, the Russian meaning of "not far off" and "soon" has turned out to be a period of time ranging up to three years when applied to activation of new transports).
- **Aeroflot will receive** aircraft capable of supersonic speeds "in the future."
- **Russia now has agreements** providing for direct air service to 31 countries, and Aeroflot is flying regularly to 28 foreign capitals.
- **Twenty-one foreign** airlines now fly into the Soviet Union.
- **Aeroflot has more** than 248,400 miles of routes, including 49,680 miles outside the USSR.
- **Planning has started** for a monorail transportation system linking downtown Moscow and Vnukovo Airport.
- **New airport terminals** were opened during 1962 at Odessa, Sukhumi, Ashkhabad, Kemerovo "and a number of other cities."
- **Aeroflot's special purpose** aircraft dusted, sprayed or otherwise treated 70 million acres of agricultural land or forest in 1962. About 1,850,000 metric tons of chemicals were applied from the air. Aerial dusting and spraying will be used on 79 million acres in 1963.
- **Airline's ambulance service** carried more than 205,000 patients and medical personnel and over 500 metric tons of medicine in 1962.

Hawaiian BAC 111s

London—Hawaiian Airlines has entered into a preliminary agreement with British Aircraft Corp. to purchase three BAC 111 short-range jet transports.

Final contract, amounting to $8.5 million, hinges on approval by the U. S. Civil Aeronautic's Board. Delivery is scheduled for 1965-66.

Approval of the contract would bring BAC's total orders for the BAC 111 to 39.

Company spokesman said the carrier expects to file a formal request for a guaranteed loan with the U. S. Commerce Dept. before the end of this month.

IATA Meets to Review Atlantic Piston Fare

Paris—International Air Transport Assn.'s proposed new common piston-fare structure for the North Atlantic is being reviewed here this week at a special meeting called in an effort to avert a threatened rate war over the route.

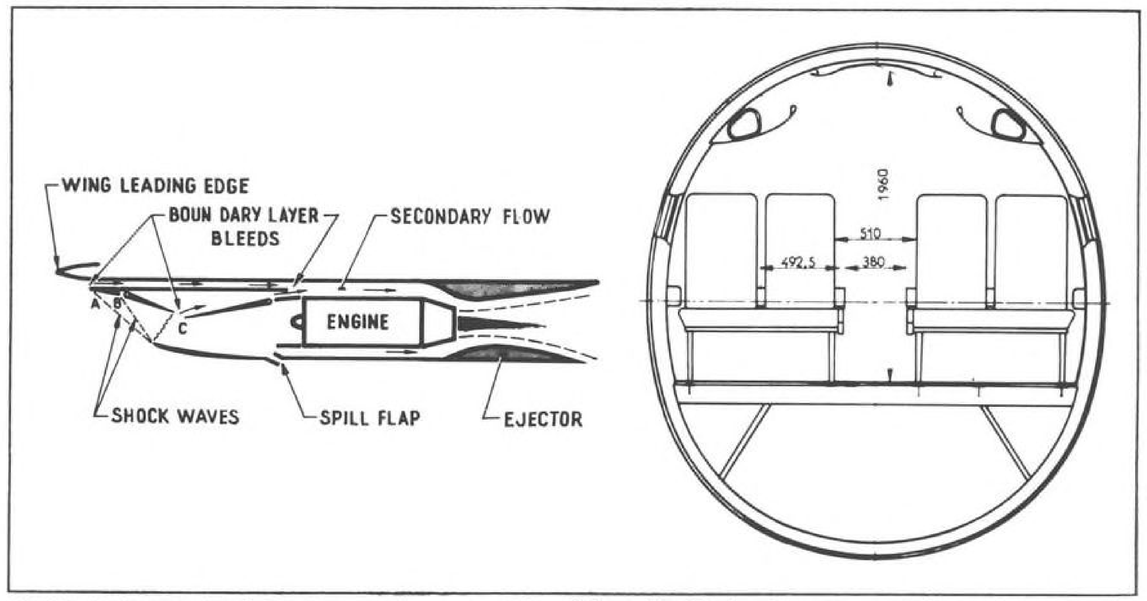
Plans for the special session were drafted after Scandinavian Airlines System threatened to reject the piston-fare structure proposed at IATA's annual traffic conference in Chandler, Ariz. (AW Dec. 3, p. 41; Dec. 17, p. 37).

Moscow-Havana Service

Moscow—Regular air service between Cuba and Soviet Union was inaugurated last month when an Aeroflot Tu-114 turboprop transport flew nonstop from Moscow to Havana. Soviet news agency Tass said the aircraft returned to Moscow in a nonstop flight Dec. 29.

The Russian-owned airline will operate the new route over international waters, north of the Scandinavian countries and across the North Atlantic below Greenland before turning south to Cuba. Governments of countries close to the route were advised of the new service before it began. There was no announcement of schedule planned for the new route. However, it was learned in Washington, D. C., that round-trip flights will probably be operated every two months.

Tass said the 6,820-mi. return flight was made at altitudes from 29,520 ft. to 36,080 ft. in less than 14 hr.



ENGINE NACELLES of Anglo-French supersonic transport (left) will have adjustable flaps for optimum air flow regulation at varying flight speeds. Cabin dimensions, shown in centimeters, will be 77 in. floor-to-ceiling, 15 in. aisle width between arm rests and 20 in. between back rests, and seat width of 19½ in. Aircraft will have 25 rows of four-abreast seats.

Anglo-French Mach 2.2 Transport Will Have $8-9 Million Unit Cost

By James R. Ashlock

New York—Relatively low unit price of $8-9 million is planned for the supersonic transport being developed cooperatively by the French and British, a figure made possible by the two governments absorbing approximately $500,000,000 in development costs (AW Dec. 3, p. 41).

Gen. Andre Puget, president of Sud Aviation and director of the joint Anglo-French supersonic program, said present production cost estimates are based on a market potential of 130 aircraft through 1975. In direct operating and seat mile costs, he said, the aircraft should compare favorably with current jets.

Direct operating cost for the supersonic transport will be $1.50-2 per nautical mile, Sud estimates, based on segments of 1,000 mi. and over. The airplane will have 25 rows of four-abreast seats on a 36-in. pitch. Seat mile cost therefore would be 1½-2 cents per nautical mile, designers estimate. In subsonic operation, the airplane's direct operating costs will be 10-15% higher than present jets.

In his first visit to the U.S. since becoming president of Sud on July 23, Gen. Puget discussed with U.S. airlines both the supersonic transport and the advanced, turbofan-powered Sud Caravelle. Airlines visited included Pan American World Airways, Trans World Airlines and National Airlines.

French and English sales teams, Gen. Puget said, are being organized for a worldwide marketing effort for the supersonic transport. The British probably will handle the Commonwealth countries, and the French will concentrate on Europe and Africa. Still undecided is the sales procedure in the U.S., South America and Asia, but it is expected that both French and British representatives will comprise the sales groups for these areas.

"There probably will be two teams of all-British and all-French personnel, and possibly one or two combined groups," Gen. Puget said.

Because the sales program is still undecided, there is no concentrated effort presently to solicit orders for the aircraft. But this activity is expected to begin in the first six months of 1963 when the sales groups are established. Primary effort then will be the seeking of individual airlines' desired interior layouts and systems preferences, Gen. Puget said.

"We plan to invite top airline executives to meet in 1963 to discuss the aircraft's requirements," Puget said. "We need their advice on it."

More definite cost figures on the airplane are expected to evolve in the first half of 1963 as the first production drawings go to the shops.

Production plan calls for completion of two flying prototypes in 1966, one at Sud's Toulouse facility and the other at the British Aircraft Corp.'s plant at Filton. A preproduction series of at least two aircraft is programmed for 1968, these being used to complete 4,000 hr. of flight testing. Production is scheduled for 1969-70, with the aircraft entering service in 1970 pending type certification.

Gen. Puget said the first prototype will incorporate features of the long-range version of the aircraft. An example is the landing gear, which on the prototype will have the 250,000-lb. capability of the long-range model, instead of 200,000 lb. as on the medium-range.

Primary difference in the two versions, aside from the landing gear, is in the vertical stabilizer size, fuel capacity and cargo space. The 3,250 mi. long-range version will have extra tanks in the wings. Compensating for the added weight will be a reduction in some of the 875 cu. ft. cargo area capacity of the 2,400-mi. medium-range version. The long-range version will also have a larger vertical stabilizer.

Although capable of cruising 1,450 mph. at altitudes up to 64,000 ft., the transport is designed to cross the threshold on landing at approximately 162 mph., about the same as subsonic jet transports. Takeoff distance for the medium-range aircraft, at full 200,000 lb. gross, is not expected to exceed 5,000 ft.

Noise research indicates that the transport, with its four 29,000 lb. thrust Bristol Siddeley Olympus 593 engines, should not pose an appreciably greater problem than current subsonic jets, Sud believes. Due to its steep climb angle, noise from the supersonic transport at 3 mi. from brake release should be about 20 PNdb less on the ground than is now experienced with the Caravelle. To further reduce noise, the supersonic transport may take off on 80% of power, using 7,200 ft. of runway.

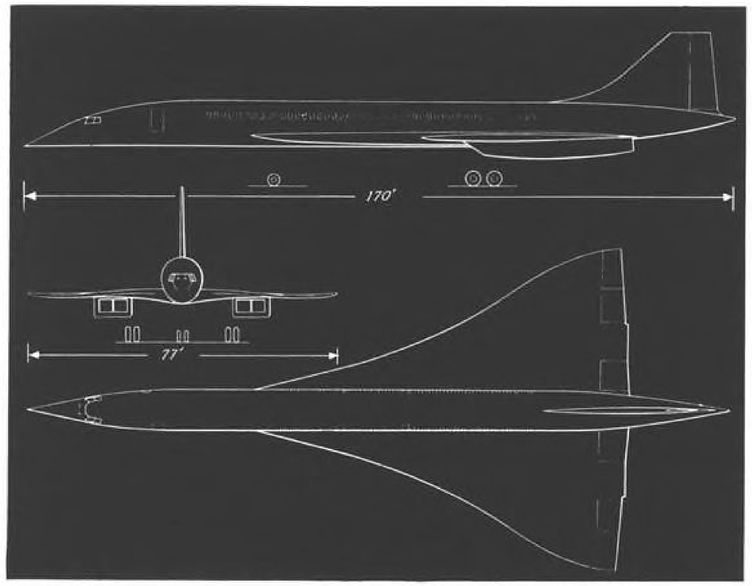
The airplane is designed to exceed Mach 1 at approximately 32,800 ft., an altitude believed sufficient to minimize the sonic boom problem. Afterburners may improve the climb angle and speed to where supersonic penetration will occur at even higher altitude.

Sud officials say the shock wave at cruise altitude, between 59,000 and 64,000 ft., should entail an overpressure of about 1 lb. per sq. ft., which is below the permissible 1.5-2 lb. Data is based on tests using Mirage 3 and 4 aircraft.

Because structural temperature of the supersonic transport is expected to reach 130C in cruise, duralumin will not be used. Instead, the airplane will have an aluminum alloy designated AU2GN (RR58), used for construction of forgings for jet engine components.

Tests show that after 10,000 hr. of heat exposure, the AU2GN, at 130C, retains 90% of the ultimate strength it has at 25C. Duralumin, under the same conditions, retains 75% of ultimate strength. Stainless steel will be used for the six elevons and the rudder, and the engine nacelles will be made of titanium or stainless steel.

Research also reveals that Viton plastic sealants, sealing such areas as wing fuel cells, are showing good endurance.



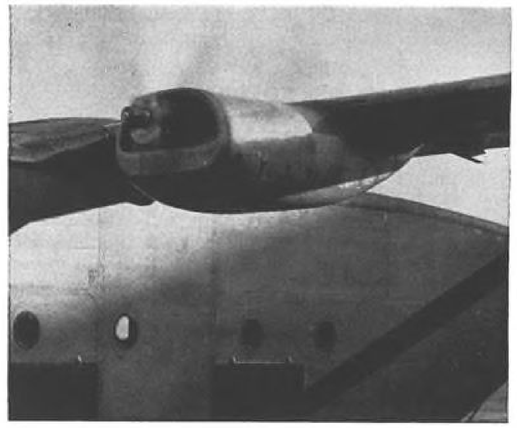
THREE-VIEW DRAWING of supersonic airliner shows position of six elevons on wing trailing edge. Adjustable unit is planned to permit more cockpit visibility in low-altitude, subsonic operation. At supersonic speeds, windshield will retract to smooth out airflow.

An adjustable cockpit windshield exposure is planned, with extension for better visibility at subsonic speeds and retraction to smooth out the nose area at supersonic velocity. Puget says the BAC team is responsible for the design of this feature.

Sud officials said a canard design originally was considered for the aircraft. However, the forward position of control surfaces caused directional instability at both low and high speeds, and also spoiled efficiency of the engine air intakes. Research showed that the ogee delta wing was the most appropriate concept, since the extension of the wing root forward on the fuselage provides the stability initially sought with the canard.

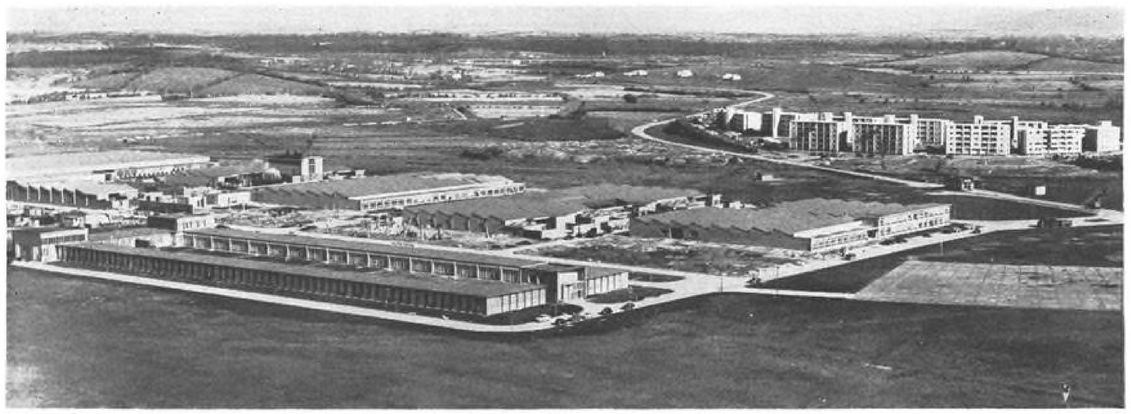
Although the name of Concorde has been associated with the airplane, this name has not been officially approved, Gen. Puget said. Indication is that a name reflecting both British and French influences is being sought.

Large carriers like Air France and British Overseas Corp. are most likely to place initial orders, but smaller airlines like El Al and Alitalia also feel they will require such an airplane, Gen. Puget said.



Short Skyvan Rolled Out at Belfast

Engine runup and taxi tests of Short Skyvan 1 cargo-passenger transport have started at Short Brothers & Harland plant at Belfast, Northern Ireland, following rollout (AW Dec. 17, p. 36). Powerplants are two Continental GTSIO-520 six cylinder horizontally opposed engines slung in pods beneath the wing, left. Bulge on top of center fuselage contains fuel tankage. Skyvan 2 production model will be fitted with two Turbomeca Astazou turboprop engines.



AERIAL VIEW OF SHANNON FREE AIRPORT shows construction activity at the industrial zone site, with worker housing in the background, behind the main road to Limerick, 16 mi. away. Site borders on the 11,000-ft. jet runway at Shannon.

Shannon Free Airport Expansion Begun

By Herbert J. Coleman

Shannon, Ireland—Shannon Free Airport is looking to the European Economic Community, the Common Market, as the key to its rapidly expanding industrial development center in an era when the long-range jet is bypassing the airport for Europe's gateway cities.

At the same time, with tourism still a major factor in Shannon's economic posture, airport development planners are coordinating the industrial sites with a highly automated air cargo and water housing center aimed directly at servicing Shannon's tenants.

To date, concentration on expanding the industrial site within the Free Port boundaries can be considered an initial success, and is a reflection of Republic of Ireland policy toward industrialization of a primarily agrarian country. As the spearhead of this trend, the Shannon Free Airport Development Co., Ltd., a governmental body, plans a world-wide promotion drive next year that will emphasize to foreign firms that Shannon will:

- **Offer exemption** from Irish income tax and corporation profit taxes on export profits until 1983, along with freedom to repatriate profits and capital gains.
- **Allow partial exemption** for local taxation levied on land and buildings.
- **Negotiate non-repayable** cash grants up to half the cost of new machinery and plant facilities, and the full cost of training workers, whenever a proposed industry will make a major contribution to airport utilization and local labor.
- **Allow import** into the Free Trade Zone of finished or partially manufactured goods and raw materials free of customs, with no time limit for goods remaining at Shannon.
- **Continue its long-range plan** to develop the Shannon industrial complex into what eventually will be a community of about 30,000 persons who will have modern housing and service facilities.

Officials at Shannon consider the airport as the natural port of entry and exit, considering the financial advantages of a free airport zone, in the sphere of influence of Common Market countries and North America. Passage of the U. S. 1962 Trade Development Act considerably heartened the development company in its efforts to promote westbound cargo volume.

Sales Campaign

So far, a low-pressure sales campaign has resulted in establishment of 12 foreign companies in the Shannon industrial zone, with at least four more currently in final stages of negotiation. Total capital investment by foreign companies is $7.5 million. Payroll in the industrial zone has risen from nothing two years ago to last year's $2.6 million.

These figures do not include impact of three new companies which will begin operations in January—Raytheon Co., of Lexington, Mass., General Electric and Pall Corp. of New York, all of which now are recruiting labor. Another new firm is Mohawk Tool Co., of Montpelier, Ohio, which will employ up to 500 persons when it begins operations in January, 1964.

This surge of interest in Shannon's industrial zone has posed some back-breaking problems for the development company, headed by Brendan O'Regan since its inception in 1959.

Most obvious problem is keeping Shannon construction ahead of the demand and obtaining the necessary capital investment funds from the Irish government for construction before actual contractual commitments with potential industries. In effect, the development company took a calculated risk that has paid off so far and still holds a bright future.

Another problem, not originally envisioned, now is plaguing the industrial site planners, according to Paul Quigley, general manager. That is recruitment of workers in the Shannon area, and transporting them to their jobs pending completion of the next phase of housing units. Labor pool itself is adequate, but the Shannon plan is based on on-site housing in the long run.

Until the Irish government allocates funds for the next round of housing projects, the development company—to maintain the present impetus of the project—is considering interim transport plans, ranging from water ferries to shuttle bus service.

Most ambitious is a plan to utilize one or two air-cushion vehicles which would operate across the River Shannon and into the Shannon Airport estuary, hauling workers from County Kerry.

Without the air-cushion craft, and since no bridge crosses the Shannon River, potential workers would be forced to drive long distances to reach their jobs. John D. Dilger, the development company's manager for commercial aviation, is researching the possibilities of using an air-cushion vehicle across the Shannon in tandem with the manufacturers and perhaps a fuel concern.

With the first phase of the Shannon industrial housing project nearing completion, there are 247 housing units available for families, according to T. A. Callanan, general services manager. These are in addition to a plan to build 22 houses designed for company executives, which will be for sale or lease. However, most companies plan to buy the properties outright.

Quigley and Callanan emphasize that before work was started on any part of the housing project, the airport officials called in outside community planners whose main job was to guard against an impersonal "company town" aspect of life. Recreation and shopping facilities are being prepared for the second phase of development. Present residents have a temporary shopping center.

Necessity for extensive advance planning also was foreseen in the building of the industrial site. Every structure is laid out on module or bay systems which will allow for expansion when volume warrants. Because of this, Shannon has permission to extend the boundaries of the Free Port zone around the airport, giving it extra room to continue the industrial expansion.

Shannon's success has already caused some local political repercussions, in that Limerick, the Irish seaport about 16 mi. away, fears a drain of its population—and thus its voting strength— to the new Shannon community. There is also some reluctance in high places to envision Shannon as a city of 30,000 population, although private opinion at Shannon itself is that this goal is a generation away.

Meanwhile, every move on industrial site promotion is closely coordinated with the over-all plan to make Shannon the leading Common Market cargo airport. The cargo handling terminal has been operating for some time, but the development company has already started an ambitious construction plan aimed at a highly automated warehousing facility connected to the main terminal by a belt system.

Dilger pointed out that the warehousing plan offers these incentives to both existing industrial zone firms and shippers from the United States and Europe:

- **Low-cost storage,** with cost held to 60 cents per square foot. First phase is construction of 110,000 sq. ft. of space, which can be expanded as needed.
- **No fees, duties or local taxes** are levied on goods in storage. Shippers may store goods, Dilger added, without tieing up capital in duties or bonds, and can have these products warehoused by independent operators or forwarders.
- **Shannon development company** will build warehouse facilities to customer requirements for lease, or a company can construct its own building on land leased from Shannon. Standard warehouse units now being built each have a total area of about 4,000 sq. ft.

Design of the automated warehouse is still under study, partly with Whitworth Gloster Aircraft, makers of the Roll-a-Mat loading system. First two of six bays have been leased; two freight forwarders already have started business, and a third will begin in 1963.

Decision to push the warehousing complex was a direct result of more advantageous cargo rate structures on the North Atlantic, both eastbound and westbound. Most Shannon cargo traffic —about 85%—is transit cargo. By the end of December, Shannon had handled an estimated 33,616 tons of cargo, a slight drop under a year ago, due to a cutback in transit traffic.

However, the trend is turning toward westbound cargo shipments from Shannon to New York, Boston and Chicago. Much of this cargo is generated by foreign firms already established in the industrial zone.

Manufacturing in the Shannon industrial zone is widely diversified. Managements and ownership cover several countries. For example:

- **Raytheon Co.'s** Shannon subsidiary will be known as Raytheon-Ireland, Inc., and will initially employ about 150 persons who will assemble electronic tube mounts for communication equipment. After training personnel, Raytheon-Ireland will manufacture the components at Shannon.
- **General Electric's** subsidiary, E. I. Co., Ltd., has leased 18,750 sq. ft. of factory space and will initially employ 100 persons who will work under GE's Radio Receiver Dept., Utica, N. Y., in manufacturing parts for radio sets.
- **Pall Corp.,** of New York has formed a joint company with Irish Wire Products, Ltd., of Limerick, to manufacture wire filters for aircraft and pharmaceutical industries. Employment is projected to 500 persons in three years.
- **Amphenol-Borg, Ltd.,** Electronics Division, a subsidiary of the parent Amphenol-Borg Electronic's Corp., Broadview, Ill., is primarily a warehouse firm handling shipments of components from Broadview for re-export to the United Kingdom and Europe.
- **British Cotton & Wool Dyers' Assn.** has formed a Shannon company in association with Lana-Knit (Ireland), Ltd., an established industrial zone firm. The firm will accept orders for dye operations from overseas customers. Lana-Knit has doubled its floor space since starting at Shannon in 1961.
- **Standard Pressed Steel Co.,** of Jenkintown, Pa., one of Shannon's largest plants, is expanding its manufacture of precision fasteners and miniaturized electronic components.
- **Sony, Ltd.,** of Tokyo, manufacturer of transistor radios, has a target date of 250,000 units by 1964 and a payroll of 200, of which five are Japanese supervisory personnel.

NEW SHANNON tourist promotion, based on a 24-hr. stopover either east- or westbound, provides tour of Bunratty Castle, six miles from airport.

Shannon Undertakes Tourist Promotion

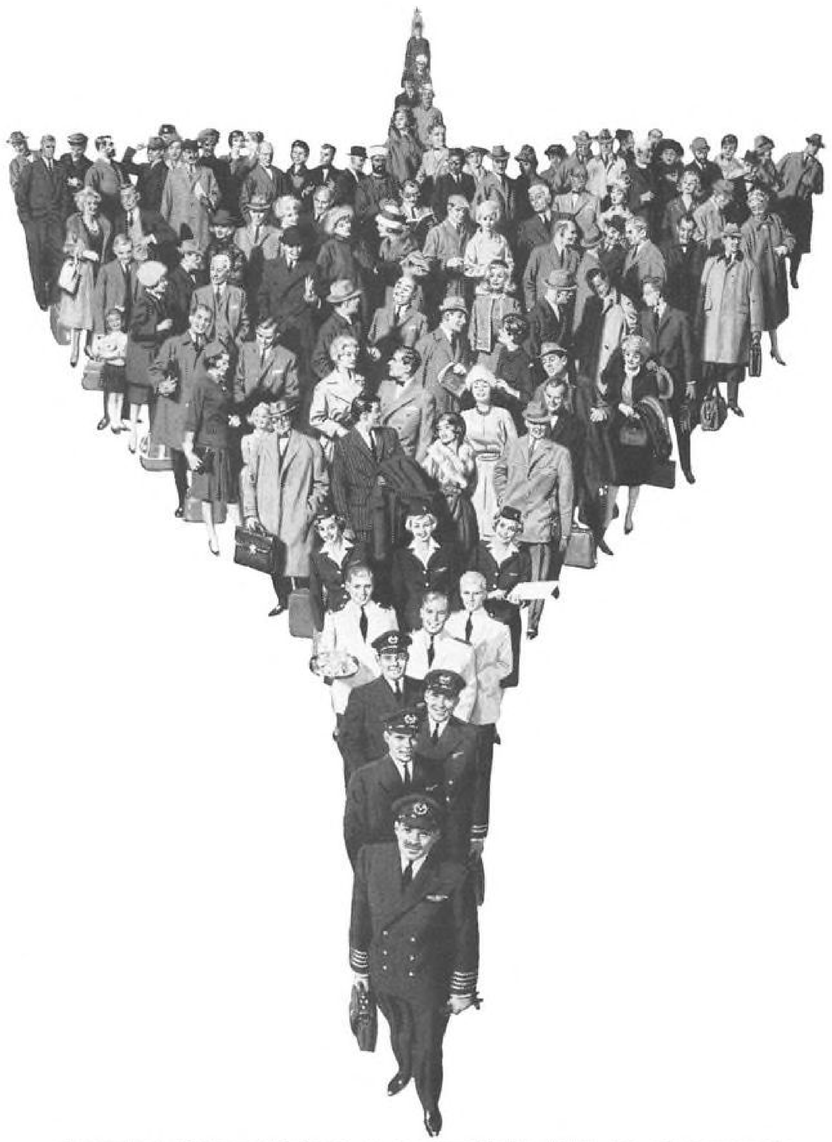
Shannon, Ireland—Ambitious project to halt a decline in transit tourist traffic at Shannon Free Airport is under way in tandem with Shannon's accelerated scheme to broaden its industrial and economic base.

Slump in both terminal and transit passenger traffic is traced to overflying of Shannon to gateway cities by long-haul jets, and to inauguration of Aer Lingus service to London and Paris from the new airport at Cork.

To reverse the trend, Shannon officials are promoting a 24-hr. stopover for a "Medieval Tour" which costs $15 and includes local transportation, accommodations and meals. Trial run, made near the close of last tourist season, at no charge, was so successful Shannon decided to charge the fee in an attempt to break even on basic costs. Tour leaves ample time for purchases in the Shannon duty-free shop.

The "Medieval Tour" highlight is a banquet in Bunratty Castle, built in the 15th century and located six miles from the airport. Development company has spent considerable funds, in cooperation with Irish Tourist Board, to restore the castle. Tour is available to eastbound and westbound passengers and includes tea in the thatched cottage, demonstrations of Irish dancing and a visit to 12th century Quin Abbey. There also is a sight-seeing tour to Limerick, 16 mi. distant.

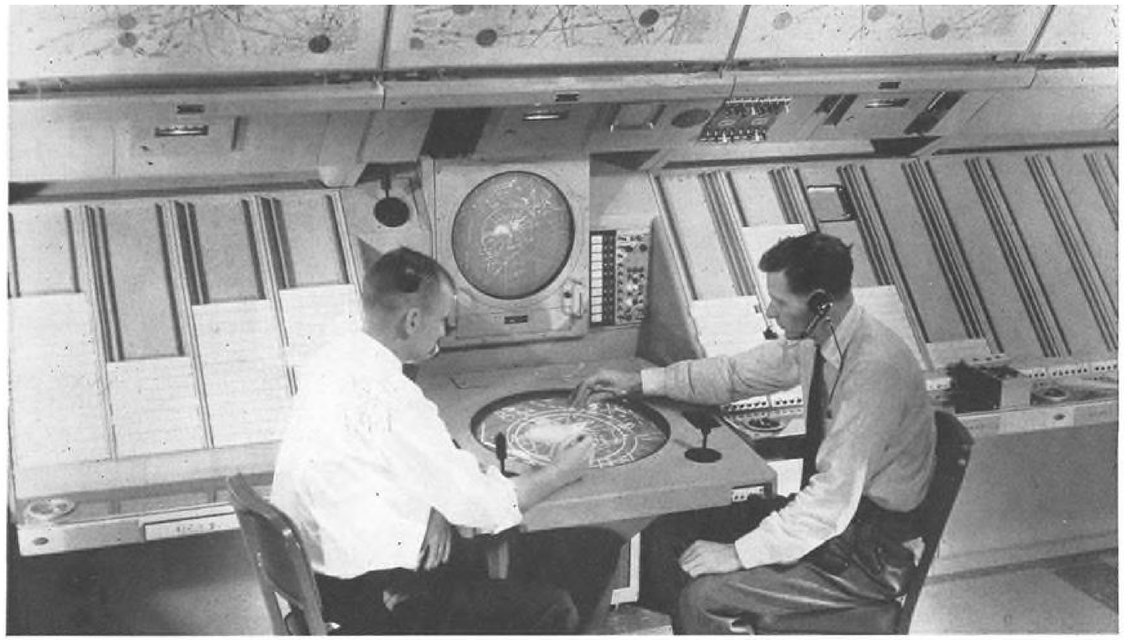
Company is considering plans to build a Folk Park near Bunratty Castle, a replica of a rural village. Stopover scheme is being backed by 11 airlines and a number of U. S. and European travel agencies.



NEW YORK TO LONDON IN 3 HOURS

BRISTOL SIDDELEY
AND
SNECMA
SUPPLY THE POWER

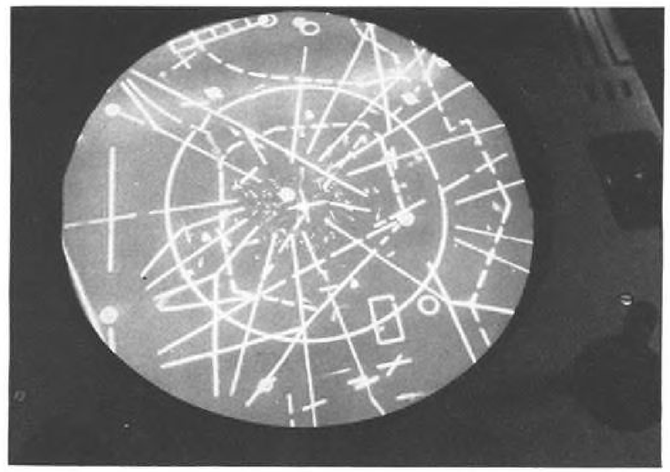
Supersonic airliners are being jointly developed by the British and French aircraft industries which will carry 100 passengers at more than twice the speed of sound. These aircraft will be powered by four Olympus 593 turbojets, which will produce a total of more than 50 tons of thrust. Development and manufacture of the engines will be undertaken jointly by Bristol Siddeley Engines Limited, and the Société Nationale d'Etude et de Construction de Moteurs d'Aviation.

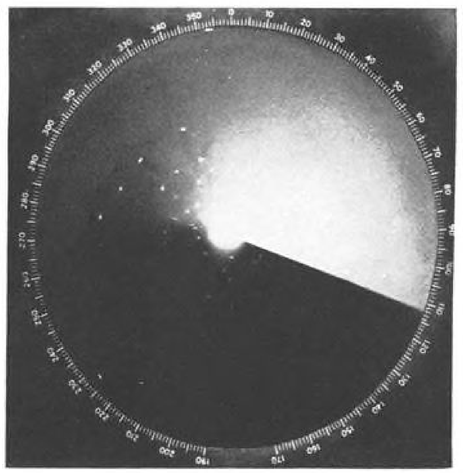


Controllers use table-top scope for plotting and scope on wall for over-all view in Raytheon-developed system now installed at Indianapolis' new Air Route Traffic Control Center. This is the first of 60 bright display systems developed for FAA.

FAA Installs New Bright Display Radar at Indianapolis Facility

Part of the new FAA bright display system developed for Federal Aviation Agency at Indianapolis' Air Route Traffic Control Center is 50-ft. antenna (right) which has a scan radius of 200 mi. Video mapping (below, left) of new Raytheon display system permits controllers electronically to superimpose area map showing reference points in order to pinpoint exact location of approaching aircraft. Traffic pattern is shown (below, right) as seen on a conventional radar scope. Pattern fades from view rapidly as operator sees pip showing plane's location with each sweep of the scanner. New system shows aircraft trails and is made possible by Raytheon storage tube. Fast-moving aircraft make wide-spaced image trails; slower plane's blips merge into continuous trail.





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Mobility, whether by foot, ground vehicle or air, is directly dependent on your lines of communication. Units must be able to communicate within themselves. They must be able to request aid and supplies at any time and from any assigned place. They must be able to maintain continuous contact with their higher command. And the communication equipment used to provide this mobility must offer compactness, reliability, operational ease, ruggedness and logistic simplicity. Collins communication equipment has all of this — and more. New Collins equipment can offer more channels of communication.

More power and frequency ranges for longer distance communication. More versatility with cross netting, which allows all elements of a unit on the move to communicate directly with one another. Communication mobility? The communication equipment to provide it? The reliability and dependability to serve in any situation, under any conditions? Let Collins help meet your requirements. Call COLLINS RADIO COMPANY • Cedar Rapids • Dallas • Los Angeles • New York • Washington • International, Dallas

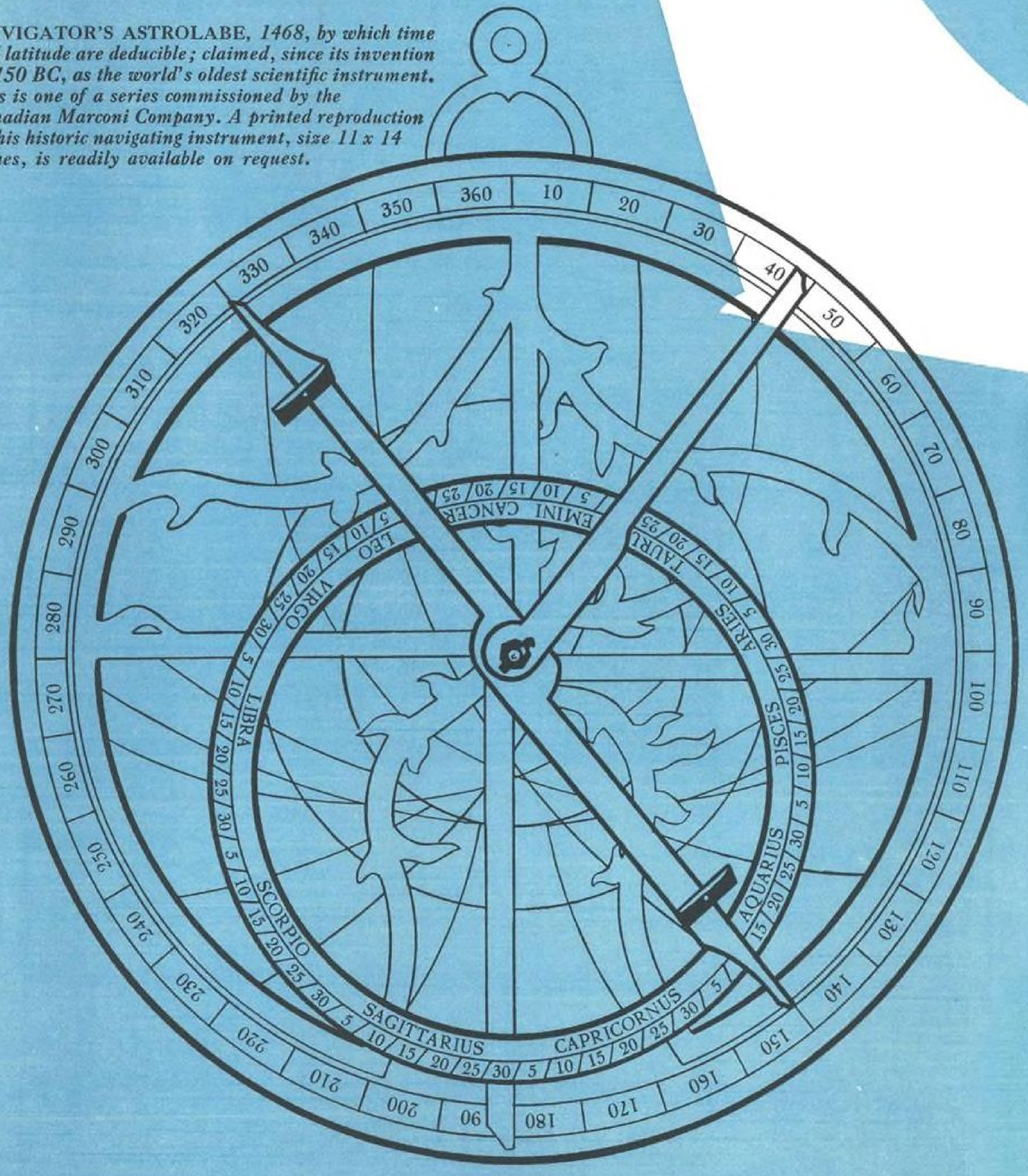
COLLINS

Airline Income and Expenses—October, 1962

(IN THOUSANDS OF DOLLARS)

	OPERATING REVENUES						Total Operating Expense	Net Profit (or Loss)
	Passenger	Cargo	Other Non-Mail	U.S. & For. Mail	Federal Subsidy	Total		
DOMESTIC TRUNKS								
American	34,687	3,844	146	930	.....	39,607	38,608	222
Braniff	6,430	420	239	227	.....	7,316	6,585	284
Continental	5,139	312	153	121	.....	5,725	5,422	24
Delta	14,567	1,143	142	360	.....	16,212	14,140	813
Eastern	18,938	1,267	333	484	.....	21,022	24,980	(4,179)
National	6,835	634	163	161	.....	7,793	7,314	121
Northeast	3,178	128	52	69	.....	3,427	4,270	(996)
Northwest	7,402	700	56	233	.....	8,391	7,915	424
Trans World	24,283	1,843	635	629	.....	27,390	27,189	(82)
United	41,292	3,779	1,092	1,485	.....	47,648	46,602	529
Western	6,026	268	111	121	.....	6,526	6,458	(24)
Trunk Total	168,777	14,338	3,122	4,820	.....	191,057	189,483	(2,864)
INTERNATIONAL								
American	554	60	27	7	.....	648	526	50
Braniff	564	80	14	40	.....	698	978	(148)
Caribair	328	25	10	4	.....	367	412	(31)
Delta	170	20	.....	.....	.....	190	286	(47)
Eastern	1,929	150	1	58	.....	2,138	2,328	(251)
Mackey	112	5	9	.....	.....	126	138	(18)
Northwest	2,844	375	239	956	.....	4,414	3,397	565
Panagra	1,212	292	126	117	.....	1,747	1,712	(30)
Pan American	30,302	5,383	3,451	3,848	.....	42,984	39,735	970
South Pacific	25	3	26	1	.....	55	93	(55)
Trans Caribbean	316	60	634	1	.....	1,011	775	52
Trans World	7,751	963	330	1,181	.....	10,225	8,422	598
United	2,158	130	59	137	.....	2,484	1,620	12
Western	569	12	3	6	.....	590	405	83
International Total	48,834	7,558	4,929	6,356	.....	67,677	60,827	1,750
LOCAL SERVICE								
Allegheny	1,402	97	12	29	551	2,091	1,926	41
Bonanza	639	19	26	5	288	977	832	56
Central	432	38	14	17	455	956	886	24
Frontier	701	52	12	17	631	1,413	1,336	55
Lake Central	532	45	29	14	356	976	887	68
Mohawk	1,612	57	77	20	399	2,165	1,971	73
North Central	1,415	109	23	39	765	2,351	2,211	15
Ozark	971	71	10	21	323	1,396	1,334	24
Pacific	618	26	7	16	354	1,021	991	(1)
Piedmont	1,211	67	34	30	417	1,759	1,618	46
Southern	741	43	43	22	514	1,363	1,206	41
Trans Texas	555	38	39	14	410	1,056	993	27
West Coast	512	24	13	12	454	1,015	942	20
Local Service Total	11,341	686	339	256	5,917	18,539	17,133	489
ALASKA & HAWAIIAN								
Alaska Airlines	293	56	472	48	159	1,028	995	10
Alaska Coastal	136	19	9	16	74	254	300	(49)
Aloha	370	7	23	2	.....	402	429	(48)
Cordova	21	12	15	12	30	90	101	(11)
Hawaiian	436	97	8	4	.....	545	619	(88)
Kodiak	19	4	7	1	4	35	36	(1)
No. Consolidated	71	45	7	68	77	268	247	5
Pacific Northern	644	154	13	98	66	975	1,226	(145)
Reeve Aleutian				Not Available				
Western Alaska	67	18	56	.....	149	290	286	2
Wien Alaska	96	50	168	95	110	519	508	1
Alaska & Hawaiian Total	2,153	462	778	344	669	4,406	4,747	(324)
HELICOPTERS								
Chicago	36	1	2	.....	95	134	150	(7)
Los Angeles	55	17	1	9	130	212	244	(33)
New York	145	6	5	1	139	296	408	(125)
Helicopter Total	236	24	8	10	364	642	802	(165)
CARGO & OTHER								
Aerovias				Not Available				
Avalon				Not Available				
Flying Tiger	.....	1,017	3,252	.....	.....	4,269	3,804	95
Riddle	.....	1,297	590	.....	.....	1,887	1,792	14
Seaboard	.....	903	1,469	310	.....	2,682	2,092	420
Slick	.....	.....	2,044	.....	.....	2,044	1,910	18
Cargo, Etc. Total	.....	3,217	7,355	310	.....	10,882	9,598	547
Industry Total	231,341	26,285	16,531	12,096	6,950	293,203	282,590	(567)

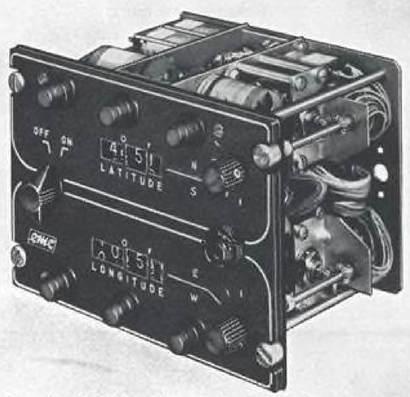
NAVIGATOR'S ASTROLABE, *1468, by which time and latitude are deducible; claimed, since its invention in 150 BC, as the world's oldest scientific instrument. This is one of a series commissioned by the Canadian Marconi Company. A printed reproduction of this historic navigating instrument, size 11 x 14 inches, is readily available on request.*



2113 years before DOPPLER

Between the astrolabe and Doppler lie 2113 years of man's attempt to mark an accurate track of his coming and going over the earth, and of his immediate position on its surface. Canadian Marconi Doppler provides a new measure to the navigator's art preceded by the astrolabe for latitude, compass for direction, sextant for position and chronometer for time. With the compass, CMC Doppler gives the art all these simultaneously, without human error, in the most accurate and reliable system used today. CMC designs and manufactures Doppler for "I" and "J" bands, Lat/Long and Along and Cross Track Computers, as well as Indicators. CMC Doppler is applied to commercial transport, aerial survey, military transport, anti-submarine warfare, helicopters, V/STOL aircraft and supersonic aircraft.

CANADIAN MARCONI COMPANY
Commercial Products Division
2442 TRENTON AVE.,
MONTREAL 16, CANADA



Doppler Lat / Long Computer Controller

AIRLINE OBSERVER

► European Common Market trend toward a sovereign federation of at least six nations could force radical changes in U. S. international air transport policy. As pointed out by AVIATION WEEK & SPACE TECHNOLOGY (Nov. 26, p. 38), development of the Common Market region into a single state could deny U.S. carriers Fifth Freedom rights in Europe since such traffic could be defined as cabotage. An equally serious threat is the possibility that all Common Market carriers could demand the right to serve the same number of major markets in the U. S. that U. S. carriers serve in all Common Market nations.

► **U. S. trunklines generally experienced substantial increases in passenger traffic during the Christmas holiday peak travel periods, compared with the same period last year, despite severe weather conditions throughout most of the U. S. Some officials believe that heavy snows diverted many travelers from automobile to air. Delays and cancellations during the pre-Christmas period were numerous, but large numbers of travelers apparently preferred to defer trips rather than cancel them.**

► International Air Transport Assn. has forecast that the world's scheduled airlines will show a 13% increase in passenger traffic and about 20% in cargo volume in 1963. The association also predicts that the airlines will carry some 136 million passengers this year, and will show a profit for 1963.

► **East Germany's Deutsche Lufthansa is carrying more than half of its passengers on international flights, according to a Russian report on the satellite airline. Of 300,000 passengers handled during a recent five-month period in 1962, 180,000 were on international routes. Deutsche Lufthansa says it now has commercial agreements with airlines in 47 countries.**

► International Transport Workers' Federation is pressing for greater government protection of labor rights in mergers because of concern over the expected formation of Air Union, a consortium of European airlines. ITF contends that negotiations for an Air Union have consistently failed to include any discussion of labor representation and feels that needed labor protective clauses can only be obtained through the direct intervention of the governments involved. The problem is also being brought to the attention of the International Labor Organization.

► **U. S. trunklines and all-cargo airlines flew 50.8 million ton miles of air freight in November for a 17.1% increase over the volume handled in November of last year. For the first 11 months of 1962, volume of air freight handled by the group increased 21% over the corresponding period in 1961.**

► Algerian government is studying the possibility of nationalizing Air Algeria or increasing its ownership. At present, the carrier is jointly owned by the Algerian government, two French shipping companies and Air France. It is possible the Algerians will drop outright nationalization, but will take over portions of the stock held by Air France. Technical and commercial cooperation between Air Algeria and Air France will continue. Air Algeria operates a fleet of four Caravelles and 15 piston aircraft, almost exclusively on routes between Algeria and France.

► **Aeroflot's first deputy chief, G. S. Schetchikov, has promised further passenger fare cuts on all routes in 1963. During 1962, the Russian carrier reduced tariffs on 100 trunklines and also introduced a system of promotional fares unprecedented in Soviet transportation history.**

► Cubana de Aviacion has purchased a Russian-built Il-18 turboprop transport for domestic service within Cuba on the Havana-Camaguey-Santiago route.

► **Bilateral air transport agreement has been signed between the Iraqi Republic and the Soviet Union.**

SHORTLINES

► **Braniff Airways** has filed a tariff with the Civil Aeronautics Board which would permit travelers who have never flown on a commercial airline to purchase air travel tickets up to $52 at $1.00 down and $1.00 per week. Called the First Flyter Plan, the tariff, if approved, will be effective Feb. 1. No interest will be charged and purchasers will be required only to sign a form certifying that they have not flown a commercial airline within the past 10 years.

► **CAB has approved** an increase of $1 million in Northeast Airlines' revolving credit agreement with the Chase Manhattan Bank. Prior to the increase, Northeast had borrowed $3.5 million under the plan. Loans are guaranteed by the Hughes Tool Co.

► **Delta Air Lines** has reported net earnings of $730,000 for November, compared with net earnings of $256,000 in the same month last year. Operating revenues rose 21% during the comparative periods, while operating expenses increased 14%.

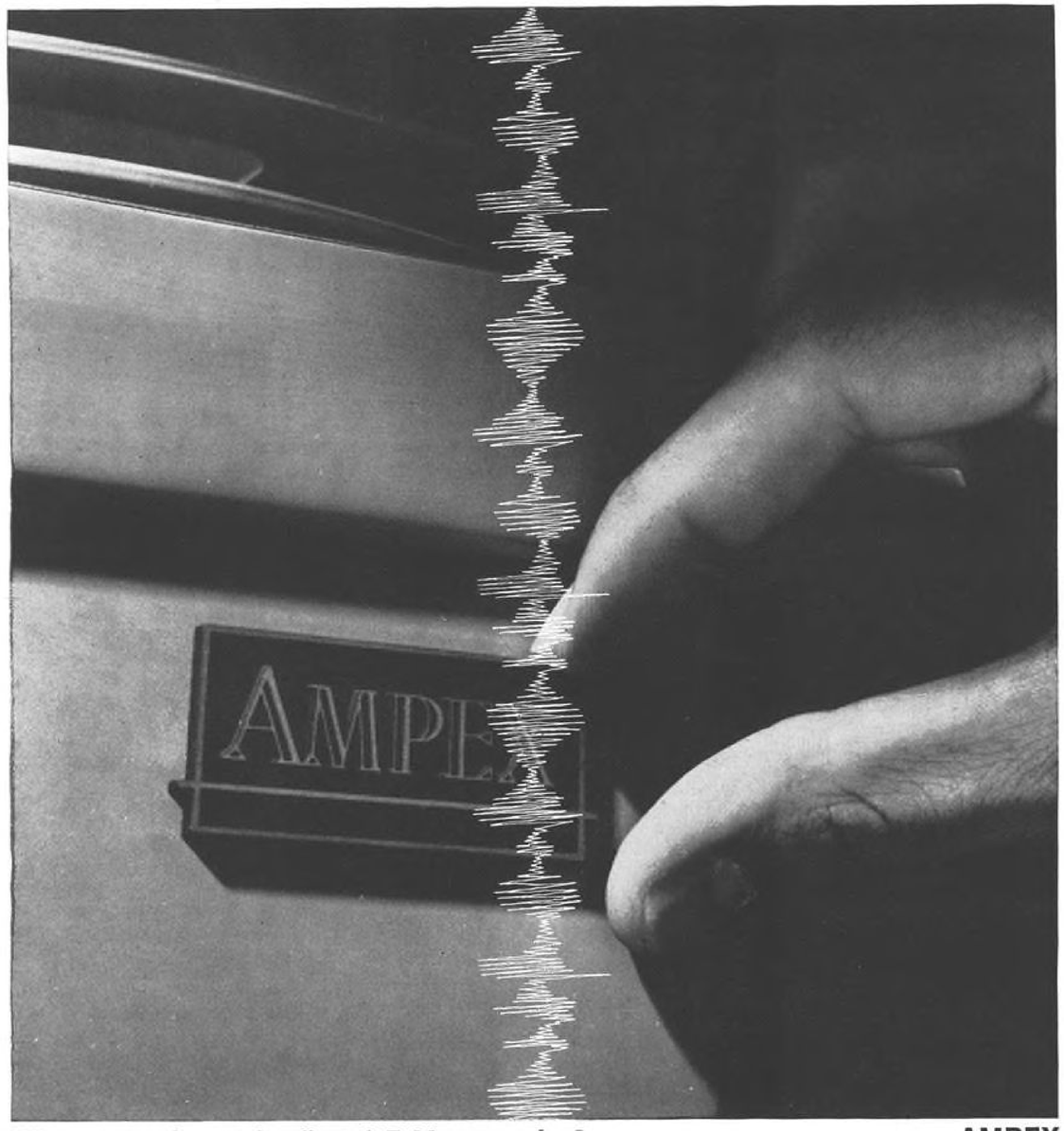
► **Lake Central Airlines** handled 10.9 million lb. of cargo during the first 11 months of 1962. In the same period last year, the airline carried 7.7 million lb.

► **North Central Airlines** will purchase Convair 440 transports at a rate of five to seven planes a year to replace its Douglas DC-3 fleet. Carrier recently purchased five additional 440s to bring its Convair fleet total up to 18.

► **Piedmont Airlines** will retire its last two remaining Douglas DC-3 transports soon. Recent purchase of two Martin 404 transports brings Piedmont's total Martin fleet to 20.

► **Seaboard World Airlines** and Lufthansa German Airlines have extended an agreement under which both carriers share cargo capacity of Seaboard's Canadair CL-44 all-cargo turboprop transports on North Atlantic routes. The agreement, which began in Jan. 1962 and was extended to June 30, 1963, will now run until Dec. 31, 1963, with an option to extend it through 1965.

► **Ten U. S. scheduled** airlines last month flew without charge approximately 800,000 lb. of drugs and medical supplies to Opa-Locka, Florida, as part of the ransom which secured release of Cuban prisoners captured in the Bay of Pigs invasion.



What name is on the first 1.5 Mc recorder? **AMPEX**

Here it is: a 1.5 Mc per track, multi-track recorder! And Ampex is the first to have it. It's called the FR-1400. It will give you the broadest bandwidth yet in longitudinal recording. What's more, it utilizes solid state electronics throughout—all in one rack. It has four speeds, each electrically switchable with no adjustments needed. And it comes with tape search and shuttle to provide quick data location and permit any portion of the tape to run repeatedly without operator attention. What about performance? Outstanding! It offers better rise time and minimum ringing on square waves, low intermodulation distortion, and improved flutter. Ampex also brings you a new 1.5 Mc tape. In both you'll find the same engineering precision, the same superior quality, that has made Ampex first in the field of magnetic recording. Write the only company providing recorders and tape for every application: Ampex Corp., 934 Charter St., Redwood City, Calif. Worldwide sales and service.

AMPEX

LOCKHEED C-130E in Military Air Transport Service markings climbs steeply out of a maximum-effort takeoff at Robins AFB, Ga. Maximum-effort performance reduces takeoff distance over a 50-ft. obstacle by about 15%.

Power Boost Planned for STOL C-130

By David A. Anderton

Marietta, Ga.—Lockheed-Georgia Co. and Allison Division of General Motors Corp. have designed an STOL version of the C-130 Hercules aimed at a nebulous Army requirement for a tactical transport with a 10-ton payload.

The design, which carries the Lockheed designation GL298-7, is basically a C-130E re-engined with Allison 501-M7B turboprops delivering about 20% more power than the currently installed Allison T56-A-7 engines. Stability and control improvements have been incorporated in the layout, and minor structural changes have been made.

Key feature of the Army requirement, and its single toughest aspect, is that landing and takeoff distances have been specified for the so-called "mid-point" station, rather than at the point of origin of the mission. This imposes a much more rigorous requirement on the design of landing gear, braking systems, high-lift devices and powerplant systems.

Army Transport

In the case of the Army transport, the aircraft would have to fly from a prepared base, carry its full payload of 20,000 lb. a distance of 500 naut. mi., and then land over a 50-ft. obstacle in less than 1,000 ft. Takeoff for the return flight has to meet the same requirement.

Final 100 naut. mi. into the mid-point station and the first 100 naut. mi. outbound on the return trip are to be flown at sea level; remainder of the mission would be at optimum cruise altitude. Other requirements now include a 1,000-naut.-mi. radius with reduced payload and a ferry range of 3,000 naut. mi., in addition to the standard specifications for assault transports.

Lockheed says its C-130E now in production can meet all the requirements " . . . as we understand them . . . " except for the mid-point landing and takeoff distances. Using maximum-effort techiniques, landing and takeoff distances can be improved materially, but at the expense of handling qualities in the low-speed flight regime.

Even assuming that pilots would readily accept the tradeoff of handling characteristics for landing and takeoff performance, the maximum-effort figures still miss the target values of the requirement by a large margin. Lockheed studies of the C-130E showed that any further performance gains would have to come from improvements in powerplants, stability and control. This led directly to the GL298-7 design.

But even that STOL version of the C-130, which the companies currently are discussing with the military services, does not meet the tough takeoff and landing requirements envisioned by the Army planners. It does come much closer than any foreseeable aircraft; close enough, the companies believe, so that factors of cost and delivery schedules will outweigh the letter of the specification.

The GL298-7 is one stop along a design route that could lead from the standard C-130 series through STOL and boundary-layer control versions to a VTOL model. Each one of these would have a price tag and a time scale attached.

1,000-ft. Requirement

"We'd be glad to develop the C-130 to meet the 1,000-ft. requirement," said one Lockheed engineer, "but it will cost a lot of money and take a lot of time. We think any prospective customer would rather have nearly the required performance now than wait a few years longer to meet the specifications in every detail."

Major advantage of the GL298-7 version, according to Lockheed, is that airplanes can be delivered in about two years after go-ahead for a price not substantially increased over that of a standard C-130E. The features of the STOL version could be retrofitted on either the C-130B or E models.

Externally, there is little difference between standard C-130s and the proposed STOL version. The GL298-7 outlines show in increased aileron chord and increased rudder area.

Major change is in the powerplants. Four Allison 501-M7B turboprop engines, each rated at 4,591 shp., replace the 3,755-shp. Allison T56-A-7 powerplants of the C-130E. Power boost in the -M7B engines comes from increased turbine inlet temperatures, which are possible because Allison has developed a turbine with air-cooled first- and second-stage vanes and first-stage blades. Turbine inlet temperatures have been increased almost 200F, from the 1,780F value for T56 to 1,970F in the -M7B engines.

Power of the new engines would be restricted to 4,200 shp. maximum to keep structural changes to a minimum. This means that the engine can deliver its 4,200-shp. rating from standard temperatures to about 80F; on a 100F day it can deliver power equivalent to the T56 it replaces.

Fuel Consumption

With the increased power, Allison also shows improvements in specific fuel consumption; values are reduced by 4-6% for takeoff and cruise conditions.

In addition to more power available at the shaft, Allison has obtained more thrust out of the engine-propeller combination by changing the gear ratio from the present value of 13.54:1 on the T56 to 12.49:1 on the -M7B powerplants.

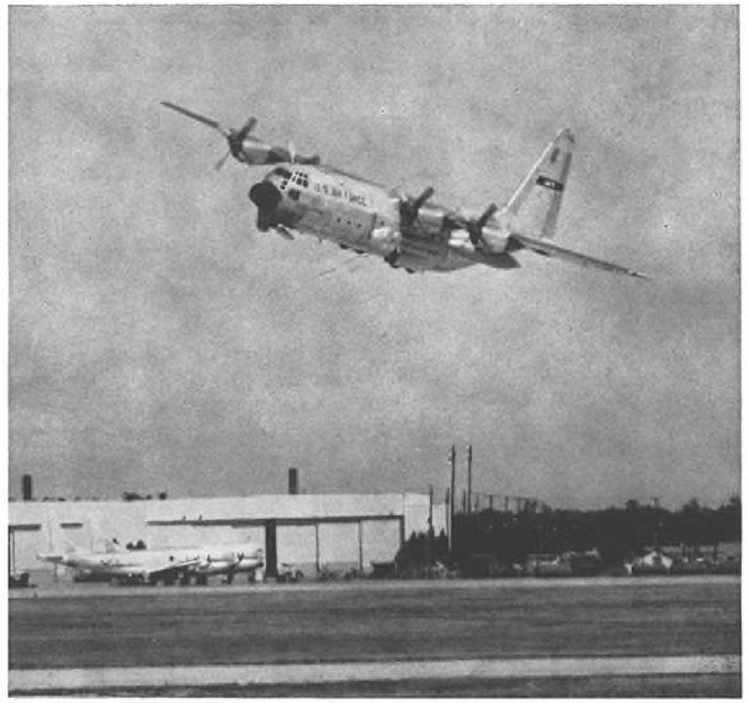
There is some associated rework necessary on the C-130 propeller blades to take best advantage of this change in propeller rotational speed. This gear box is already in production for the T56-A-8 engines in use on the Grumman E-2A (formerly W2F-1).

Because of the expected deterioration of control power and stability characteristics at low speeds, Lockheed-Georgia has proposed changes in the basic control surface designs and their operations for the GL298-7. These changes include:

- **Aileron chord increase** of 30% to increase rolling power available in the low-speed flight region. Aileron boost capacity is also increased.
- **Elevator down-deflection increase,** from the current value of 15 deg. for the C-130E to 25 deg. for the proposed STOL version.
- **Rudder area increase** of 40% to provide additional directional stability under high-power, low-speed flight conditions.
- **Automatic yaw stabilization** system installation.
- **Duplicate full-power** hydraulic servo rudder control with artificial feel is proposed for the GL298-7.

High-lift, drag and braking systems also have been changed to improve landing and takeoff performance. These changes are:

- **Doubled operating rate** of the flap, from 3 deg./sec. now standard on the C-130E to 6 deg./sec.
- **Increased full-deflection angle** for the flap, from 36 deg. to 50 deg. proposed for the GL298-7.
- **Modulating anti-skid system,** replacing the present "on-off" type, to improve the braking efficiency.
- **Ring-slot parachute** of 22-ft.-dia. installed to increase drag and reduce landing distances.



LOCKHEED C-130E banks during climbout in demonstration of maximum-effort takeoff. Technique uses liftoff speed of 110% power-on stall to reduce takeoff ground roll and climbout to a minimum.

Structural Changes

These changes are accompanied by some minor structural changes in the inner wings, fuselage, nose landing gear and nacelles to increase both the strength and the fatigue life of the modified aircraft.

All of these changes listed above result in an increase in empty weight of 2,412 lb. on the STOL C-130. Of that amount, 647 lb. is due to the strengthened wings, flaps and increased area of the ailerons. Second largest incremental weight, 507 lb., is charged to the empennage for increased rudder area and elevator deflection.

Propulsion units and nacelles account for 400 lb. of the weight increase, and the fuselage changes add another 395 lb.

The remainder is due to the landing gear, drag chute and instrumentation changes.

Consequently, the empty weight for the STOL version becomes 71,003 lb. compared with 68,582 lb. for the standard C-130E. Equipped weight empty is 72,769 lb. Adding 20,000 lb. for payload and 20,791 lb. for fuel, the takeoff gross weight becomes 113,560 lb. for the GL298-7.

On the 500-naut.-mi.-mission, the STOL C-130 shows a calculated takeoff distance over a 50-ft. obstacle of 1,730 ft. The landing distance at the mid-point field is estimated at 1,550 ft., of which 815 ft. is ground roll. The mid-point takeoff distance is 1,480 ft., with an 820-ft. ground roll. The difference between these figures and the desired values of 1,000 ft. for both takeoff and landing at the mid-point are talking points for tradeoffs in performance, price and schedule.

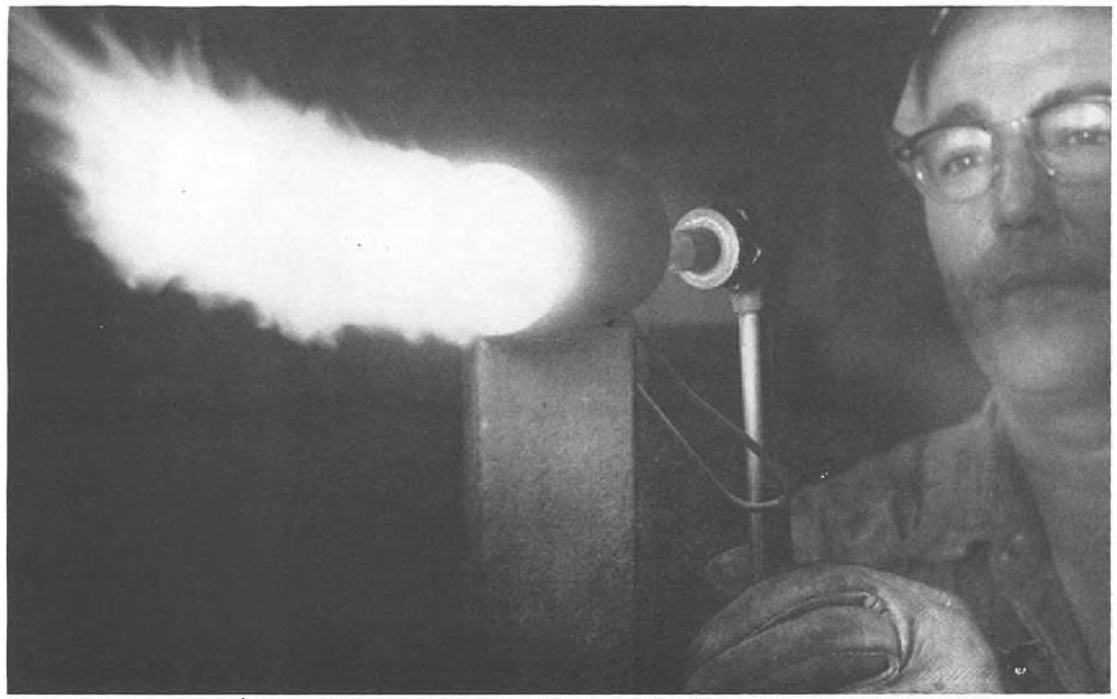
Ferry Range

With standard pylon tanks as fitted to the C-130E, the ferry range of the STOL C-130 becomes 4,635 naut. mi., well in excess of the 3,000-naut. mi. goal.

Takeoff and landing performance for the STOL aircraft is based on computations assuming maximum-effort flight techniques. For landing, the approach and touchdown are made at 110% of power-on stall speed where the power is that amount necessary to establish an average rate of sink of 9 ft./sec. during approach.

Flare rate is assumed so that the rate of sink at touchdown is about 6 ft./sec. Drag chute is used in approach to increase power needed for flight and there-

What can this new metal help you do?



The flame of an acetylene torch is passed through a tube of Du Pont TD Nickel in a visual demonstration of the new alloy's stability at high temperatures.

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For example, TD Nickel has an ultimate tensile strength of 10,000 psi at 2400°F—approximately 90% of the melting point of nickel. Relative to many nickel or cobalt base superalloys, TD Nickel has *superior mechanical properties* in the 1900°-2300°F range. TD Nickel also retains the *desirable physical properties* of pure nickel.

Yet, TD Nickel *is workable* in normal atmospheres... can be cold-drawn, rolled, forged, machined, sheared... *using standard metal-working techniques.*

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fore to reduce the touchdown speeds as well as the landing distance.

Maximum-effort takeoff technique is to hold the airplane with the brakes, run the engines to full power and start the takeoff roll. Nine seconds before the computed liftoff point, which occurs at 110% of power-on stall speed, the pilot initiates flap extension. The flap then is fully deflected at takeoff, which minimizes the drag contribution of the flap prior to liftoff. Climbout follows at 110% of the power-on stall speed.

Limiting Factors

The catch in the maximum-effort performance is the minimum control speed, which depends on the powerplants and on the aircraft stability and control. At the lighter operating weights of the STOL C-130, rudder power becomes the limiting factor; toward the heavier end of the scale, the ailerons limit the minimum control speed.

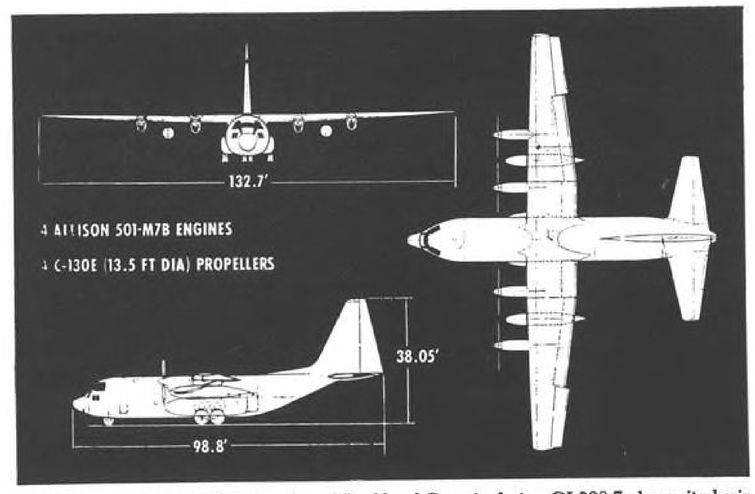
For most operational weights, the minimum control speed for the GL298-7 is about 80 kt. At this speed, the aircraft can maintain straight and level flight at military power after loss of the most critical engine.

But even this low minimum control speed is well above the liftoff speeds for the maximum-effort performance, particularly at low weights. At 100,000 lb. operating weight, the minimum control speed is 79 kt. and the liftoff speed is 66 kt.

By increasing liftoff speed to the point where it equals the minimum control speed, the ground run is increased during takeoff. Lifting off at the higher speed, however, means that the pilot can pull up at a higher normal acceleration; therefore, the air distance required to clear an obstacle is shorter.

For comparison, the maximum-effort takeoff distance, regardless of minimum control speed, is 1,200 ft. over a 50-ft. obstacle and at an operating weight of 100,000 lb. If the liftoff speed is allowed to build up to the minimum control speed, then the total takeoff distance for the same conditions increases to 1,450 ft.

What all this says is that the GL298-7 can take off at minimum-controls speeds in distances which are only a few hundred feet greater than the maximum-effort performance.



GENERAL ARRANGEMENT drawing of Lockheed-Georgia design GL298-7 shows its basic similarity to the standard C-130E version. Note that aileron chord and rudder area have been increased over the standard models.

This design for the GL298-7 represents Lockheed's current thinking on the best compromise between rigid adherence to a specification and an aircraft with acceptable performance and favorable cost and delivery schedules.

But there is a second design which has been studied in detail as one of the 10 configurations which Lockheed and Allison evolved.

Second Design

This design, designated GL298-6, takes full advantage of the shaft horsepower increase available in the Allison engines. In this design, the Allison 1100-E1 propulsion units would be the powerplants. This engine is basically the -M7B turboprop running at its full rating of 4,591 shp. and driving a 15-ft.-dia. propeller.

With this combination, static thrust for start of takeoff would be about 13,000 lb. per engine-propeller combination for a total of 52,000 lb. takeoff static thrust. This compares with about 9,500 lb. per powerplant for the C-130E and about 10,600 lb. per powerplant for the STOL C-130.

In the -6 version of the STOL modification, there would be extra soundproofing for the cabin, increased flap deflection and operating rate, increased vertical tail area, and a 32-ft.-dia. drag chute. Other changes would be about the same as specified for the GL298-7.

This would be a costlier program, involving increased development money and time for both Allison and Lockheed.

Performance Comparison for Standard C-130E, C-130E Maximum-Effort and STOL C-130 (GL298-7)

Item	C-130E Standard	C-130E Max.-Effort	STOL GL298-7
Initial takeoff gross weight, lb.	109,460	109,460	113,560
Initial takeoff distance over 50 ft., ft.	3,340	2,170	1,730
Midpoint landing distance over 50 ft., ft.	2,250	1,920	1,550
Midpoint takeoff distance over 50 ft., ft.	2,860	1,880	1,480
Average cruise speed, kt.	260	265	275
Ferry range, naut. mi.	4,765	4,765	4,635

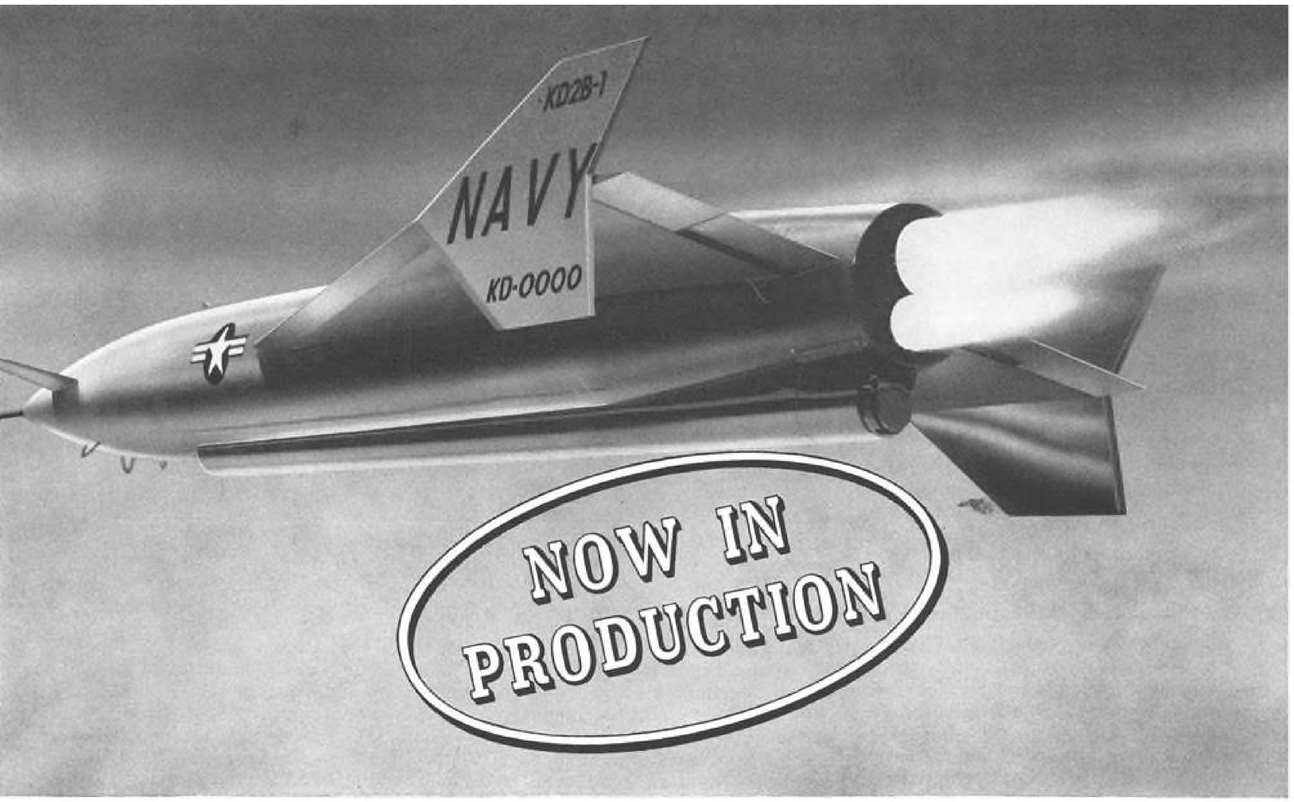
PRODUCTION BRIEFING

General Dynamics/Convair has been awarded a $61,000 National Aeronautics and Space Administration contract to study metal creep, one of the basic problems involved in development of a supersonic transport plane. Combination of stress and high temperature anticipated on the SST is expected to cause the metal to creep, or elongate. General Dynamics will study methods of restricting or eliminating the deformation.

Wilmot Castle Co., a subsidiary of Ritter Co., will continue its research of methods for sterilizing space probe components under a $91,609 follow-on contract from National Aeronautics and Space Administration. Studies are aimed at keeping other planets free from living organisms from earth.

Leach Corp. will build command receivers for the Army Missile Command's Arpat ballistic missile defense system under a subcontract from Hughes Aircraft Co.

Marquardt Corp. has received a $3.36-million contract from Douglas Aircraft Co. to build 1,750-lb.-thrust ullage rocket engines for positioning propellants in the Saturn S-4B stage.



Beech-built "missing link" ends make-believe training

KD2B-1, now being produced under U. S. Navy contract, is another example of Beech's systems management capability

The Beech KD2B-1—shown above—is America's first missile target system to match the performance of the fastest enemy jets. **It ends the need for target towing, faking, or simulation of any sort.** By matching actual supersonic aircraft speeds, altitudes and target characteristics, it makes possible low-cost realistic training. It can evaluate proficiency of every advanced weapons system, including radar-directed and heat-seeking missiles.

But weapons evaluation is only one of the many jobs the Beech KD2B-1 is capable of doing. It has capabilities for use as an inexpensive operational missile. Its payload capacity and low-maintenance design fit it admirably for a wide range of tactical missions.

The KD2B-1 is easily adaptable to air-launching, surface-launching, or ship-launching with existing equipment. It is capable of Mach 2 speeds at 70,000 feet and Mach 3 speeds at 100,000 feet.

Designing, developing and building missile systems is one of the many elements that make up the comprehensive Beech capability. It's one reason Beech is prepared to undertake complete systems management responsibilities for a wide range of space-age projects.

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Bell Aerosystems Co. has received a $2-million contract from the Boeing Co. for development of a reaction control system for the X-20 (Dyna-Soar) space glider. Hydrogen peroxide system is based on the same design concept as the Mercury spacecraft control system.

American Bosch Arma Corp.'s Arma Division will produce two types of fire control evaluation systems for Air Force's B-52 bombers. One will check the armament of the tail defense system and the other will test gunner's proficiency against fighter attacks.

Goodyear Aviation Products Division has received a contract from Boeing Co. for production of wheel and brake assemblies for Boeing's 707-320C intercontinental jet transport. Eight forged aluminum wheels of the utility jet are designed for its 328,000-lb. maximum weight.

Lockheed Missiles and Space Co. will develop a technique for assessing the over-all hazard potential of operational nuclear vehicle systems under a $188,318 study contract from National Aeronautics and Space Administration. Lockheed will try to determine what effect the time between failure of a nuclear space vehicle and impact of the vehicle or parts of it on earth will have on the degree of hazard at the impact site.

Thompson Ramo Wooldridge's Tapco Division, Cleveland, Ohio, will develop 150-lb.-thrust engines to stabilize the Saturn S-4B stage in pitch, yaw and roll, under a $1.3-million contract from Douglas Aircraft Co.

Avco Corp.'s Lycoming Division has received production contracts exceeding $29.9 million for T53 gas turbine engines to power Marine Corp.'s Bell UH-1E assault helicopter and for T53-L-11 engines to power Army's Bell UH-1D helicopter.

Goodyear Aircraft Corp. will develop radomes for Air Force's RF-4C reconnaissance aircraft under a subcontract from McDonnell Aircraft Corp. Radomes, constructed of reinforced glass fiber, will wrap around the bottom corners of the fuselage, slightly in front of the wings.

Alco Products Inc., Schenectady, N. Y., has been awarded a $1,240,000 National Aeronautics and Space Administration contract to build 13 diesel-engine pumping units for use at the George Marshall Space Flight Test Center, Huntsville, Ala. Units will be used to pump cooling water at the rate of 270,000 gpm. at the Saturn missile test pad.

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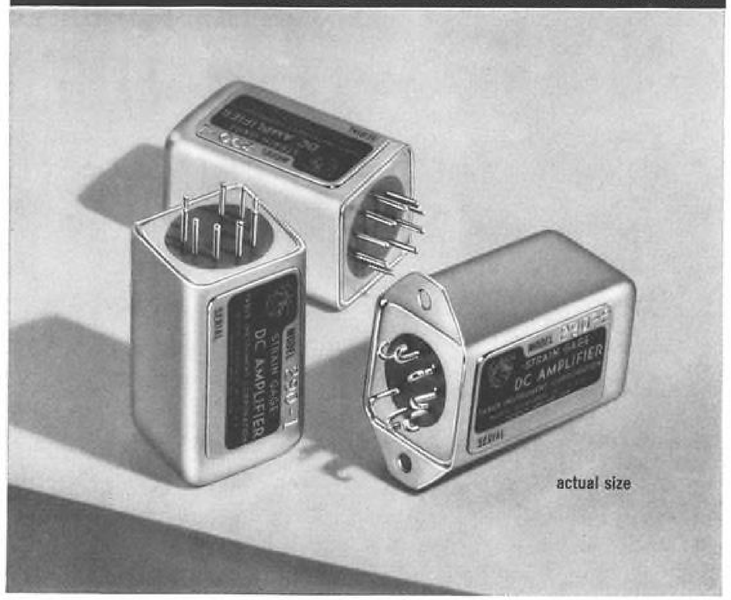

new Taber strain gage DC amplifier boosts low level signals to 5 volts

Extremely refined, Taber's Series 290 Amplifiers have wide application in airborne and ground support systems, low level communications systems, and analog computers. With entirely welded construction, epoxy encapsulation and stainless steel outer cases, the amplifiers provide optimum performance under extremes of vibration and temperature using no choppers and all solid state components.

Gains are factory set from X100 to X500. Linearity is better than 0.05%. Available with thermal gain stability to better than 0.0025% per Fahrenheit degree from −65°F to +250°F and thermal zero stability better than 1.5 microvolts per Fahrenheit degree (referred to input). Output impedance is approximately 8 ohms.

When used in conjunction with a Taber Strain Gage Pressure Transducer, this new amplifier provides a 5 volt DC full scale output in precise relation to the strain gage input. Weighing 1½ oz., the 290 measures ⅞" x ⅞" x 1½". It can be combined with any Taber Transducer to provide a Transducer/Amplifier unit in a single package.

Detailed, illustrated literature on Taber Strain Gage DC Amplifiers may be obtained by mailing this coupon attached to your letterhead.

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FLIGHT-QUALIFIED GUIDE FOR A FLEDGLING FLEET

WHEN THE USAF's FIRST C-141 jet transports become operational—under MATS command—in 1965, their globe-girdling flights will be guided by an on-board, flight-qualified *automatic* navigation system. Functional heart of the system: a Librascope-built AN/ASN-24(V) Navigation Computer Set. Its predecessor, AN/ASN-24 (XY-1), was subjected to hundreds of hours of rigorous USAF testing during a 3-year period. Result: the AN/ASN-24(V) will introduce versatility and accuracies never before available in navigation systems for either commercial or military aircraft. □ The AN/ASN-24(V) consists of a lightweight, real-time digital computer, a converter chassis, and control/display panels. Weighing just 43 pounds and occupying only 0.60 cubic foot in volume, the computer will perform thousands of critical flight-data calculations per second, thus relieving C-141 navigators of many tedious, time-consuming tasks. Extensive extra built-in capability will enable the computer, eventually, to perform such additional functions as (1) troop/material air-drop computations, (2) fuel and flight-plan monitoring, (3) vertical-navigation computations, and (4) take-off monitoring. □ THE COMPUTER UNIT traces its origin to a unique logic-design concept born at Librascope in 1955. Granted USAF sponsorship in 1957, the AN/ASN-24 computer series is now virtually off-the-shelf equipment. No extensive redesign or modification of existing airborne sensors was needed to adapt them for use with the AN/ASN-24(V) Navigation Computer Set. □ ACCURACY, VERSATILITY, AND RELIABILITY of the AN/ASN-24 computer have brought other assignments. The L-31 version, for example, is slated to automatically guide NASA's hydrogen-burning Atlas-Centaur space vehicle on a series of planned orbital and deep-space missions. The computer's general-purpose design makes it adaptable for other similar programs where massive, complex computing tasks must be performed. □ WANT MORE INFORMATION about Librascope's leadership in computer and data-processing technology? Write today.

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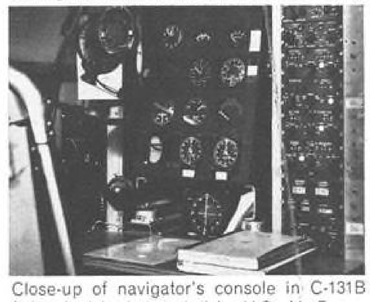
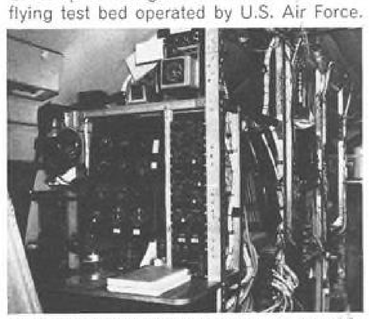
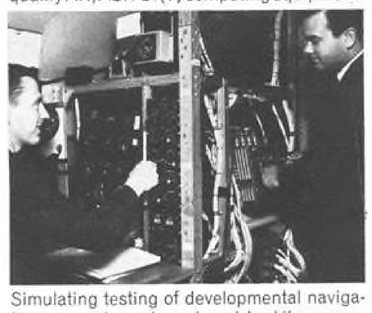
G2-540

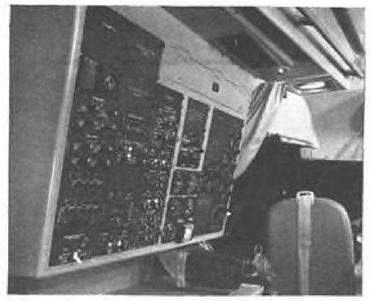
Two developmental-team members discuss configuration for the AN/ASN-24 (V).

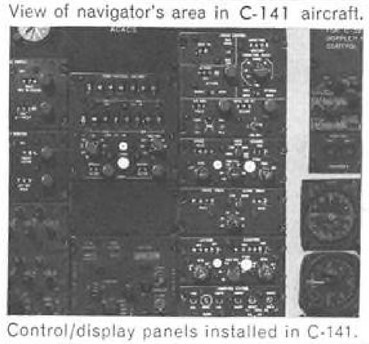

Close-up of navigator's console in C-131B flying test bed operated by U.S. Air Force.


Elaborate installation here helped flight-qualify AN/ASN-24(V) computing equipment.

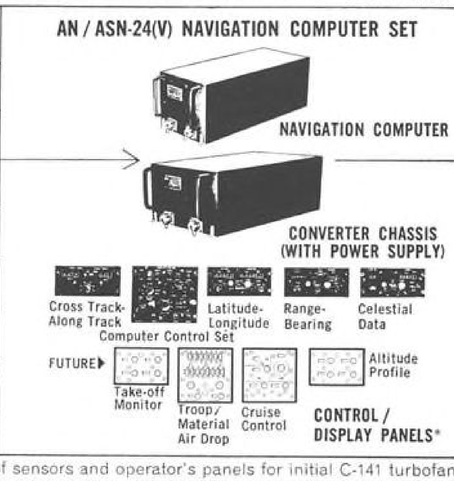

Simulating testing of developmental navigation computer set produced by Librascope.

C-131B aircraft—Air Force's flying test lab.


View of navigator's area in C-141 aircraft.


Control/display panels installed in C-141.

C-141 "Star Lifter"—slated to assume operational status in 1965 under MATS command.



NAVIGATION SENSORS	INPUTS
GYROSCOPIC COMPASS	Magnetic Heading Free Gyro
DOPPLER RADAR SET	Ground Speed Drift Angle
CENTRAL AIR DATA COMPUTER	True Airspeed, Pressure Altitude and Mach Number
TACAN NAVIGATION SET	Magnetic Bearing Slant Range
LORAN C RECEIVING SET	Time Difference X Time Difference Y
SEARCH RADAR SET	Relative Bearing Horizontal Range
ASTRO-TRACKER	Elevation Relative Bearing
AIRCRAFT FUEL SENSORS (FUTURE)	Flow Rate Quantity Remaining

OUTPUTS	PILOT / CO-PILOT INSTRUMENTS AND INDICATORS†
Heading Error Lateral Displacement	FLIGHT-DIRECTOR COMPUTER
Heading Error, Range and Lateral Displacement	HORIZONTAL SITUATION INDICATOR
Pitch Command	ATTITUDE INDICATOR
Heading Error Lateral Displacement	C-141 AUTOPILOT
	*Mounted on Navigator's Console †Mounted in Cockpit

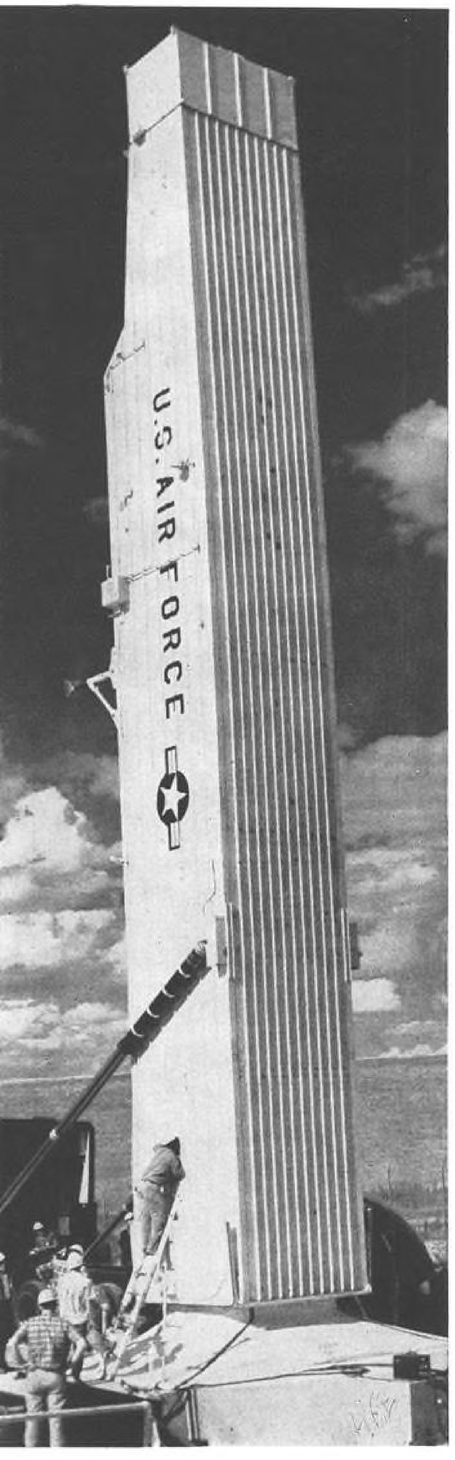
Functional block diagram shows tie-in of sensors and operator's panels for initial C-141 turbofan transports. Functions indicated by lower row of display/control panels will be added in later models. AN/ASN-24(V) will enhance decision-making capability of U.S. Air Force navigators.

Some of the outstanding design features of the AN/ASN-24(V) are: Completely integrated system, including interface equipment and control and display panels · Remote outputs compatible with military-integrated panel concepts · Existing, tested program routines for aircraft navigation · Automatic computer self-check · Modular packaging · Simplified maintenance · Proven magnetic memory drum · Silicon semiconductors · Minimum circuitry · General-purpose programming, assuring maximum flexibility · Simplicity of program and input/output changes · Accuracy beyond threshold of observation (present sensors) · Negligible obsolescence factor · Impressive potential for growth.

AN/ASN-24(V) Accuracy		
FUNCTION	OPERATIONAL RANGE	ACCURACY DEGREE (with error-free sensors)
Present position latitude	N90° to S90°	±0.05% of distance traveled, plus 0.2′
Present position longitude	W180° to E180°	±0.05% of distance traveled, plus 0.2′
Multiple destination storage	N90° to S90° lat. W180° to E180° long.	Normal: ±0.2′ High precision: ±0.01′
Range	Flat earth: 0-100 miles	±0.02 mile
	Great circle: 100-1000 miles	±0.02 mile
	1000-10,000 miles	±2.0 miles
Bearing	Flat earth: 0-100 miles	±0.2° (on display panel)
	Great Circle: 100-10,000 miles	±0.04° for remote equipment

Along-course distance	0-100 miles 100-1000 miles	±0.02 mile ±0.2 mile
Off-course distance	0-10 miles 10-100 miles	±0.002 mile ±0.02 mile
Astro heading	Star alt.: —5° to 60°	±1.5′ (slightly degraded at greater altitudes)
Astro line-of-position	Star alt.: 7° to 70°	±0.7 mile (slightly degraded at all other altitudes)
TACAN fix	TACAN distance: 5-75 miles 75-200 miles	 ±0.4 mile ±0.7 mile
LORAN fix	—	±0.1 mile
Search radar fix	0-200 miles	±0.02 mile
Jet penetration profile	0 to —20° (pitch)	±0.25°

First SAC Crews Controlling Minuteman



MISSILE BEARING TRAILER of Minuteman transporter-erector is shown raised to the vertical position during a demonstration at a silo site near Malmstrom AFB. Aft end of trailer is bolted to a brace at silo opening.

By C. M. Plattner

Great Falls, Mont.—First Strategic Air Command crews of the 341st Strategic Missile Wing at Malmstrom AFB are shaking down operations and maintenance procedures for the SM-80 Minuteman solid propellant intercontinental ballistic missile in its initial deployment near here (AW Dec. 17, p. 27).

Malmstrom deployment includes these key factors:

• **Minuteman squadron** basic unit is the launch control facility (LCF), which is assigned 10 missiles deployed in underground silos. The LCF is staffed by a seven-man crew—a two-man strike team to maintain security, a missile combat crew commander and his deputy, one dispatcher and two cooks. Except for the missile combat crew commander and his deputy, who remain underground in the hardened launch control center, all other crew members remain above ground in "soft" buildings.

Main LCF building sleeps between five and seven men, has complete kitchen facilities, dining and recreation room, and dispatch office overlooking the main gate. An adjacent wing of the building houses emergency-power diesel and fuel tank, brine tank for equipment cooling system, air-conditioning equipment and telephone terminal boxes (part of the above-ground communication network). Only other LCF building is a combination garage and pumphouse. A hardened UHF antenna, resembling a nose cone protruding from a concrete slab, provides air-ground communications in the event normal surface communications with Strategic Air Command Headquarters are destroyed.

• **Minuteman missiles** deployed in unmanned silo sites are scattered around the LCF at varying distances, depending on terrain. Each silo site has a three-way security system. Four RF surveillance antennas, which are sensitive enough to detect falling snowflakes, can record any movement inside the two-acre, fenced site area. Underground seismograph detectors protect against tunneling, and the main entrance gate has an alarm system as a final security measure. An outer, double-strand barbed-wire fence keeps animals away from the inner fenced area. Violation of any of the security systems is indicated by a light and buzzer mechanism in the launch control center. Crewmen then dispatch the two-man strike team to investigate.

• **Primary electrical power** for Minuteman emplacements is supplied by the local power company. A diesel engine and batteries are installed at each LCF and silo site for emergency power. The diesel, located at the silo site, starts automatically if power fails, and has a 30-day fuel supply. It is located in a soft environmental control room, an underground structure at the silo site. Batteries are located in an equipment room, an enlarged area surrounding upper part of silo emplacement. Environmental control room at the silo site also houses a hardened communications cable pressurization pump (6-9 psi.) and an air conditioning system.

• **Installation of the missile**, its alignment, and all maintenance is conducted by the 341st Missile Maintenance Squadron at Malmstrom. Missiles are shipped in Douglas C-133Bs from Hill AFB, Ogden, Utah, completely assembled except for the re-entry vehicle. The missile is enclosed in an environmental container within the aircraft, offloaded onto a trailer and taken to an air-conditioned transfer building. It is then winched into a special tractor-trailer, called a transporter-erector, which conveys it to the silo for emplacement. Transporter-erector is 10 ft. wide, 65 ft. long and weighs 59 tons loaded. Top speed is 15 mph.

Environmental control units in the transporter-erector and silo site maintain a temperature close to 70F, primarily to keep guidance control package components in a standard environment. The front end of the transporter-erector is raised hydraulically to a vertical position after its aft end is bolted to two steel braces protruding from cement slab near the silo opening. Installation of the missile in the silo requires a full day. The re-entry vehicle is attached to the missile by a special team after it is in the silo.

• **Course alignment** of Minuteman, within one to two degrees, is made when it is placed in the silo. Further fine alignment is performed by a team working with a transit located with reference to a nearby Coast and Geodetic Survey bench mark giving altitude and triangulation information. A minimum of 64 transit sitings are required for final alignment tolerance of 0.1 sec. of arc. Measurements are made through a north-star, or Polaris, siting tube, using a double mirror theodolite system. The tube, opening into the equipment room of the silo, is canted to permit alignment with the North Star at night. Geodetic bench marks are installed so that crews can align missiles during daylight and at night if there is cloud cover.

• **Firing a flight** of Minuteman missiles may be accomplished in any combination from a single missile to a salvo of all 10. Actual firing of one or more missiles requires cooperation of two separate launch control centers and their four crewmen. After the launch order is given by the President, the countdown—which requires less than one minute—is started. Missile firing occurs when all four members of the two missile combat crews insert and turn keys in their separate control panels. Control panels in each launch control center are 10 ft. apart, precluding one man turning both keys. All four keys must be turned within a period of several seconds to launch the pre-designated missile or group of missiles.

As a further safeguard, up to ignition time, an order from the President could still halt launch. Any mechanical defect is noted automatically during countdown by system's guidance and control package, which also serves as a checkout system, and a no-go signal is transmitted to hold the missile. A redundant hardened underground cable network interconnects launch control centers and silo sites so that all missiles of a particular squadron could be fired if three out of five launch control centers were lost.

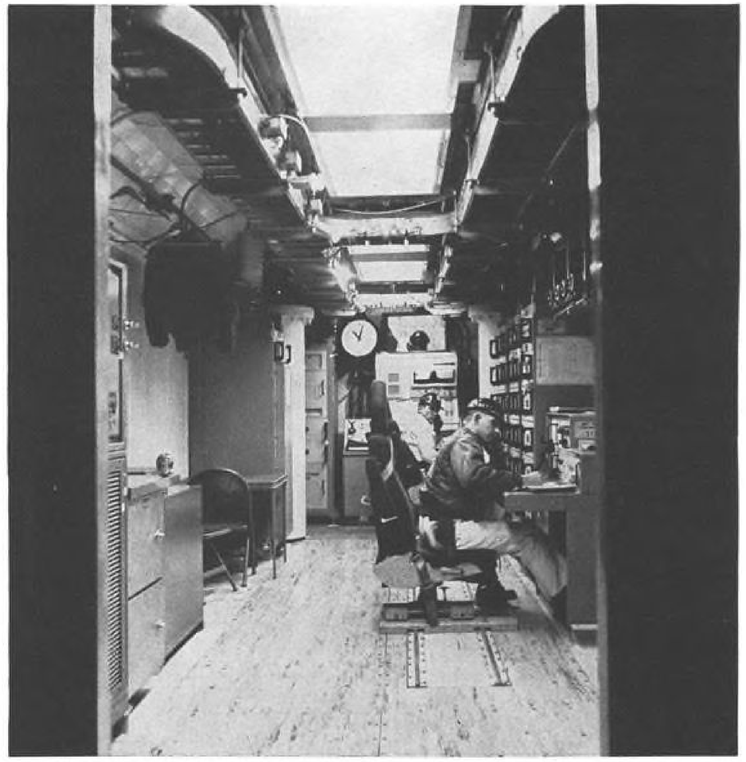
Minuteman is clear of the silo less than two seconds after ignition. Ignition occurs 12 to 15 sec. after the 4½-ft.-thick silo cover is rolled back by a cable attached to a cylinder activated by an explosive charge for quick-action.

Minuteman missile weighs approximately 70,000 lb., has a 6.2 ft. diameter, and is 53.7 ft. long. Range of 5,500 naut. mi. results from a burning time of about one minute for each of the three solid-propellant rocket stages.

Maximum velocity is 15,000 to 16,000 mph. First stage weighs approximately 50,000 lb., second stage 11,677 lb. and third stage 4,169 lb. (for detailed reports on Minuteman engines, see AVIATION WEEK, Aug. 27, p. 54; Sept. 3, p. 68; Sept. 10, p. 162.)

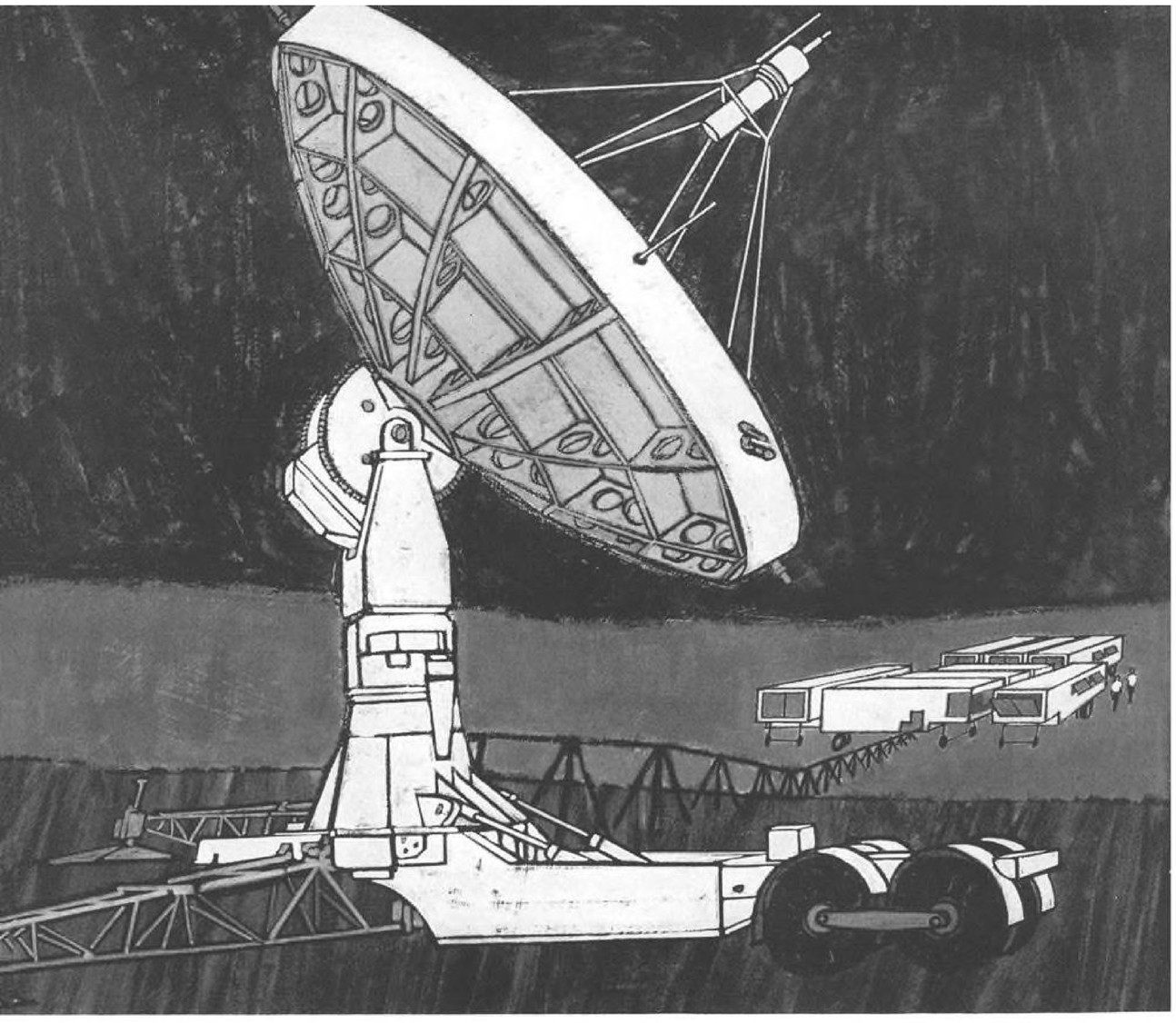
Inter-site communications are conducted mainly by regular telephone and VHF radio. Hardened cable is not generally used for ordinary operational and maintenance communications. All personnel entering any launch control complex must check in with the launch control center.

The missile combat crew commander has complete authority over all per-



TWO-MAN CREW CONTROLS a flight of Minuteman missiles from a launch control facility of the 341st Strategic Missile Wing at Malmstrom AFB, Mont. Firing of a Minuteman flight requires cooperation of two separate launch control centers and the four crewmen, who each have to insert and turn keys in their panels. Panels are 10 ft. apart to prevent one man from turning two keys in his center.

AERIAL VIEW OF OPERATIONAL Minuteman intercontinental ballistic missile launch control center shows the above-ground buildings which house off-duty combat missile crews and support equipment. Main building sleeps five to seven men, has complete kitchen, dining and recreational facilities and houses dispatch office. Hardened UHF antenna is set in concrete near the buildings (lower center).



The SYNCOM ground terminal story. It is a moving one.

The SYNCOM experimental satellite will employ surface terminals that have no permanent locations. They can be moved as often as necessary. That's a unique feature about Project SYNCOM. It's our job to design and construct the mobile ground facilities under contract to the U.S. Army Electronic Research and Development Laboratory.

Bendix Radio's participation in Project SYNCOM—a NASA R&D program in which the U.S. Army Satellite Communications Agency has responsibility for surface terminals and communications testing—is a typical example of our capability in the fast moving communications field. Bendix Radio's experience and performance in developing equipment for fixed ground stations and shipboard terminals for the military communications satellite program helped lead to our selection by the Army to participate as a prime contractor in the NASA SYNCOM project. Project SYNCOM is to demonstrate the feasibility of communications between surface stations via a lightweight satellite in a 24-hour synchronous orbit at the 22,300 mile high altitude.

The SYNCOM ground stations in some respects represent a state-of-the-art Super High Frequency equipment development. This development also provides basic SHF building blocks for consideration in other advanced Government-sponsored programs.

Take advantage of our experience and minimize development costs in communications systems by contacting Government Sales, Bendix Radio Division, The Bendix Corporation, Baltimore 4, Maryland.

Bendix Radio Division THE Bendix CORPORATION

sonnel in the area and can assign them in an emergency. Two-way VHF radios are used in maintenance vehicles, and repeater sites are utilized to maintain contact beyond line-of-sight.

Transportation is an important facet of the Minuteman operation. The Malmstrom wing encompasses about 18,000 sq. mi., stretches 120 mi. east and 60 mi. west of the air base. More than 50% of the emplacements are farther than 80 mi. from the base. Both air and ground transportation are used.

Aircraft include four Cessna 180s, one Cessna 185, and one Sikorsky H-19 and four Bell 47J helicopters. Future plans call for a fleet of 22 helicopters for the Malmstrom wing—five large models capable of carrying re-entry vehicles and 17 smaller craft for operational and maintenance inspections.

Ground transportation units include standard Air Force vehicles, the specially designed transporter-erector and eight-passenger Trackmasters, one of which is assigned to each launch control center. Continuous, wide-tread Trackmaster with enclosed cab is suited for winter and summer operations on the rolling Montana terrain, providing transportation when weather conditions curtail operations of standard vehicles.

Maintenance program is designed to provide a high degree of operational readiness. The electronic monitoring system is accurate enough to pinpoint trouble in a particular section of the missile or its support equipment.

A telephone call from the missile combat crew commander to the maintenance control center at Malmstrom, giving details of the trouble, brings a mobile repair team with a pre-packaged tool-and-replacement kit.

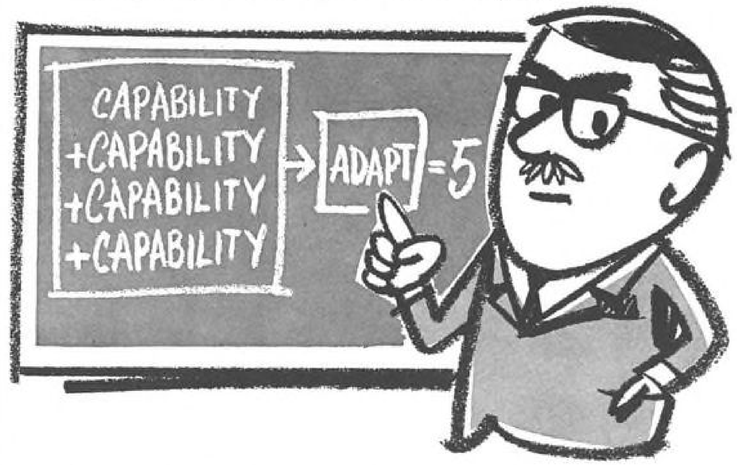
Electronic repair work in the field is minimized by replacing, with a standby unit, the complete electronic component drawer in which the malfunction has occurred. The removed drawer is returned to the repair shop. If detailed repair work is needed at the site and cannot be handled by the mobile teams, specialists are dispatched.

Maintenance road network at Malmstrom wing complex is about 3,000 mi. long and includes federal, state and country roads, mostly paved.

Educational requirements for the missile combat crew, all volunteers, include an engineering or science degree. A missile combat crew commander must be a senior captain or a major, and the deputy commander is junior captain or lieutenant.

During the three-year tour, both these officers earn a masters degree in aerospace engineering from the Air Force Institute of Technology. As students they spend two days each week attending classes in the institute branch at Malmstrom. They are allowed to study while on 12-hr. launch duty.

MAKING TWO AND TWO EQUAL FIVE



(Or: Problem-solving in communication electronics)

A good way to minimize lag in applying existing capabilities to the solution of new problems is to start applying them before the problems exist. This is not a play on words, nor a postulation of minus time, but a highly workable concept containing much food for thought—as the members of Budd Electronics' ADAPT group will be glad to demonstrate.

ADAPT, which means Advanced Development and Planning cenTer, starts with the realization that it's often no simple matter to put capabilities to work today. Our most urgent problems can be solved only by approaches that cut across the lines of many disciplines. Developing such approaches from within the confines of a single capability is understandably difficult. The view must be broader, and that's where ADAPT comes in.

The work of our ADAPT group is based on the conviction that planning—the kind of planning it takes to adapt and integrate today's fast-moving technologies to meet new needs—*is in itself a technology*.

This kind of planning calls for reaching into an array of varied capabilities, selecting those that can contribute to the solution of the problem at hand, reorienting and reorganizing them toward that solution, and determining what new concepts and new capabilities must be developed if the solution is to be attained. In a very real sense, the total capability that results is more than merely the sum of its parts.

Such planning calls for exceptional men—men like the specially-assigned senior physicists and engineers of the ADAPT group. This group makes available an unusual depth and a complete range of experience in communication electronics—in point-to-point communications, detection systems, information systems (including readout devices), guidance, telemetry, atmospherics and other related areas.

ADAPT men are themselves eminently adaptable . . . can turn their skills with equal competence to applied research or systems design, to concept development or engineering planning. In sum, they excel at designing practical programs for bringing ideas to reality.

ADAPT can and should be applied at the earliest possible stage of the game. If you have needs in communication electronics . . . or think you're *going* to have needs . . . you will find a discussion with the ADAPT group rewarding. You will speak immediately to knowledgeable people . . . determine the proper path for your program and have the required capabilities focused without delay. We will be glad to tell you more about ADAPT . . . and about the growing Budd Electronics capabilities it draws together. Write or call Mr. Robert O. Voight, Director, ADAPT, Budd Electronics, 1815 No. Fort Myer Dr., Arlington, Va. Phone 202-2965075.

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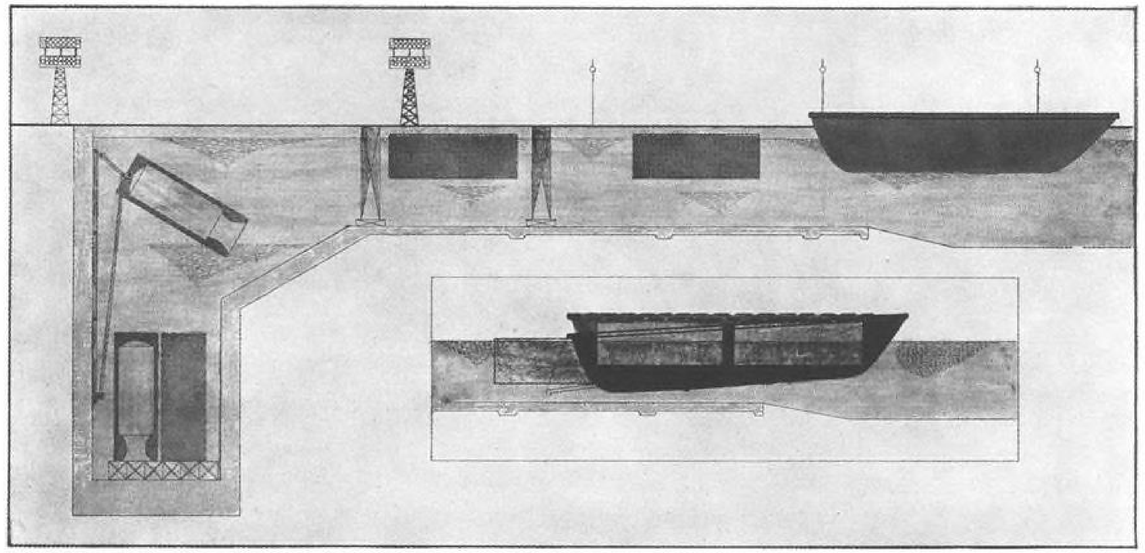


THIOKOL BUOYANT HANDLING SYSTEM can be adapted for use at the launch site, as shown in the above artist's concept. Loaded cases, sealed in their caissons, are floated nozzle-end first over a submerged launch pad. Caissons are ballasted, tipped upright and submerged to the launch platform. Booster could be launched from the drained pit, or the platform could be raised to ground level for firing.

Buoyant Rocket Handling System Studied

By Donald E. Fink

Buoyant handling system, using large caissons capable of floating cases for the Air Force's proposed 264-in. solid propellant booster, has been designed by Thiokol Chemical Corp. for use in a plant Thiokol will build at Brunswick, Ga., if it receives the booster development contract.

Site for the proposed plant is a 15,000-acre tract on the inland waterway about 30 mi. south of Brunswick on which Thiokol holds an option. Architectural studies of the site are completed, but construction will not begin before USAF awards the 264-in. contract (AW Dec. 17, p. 31).

Size and production capacity of the plant also will not be determined until the Air Force gives some indication of the program's scope. Cost of the facility is in the $10-million range.

Other Contenders

Other contenders for the program, which currently is expected to call for two parallel 18-month studies leading to selection of a single contractor by mid-1964, include Aerojet-General Corp., Hercules Powder Co., United Technology Corp., Lockheed Propulsion Co., and North American Aviation's Rocketdyne Division.

Aerojet's advanced design work on the large booster is being done at its Sacramento, Calif., solid rocket plant. If Aerojet is awarded the contract, manufacture of the test and production motors would be transferred to a $7-million plant the company is building on a 75,000-acre site 40 mi. southwest of Miami, Fla. Though not capable of immediate full-scale production of the 264-in. booster, the plant will form the nucleus on which Aerojet will expand if it wins the contract.

Aerojet has a 120-ft. long, 260-in. diameter steel case under construction at the Sun Shipyard in Baltimore, Md. When completed, it will be barged to Key Largo, Fla., where it will be transferred to an 80-ton capacity highway truck and hauled a short distance over land to the new loading plant. Object will be to test the feasibility of transporting large cases by barge and handling them with heavy-duty cranes.

In actual production of the 264-in. motor, the cases would be barged directly to the Miami plant through a special series of canals. Barges also would be used to position the cases under the propellant loader and move them to the curing facility.

Loaded motors would then be barged to Cape Canaveral on the intercoastal waterway.

Hercules is proposing near-site fabrication of the rocket motors by stacking wedges of propellant to form a fuel core and then winding a glass fiber case over it. Air Force proposal requests are expected to include categories for monolithic steel cases and cases fabricated by advanced technology, probably glass filament winding. Hercules will pursue the latter course.

Thiokol's buoyant handling system will be designed to load monolithic cases at the Georgia plant and barge them to Cape Canaveral for assembly into boosters.

Floating Caissons

Basic component of the buoyant system will be the caissons, each one capable of floating a single 120-ft. long case. Caissons, which also will serve as shipping containers and curing ovens, will consist of:

- **Attachment rings,** fitting around each end of the rocket case.
- **Longitudinal support beams.**
- **Rounding rings** forming a framework along the longitudinal members.
- **Caisson panelling** to make the assembly airtight.
- **End closures.**

Basic caisson frame, consisting of the end closures, attachment rings and two support beams, will be put on the rocket motor case by the case manufacturer. This will serve as a handling harness and will help prevent structural damage during the final stages of case assembly.

Support beams also will form part of the hydrostatic test vessel.

Completed case will be lifted into a half caisson shell mounted in a transportation barge. Remainder of the caisson shell will be assembled and the container will be pressure tested to insure water-tightness.

The entire assembly will then be barged to Thiokol's loading plant, indicating the case manufacturer's plant must have waterway facilities. Principal parts of the Thiokol plant will include the following:

- **Leveling basin.** Barges carrying the empty cases will be brought into the basin from the inland waterway. The barge, equipped with ballast tanks, will be sunk and the caisson floated free.
- **Casting basin.** Locks between the leveling basin and the casting basin will be opened and the caisson will be floated in head end first. Ballast compartments in the head end of the caisson will be flooded and the caisson will tip to a vertical floating position.
- **Supporting device.** Water will be pumped out of the casting basin, permitting the caisson to be lowered into a circular metal frame which will hold the caisson upright in the empty basin. The caisson will then be unsealed, giving access to the bottom of the rocket case.
- **Large propellant loader.** Propellant will be packed into the case in the upright position. The loaded case will be cured in the same position, using the resealed caisson as a curing oven. Heating units will circulate warm air through removable panels.

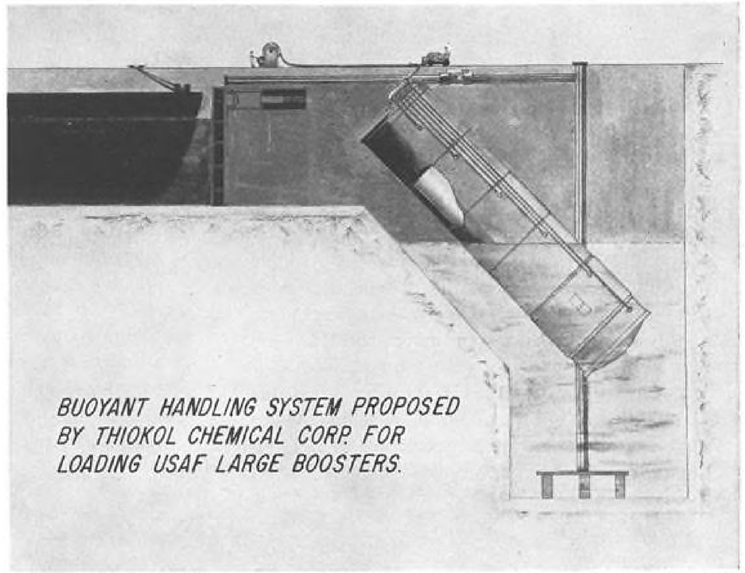
Added Weight

After the case has been cured, cobalt detectors will be used to check it for voids. Flotation tanks will be attached to the caisson to allow for the added weight of the propellant and the casting basin will be flooded again. As the flooded caisson compartments are pumped out, the assembly will tip back to the horizontal floating position.

Caisson will then be floated back out to the leveling basin and into the submerged barge, which will be raised under it. Heavy-duty cranes also are being considered for lifting the loaded caissons onto barges, capable of carrying four cases.

Loaded cases will be transported to Cape Canaveral on the inland waterway, with the caisson still acting as shipping container. At the Cape, a similar flotation system could be used to raise the boosters to gantries in flooded pits for clustering. Mobile derricks and heavy-duty cranes also are being considered for use at the Cape.

Company officials say the three major advantages of the buoyant handling system are its simplicity, economy and reliability. The system will use water pumps, lock gates and other components which are off the shelf items. Replacements are readily available and repairs can be made quickly.



BUOYANT HANDLING SYSTEM PROPOSED BY THIOKOL CHEMICAL CORP. FOR LOADING USAF LARGE BOOSTERS.

EMPTY CASE for Air Force's proposed large booster is shown in artist's concept as it is floated into the water-filled casting basin. Compartments in the forward end of the caisson are flooded, tipping it to an upright position. Casting basin then is drained, lowering the caisson into a supporting device, where it is unsealed and propellant loaded.

No new developments in the techniques of floating heavy objects are required and the reliability of a flotation systems has been demonstrated by widespread use of floating dry docks in the shipbuilding industry.

Cost of the caissons will be offset by the fact that they will replace the heavy harnesses required in mechanical lifting systems and will serve as shipping containers and curing ovens. Flotation system also has good growth potential, since it is capable of handling tremendous weights and can be kept abreast of rocket motor development without major facilities overhaul.

Location of the casting pit below the ground level is desirable, since it will eliminate the need for a complex, overhead structure for the loading facility. The pit also would help contain any fire or explosion which might occur during propellant loading.

Management System

Proposed facility will be managed by the company's Alpha Division, which was recently organized to replace the Redstone Division at Huntsville, Ala. Heading the Alpha Division is J. W. Wiggins, former general manager of the Redstone division.

Manufacture of rockets in the 264-in. category will require vast expansion of conventional loading and handling techniques, but company officials say it will not require major advances in the state-of-the-art.

Both steel and plastic-based materials are being considered by Thiokol. Study phase will include extensive tests of both types of materials. As with previous rocket motor production, Thiokol would subcontract the case fabrication to materials specialists.

Thiokol has had a study team of 55 designers, engineers and financial experts working on the large solid program since last May. Company-funded studies date back to 1960. At present, 14 facilities design engineers are in Georgia studying the new plant site.

Construction Time

Construction of the plant would require about 18 months, the same period expected for the 264 in. study contract. Finished plant will allow for possible increase in booster size to 300 in.

Size of the proposed booster originally was to be 240 in. This was increased to 260 in., then to 276 in. and finally reduced to 264 in. It might be increased to 280 in. by the time final contract proposals are made and advanced-performance boosters may be increased to 300 in.

Big booster program has been in a state of flux since early 1962, when Air Force was given management responsibility of the large solid rocket development. Requirement that Air Force also satisfy National Aeronautics and Space Administration's needs for big boosters delayed the program until November, when Defense Dept. and NASA agreed on the way the development program was to proceed. Development program probably will run through 1967 and is expected to produce a man-rated booster in time for the proposed interplanetary flights of the early 1970s.

When Minuteman called for THE WORLD'S LARGEST AIR CONDITIONING JOB

nobody was certain that it could be done by a single supplier. Minuteman was to be the weapon of *instant* retaliation—from untended silos dispersed underground, always ready to strike back, even under attack. On the automatic environment control system in each silo rested the reliability of the weapon itself. Actually, few firms even felt qualified to bid on the initial assignment—an $11-million contract for system development and the 18,000-square-mile installation in Montana.

So it's with excusable pride that American Air Filter, a middle-size company, points to the success story now almost complete: first prime contract fulfilled . . . next assignment, the second wing installation near Ellsworth AFB in South Dakota.

AAF's capability for tasks like this has evolved out of four decades of pioneer engineering and production for military and civilian industry. Following its well-proved pattern, the AAF Defense Group assumes the engineering and management responsibility, utilizing its own plants and personnel, plus resources of our Air Filter Division, Temper Air Group (Herman Nelson), Fiber Glass Group (Amer-glas), and other American Air Filter divisions and subsidiaries.

But even AAF's project veterans were surprised at the ways in which Minuteman's urgent schedule carried them beyond previous limits of the art. We even found we had to utilize one of *nature's* existing facilities: the eight-thousand-foot mountain, below, which we rented for a radio relay station to keep in touch with on-site AAF and contractor personnel.

If environment control is important to your project, send for AAF Bulletin D-164. Write Defense Products Group, American Air Filter Company, Inc., 310 Third Street, Rock Island, Illinois.

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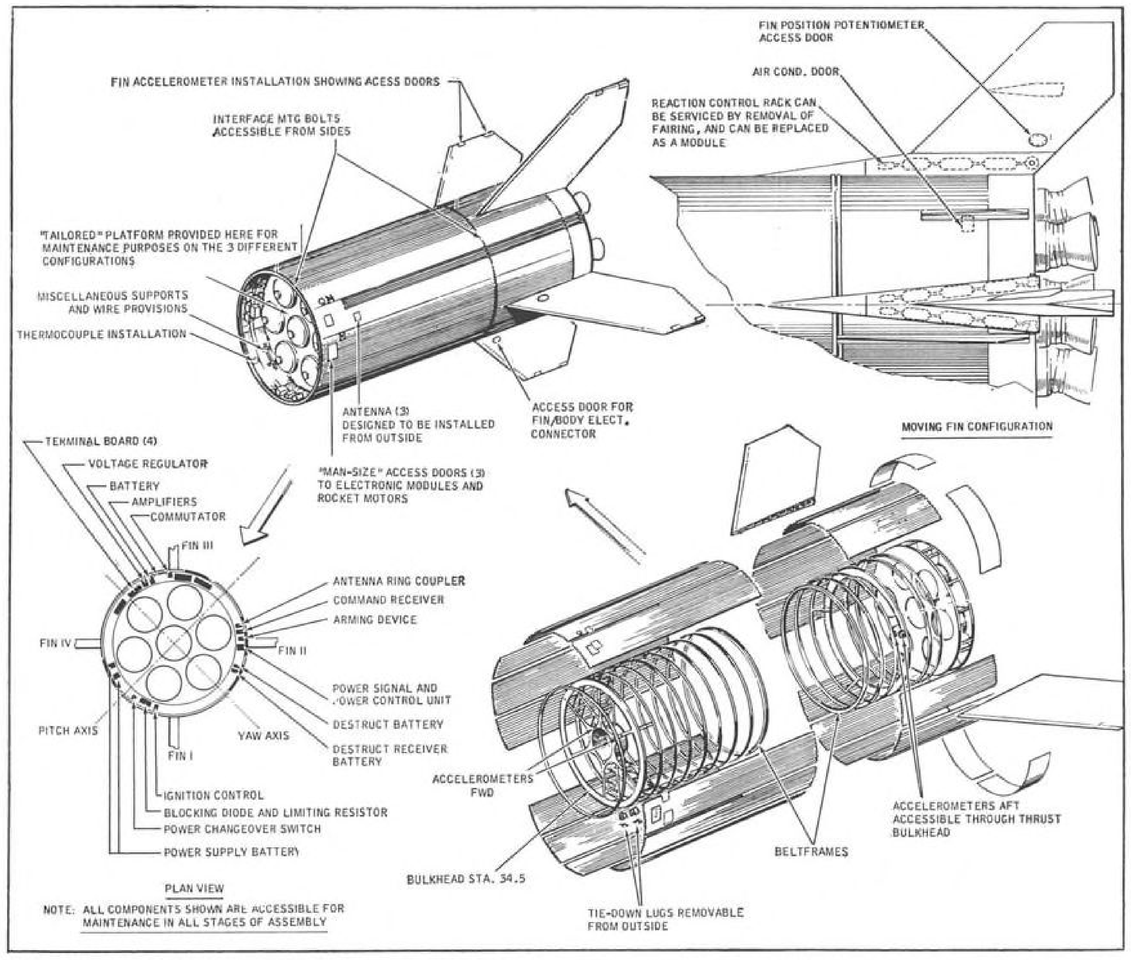


STRUCTURAL COMPONENTS, motors and power supplies of General Dynamics/Convair Little Joe 2 vehicle are shown. Advanced version, top right, would have moving fins and reaction controls. This would enable the vehicle to boost service module and lunar excursion module for propulsion systems qualification. Convair manufacturing philosophies for Little Joe 2 call for using already proven components.

Growth Potential Seen for Little Joe 2

By Edward H. Kolcum

Washington—Little Joe 2 designers already see a significant growth potential and long life for the vehicle system, even though the first launch is six months away.

Little Joe 2, first launch vehicle which will test a full-scale Apollo spacecraft, is being designed and built by General Dynamics/Convair in San Diego. Manufacturing philosophies being used are the same which North American followed in producing Little Joe 1—economy, simplicity and reliability—which are to be achieved by selecting components that have been proven by wide prior usage.

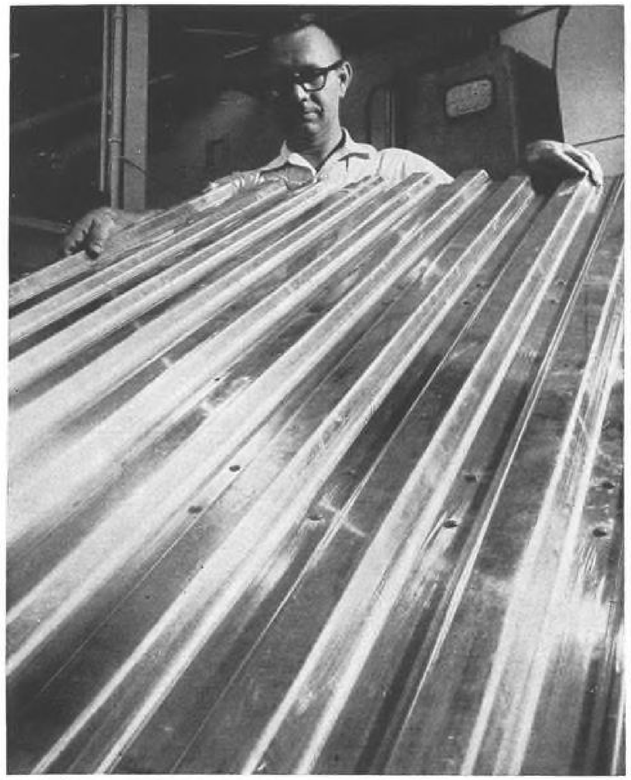
Like Little Joe 1, which flew qualification missions for Mercury systems, Little Joe 2 will be a sub-orbital vehicle and will take Apollo systems on ballistic flights. The two vehicles differ mainly in size and payload capability (see drawing). Because it can boost as much as 80,000 lb. to an altitude of 400,000 ft., Little Joe 2 is considered flexible enough to test full-scale vehicles such as the X-20 Dyna-Soar and Grumman lunar excursion module.

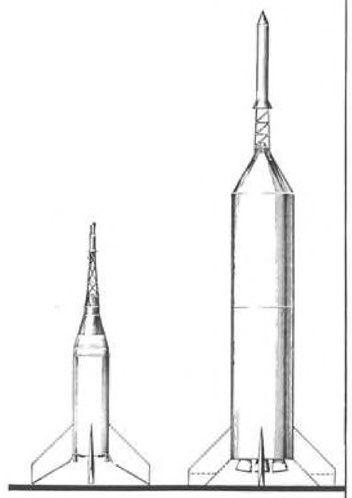
Scheduled Missions

Recent re-alignment of the Apollo test program has reduced the number of firm missions for Little Joe 2 from 14 to four, all of which are to qualify the escape tower under maximum dynamic pressure (q) conditions duplicating those which would occur in a Saturn-Apollo launch. Vehicle can attain velocity corresponding to a maximum q of 1,400 psf., but Saturn maximum q is something less than 1,000 psf. and ballasting will be added to reduce the load.

J. B. Hurt, Convair Little Joe 2 program manager, said the vehicle has a wide range of potential because the seven Aerojet Algol 1-D motors which make up the propulsion unit can be fired in sequence to simulate staging. The sequence would call for firing four motors, then two, and finally the center motor. In addition, the heavy payload lifting capability of the launch vehicle allows considerable ballasting so that a variety of altitudes and velocities can be achieved.

Little Joe 2 is 35 ft. long, with about a 13 ft. dia. The Algol motor spaces will also accommodate smaller Thiokol Recruit motors. Both Algol 1-D and Recruit solid-propellant motors have had extensive use by the National Aero-





	LITTLE JOE I	LITTLE JOE II
TYPE	Suborbital Mercury launch vehicle	Suborbital Apollo launch vehicle
HEIGHT (total)	48 feet	95 feet
WEIGHT (maximum)	41,330 lbs.	245,586 lbs.
DIAMETER	6.66 feet	12.83 feet
PROPULSION	4 Pollox, 4 Recruit solid-fuel rockets	7 Algol solid-fuel rockets
THRUST	250,000 lbs.	720,000 lbs.
MAXIMUM PAYLOAD	3,942 lbs.	80,000 lbs.

MACHINIST AT GENERAL DYNAMICS/CONVAIR, left, inspects section of corrugated aluminum alloy to be used in Little Joe 2 afterbody airframe. Convair has designed tooling for a minimum of 14 Little Joe 2 vehicles. At right, North American Aviation Little Joe 1, used to qualify Mercury capsule in suborbital tests, and Little Joe 2, planned for Apollo module tests, are shown in comparison.

nautics and Space Administration. The 1-D was used as the booster in the first eight Scout launches and develops nearly 120,000 lb. thrust. There have been 20 successful 1-D launches and no 1-D motor failures in the Scout and Blue Scout programs.

The fully-loaded Little Joe 1 booster consisted of four Recruits and four Thiokol Castor motors.

Simple Structure

Little Joe 2 structure is relatively simple, consisting of a series of rings with corrugated 2024 Alcoa aluminum alloy wrapped around as the airframe. Hurt said the entire structure is aluminum except for a few bottom fittings where the 50 sq. ft. fins bear. Use of this manufacturing system eliminates the need for stringers. Alcoa forms the sheets for the vehicle skin with the same dies used for industrial siding and roofs.

The aluminum skins are 41 in. wide. Twelve sheets, either 10 ft. or 20 ft. long, are riveted to 15 identical ring frames to form the airframe.

Hurt pointed out that the largest subassembly weighs approximately 4,000 lb. Sub-assemblies will be trucked to the White Sands Missile Range launch site where they will be assembled.

Little Joe 2 will have four fins of a 45 deg. swept plan form, which, Hurt said, is the best compromise between aerodynamic and structural requirements.

The only major subcontractor to Convair in the entire project is the Walter Kidde & Co. Aerospace Division, which furnishes a reaction control guidance system similar to the system Kidde manufactures for the Scout second stage. Guidance system is not a part of the four missions on the program, but is an important part of the growth potential for the vehicle because it is designed to augment the fin control in the atmosphere, and to provide control in space.

Reaction Jets

For Little Joe 2, the reaction jets are built as self-contained modules and are installed in fairings at each fin root.

The autopilot, Hurt said, simply commands a constant flight attitude by summing rates of pitch, yaw and roll, integrating the rates and sending orders to elevon actuators or to reaction jets.

Simplicity of the system is matched with an equally simple launcher, which can aim the vehicle in both azimuth and elevation. Existing Redstone gantry at White Sands is being modified to serve as the Little Joe 2 gantry by providing new cutouts for vehicle access. A new concrete pad is now being poured at the range because the old Redstone pad was considered too close to the blockhouse.

Vehicle Reliability

Because of the simple vehicle design, and the reliability numbers assigned to the motors and other off-the-shelf components, Hurt said Little Joe 2 will have a reliability of 0.95.

Although the system presently has no provision for an abort sensor, it has been designed so that it can be manrated, he said.

Confidence in the system even before flight is so great that the vehicle will not undergo any static testing. First flight in mid-1963 will be the first live firing.

Before the test program was realigned, 14 launches were scheduled to evaluate Little Joe 2's full-scale configuration concepts, systems hardware performance and spacecraft structural integrity, as well as the launch escape tower system.

Present contract is for four vehicles and two launchers.

NEW AEROSPACE PRODUCTS

Thermal Expansion Meter

Instrument, Model MD-1, measures thermal coefficient of expansion of materials.

Device is portable and battery powered and can read either expansion or contraction of a given material. Direct readout in micro-inches is provided when the multi-turn potentiometer is adjusted to the null.

Sample of a material is mounted in clamps below the instrument. Meter is then tuned to the null by adjusting the clamp screw below the instrument. Sample is heated in boiling water and the instrument again tuned to the null. Dial reading divided by the difference between room temperature and 212F gives coefficient of linear expansion, the manufacturer says.

Stathem Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif.

High Temperature Thermocouple

Thermocouple is designed to measure temperatures as high as 6,000F in applications such as nose cone re-entry, direct measurement of reactor rod temperatures in atomic powerplant operations and others.

Instrument, Model HTT-522, is described as rugged and capable of ex-

Why selecting a scientific or engineering computer without a feasibility study can be a costly error

And the one sure way to find
the computer that suits you best

A scientific or engineering computer is a sizeable investment. Selecting one calls for a responsible decision. Far from being alike, computers vary in efficiency and in ways they can be used. They vary, too, in price—and the equipment price tag doesn't always reflect **true cost.**

Your selection, then, should be based upon a careful study. Concentrate not on details, but on finding the one computer that will best suit your firm's particular needs. You may find your answer in the Recomp® line of solid-state computers, as so many companies have. But two important considerations—**total** problem-solving time and **total** cost—best measure a computer's worth.

Which is the fastest computer?

The criterion to use is total problem-solving time. On the average, computing time represents only about 10% of the time required for complete solution of an engineering or scientific problem. Microseconds saved in computing mean nothing if hours are lost in programming, which often is 90% of the total job.

The Recomp line of small and medium-scale computers save programming **hours,** not just computing **microseconds.** They are simple to program, easy to operate, and have exceptionally large memories.

Which is the cheapest computer?

Scientific problem-solving computers sell from $40,000 and up; rent from $1,000 a month, and up. But in comparing price, remember: 1) Cost figures should cover the **entire working system** needed to accomplish a job. 2) "Man hours" saved are an important facet of cost. A company which once got 2 proposals a year from a top creative scientist increased this to 3½ with a computer (not Recomp). With Recomp, the company now gets 9 proposals per man a year.

Recomp offers a broad price range. The Recomp III, ideal for small-scale needs, can be leased for $1,495 per month, complete. For medium-scale needs, Recomp II can be leased beginning at $2,495. A complete line of peripheral equipment is available for both.

Will special personnel be needed?

Some computers are so complicated that engineers must spend months in learning how to use them. Others require the hiring of trained programming personnel. Both types, therefore, are more expensive than they might appear. Worse, the necessity of a programmer doubles the communication time between scientist and machine, thereby off-setting the value of the computer as a quick problem-solving device.

Recomp computers are among the easiest of all to operate and program. Engineers with less than eight hours instruction have had no problem using them profitably.

The one sure way to select a computer

The computer requirements of your company are unique. Only by conducting a feasibility study can you be sure of which computer suits you best.

Put Recomp side by side with comparable computers, and some solid facts will speak for themselves. You'll see why no computer feasibility study is complete without Recomp. As a study guide, send today for a copy of "Management Guide to a Computer Feasibility Study."

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THE MANAGEMENT OF KNOWLEDGE COMPRESSES TIME AND SPACE

Once on the moon, we can say with certainty that we have taken a long step into space. + Yet the time will come when the moon is a familiar way station. + Centuries have passed while we prepared to take that first substantial step. But the immensely greater steps beyond will only require brief spans of years. + This compression of time is the product of knowledge—its storage, classification, and application. To gather such knowledge, to grasp its significance, to direct its application in new ways to new problems—these are the disciplined activities that accelerate our space program. + The compound of talent and experience that generates such knowledge is present in only a few organizations. + General Dynamics | Astronautics is one of them.

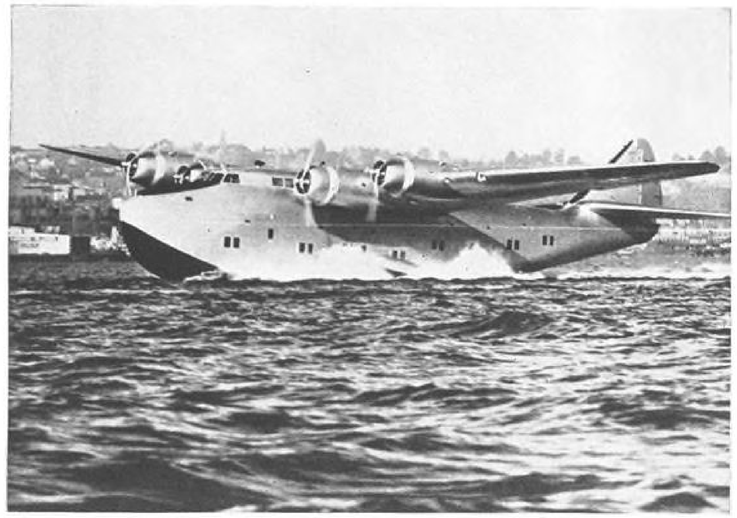
GENERAL DYNAMICS
ASTRONAUTICS DIVISION

SAN DIEGO, CALIFORNIA

Atlas has now accumulated more than 45,000 seconds of flight, providing data through more than 34,800 telemetry measurements. More than 35 million manhours of performance testing have gone into Atlas. More than 3,500 sub-contractors, vendors and suppliers are involved in the program. Reliability: 18 successful launches out of the last 20 announced flights — 90%.

Remember the Boeing Clipper?

GIANT OF THE TRANSOCEANIC TRANSPORTS IN 1937 . . .



UPI Photo

. . . and Barber-Colman was there!

Remember the "Good-Neighbor" policy? The Boeing 314 Clipper helped Pan-American Airways promote that trade policy between North and South America in the late 30's and early 40's.

"Pan-Am" also used the Clipper in pioneering transoceanic flight over both the Atlantic and Pacific. Barber-Colman was pioneering there, too . . . introducing automatic temperature controls for passenger comfort.

Cabin heaters in the Clipper were controlled by Barber-Colman commercial-type room thermostats . . . suspended on springs to avoid vibration! This first automatic temperature control system in any aircraft, used 60-cycle equipment.

Aircraft design has come a long way since the Boeing Clipper days. So has the precision of Barber-Colman temperature control systems. New problems . . . new solutions . . . new performances.

New Barber-Colman approaches to all types of temperature control problems in ground carts, aircraft, and missiles are based on over three decades of experience.

Use this experience in depth on your own temperature control applications. Consult the Barber-Colman engineering sales office nearest you: Atlanta, Baltimore, Dayton, Fort Worth, Los Angeles, Montreal, New York, Rockford, San Diego, and Seattle.

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Douglas DC-8
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—PATRICK HENRY

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Dept. M1422 Rock Street, Rockford, Illinois

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tended operation at 4,200F and for shorter periods at 6,100F.

Unit provides excellent repeatability and can be used under the most severe conditions of flow and environment, the manufacturer says.

Arnoux Corp., 11244 Playa Court, Culver City, Calif.

Wire Stripper

Thermal Wire Stripper eliminates nicking wire during stripping operations, the manufacturer says.

Heating element is used to melt the wire covering and anneal the wire, which makes it more flexible and eliminates wire breakage, the manufacturer reports. During the stripping process a bead of insulation is formed giving the wire covering additional strength at that point and preventing the wire covering from unraveling or tearing sideways.

Unit has variable temperature settings for Teflon, Formvar, Nyclad, Vinyl or other plastic coverings. Adjustment provides capability for stripping enamel wire.

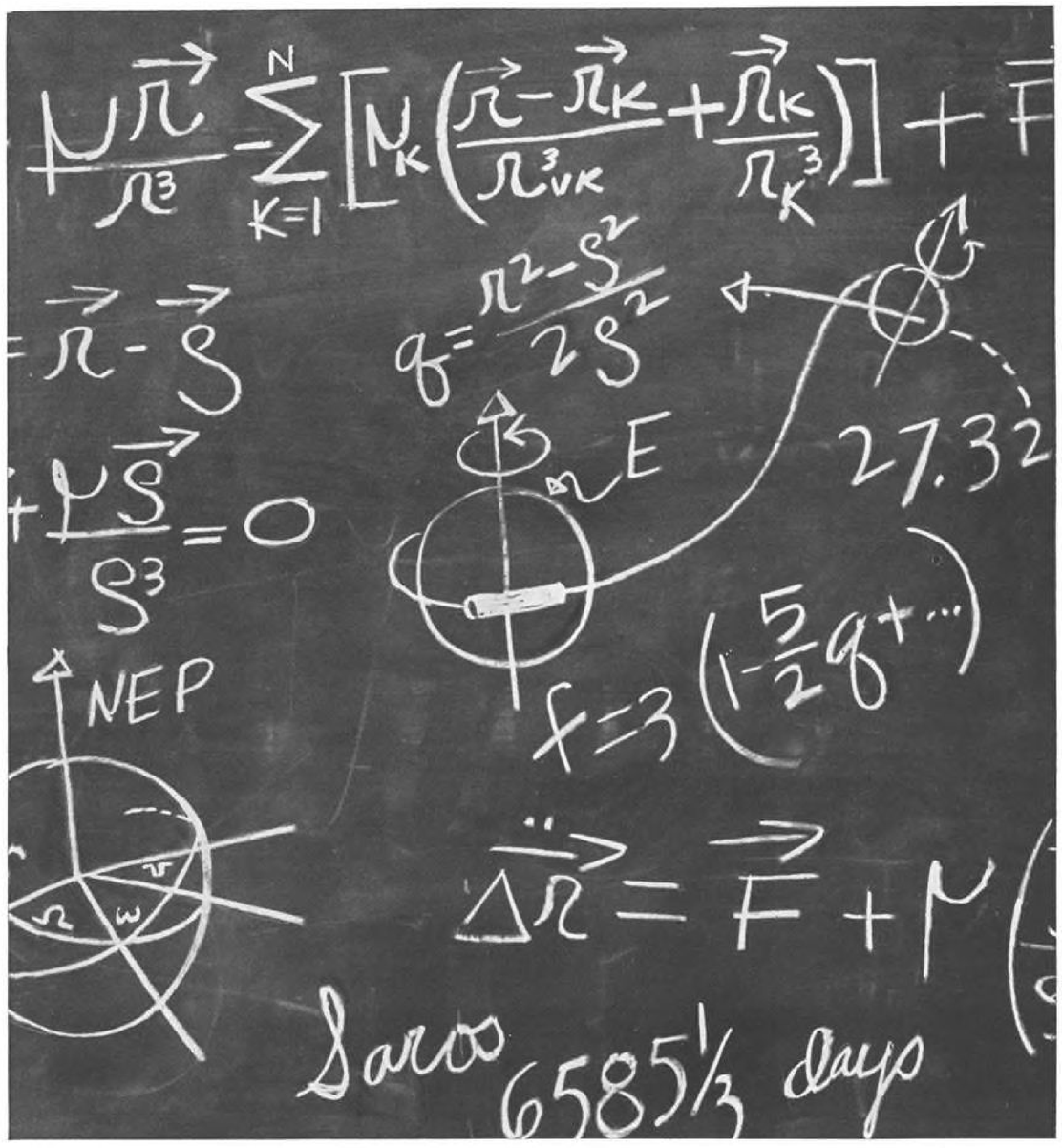
Sentry Electronics, Inc., 707 So. Okfuskee, Wewoka, Okla.

Device Shows Liftoff Distance Continuously

Aircraft indicator, which displays a continuous reading of liftoff distance based on acceleration data corrected for runway and atmospheric conditions, has been developed.

Instrument measures acceleration and reads outs runway distance, in feet, at which plane will lift off. Reading is given in relation to total usable distance, thus permitting pilots to assess takeoff safety margin from brake release to liftoff.

Only two settings, gross weight and a conservative estimate of wind velocity, are required before brake release, according to the designer, Harry F. Bunze, of Redlands, Calif. Runway temperature and atmospheric pressure are sensed by the instrument for automatic distance correction.



How the moon looks to Bellcomm

The moon is more than our nearest celestial neighbor. To Bellcomm it is a proving ground for work in the environment of space – meteoroids, radiation effects, magneto-hydrodynamic phenomena. It is a study in heat transfer, thermodynamics, combustion. It is a laboratory for application of the principles of solid state physics. It is a gigantic experiment in the life sciences, life support systems, and bio-engineering. It is electronics, propulsion, guidance, orbit mechanics . . . and more.

Bellcomm, a new Bell System company, offers experienced engineers, physical scientists, and technical men of many disciplines opportunities to engage in system studies involved in manned space flight programs for the National Aeronautics and Space Administration.

If you would like to be a part of Bellcomm, please send your résumé to Mr. W. W. Braunwarth, Personnel Director, Room 502C, 1737 L St., N. W., Washington 6, D. C. It will receive prompt, careful study. Bellcomm is an equal opportunity employer.

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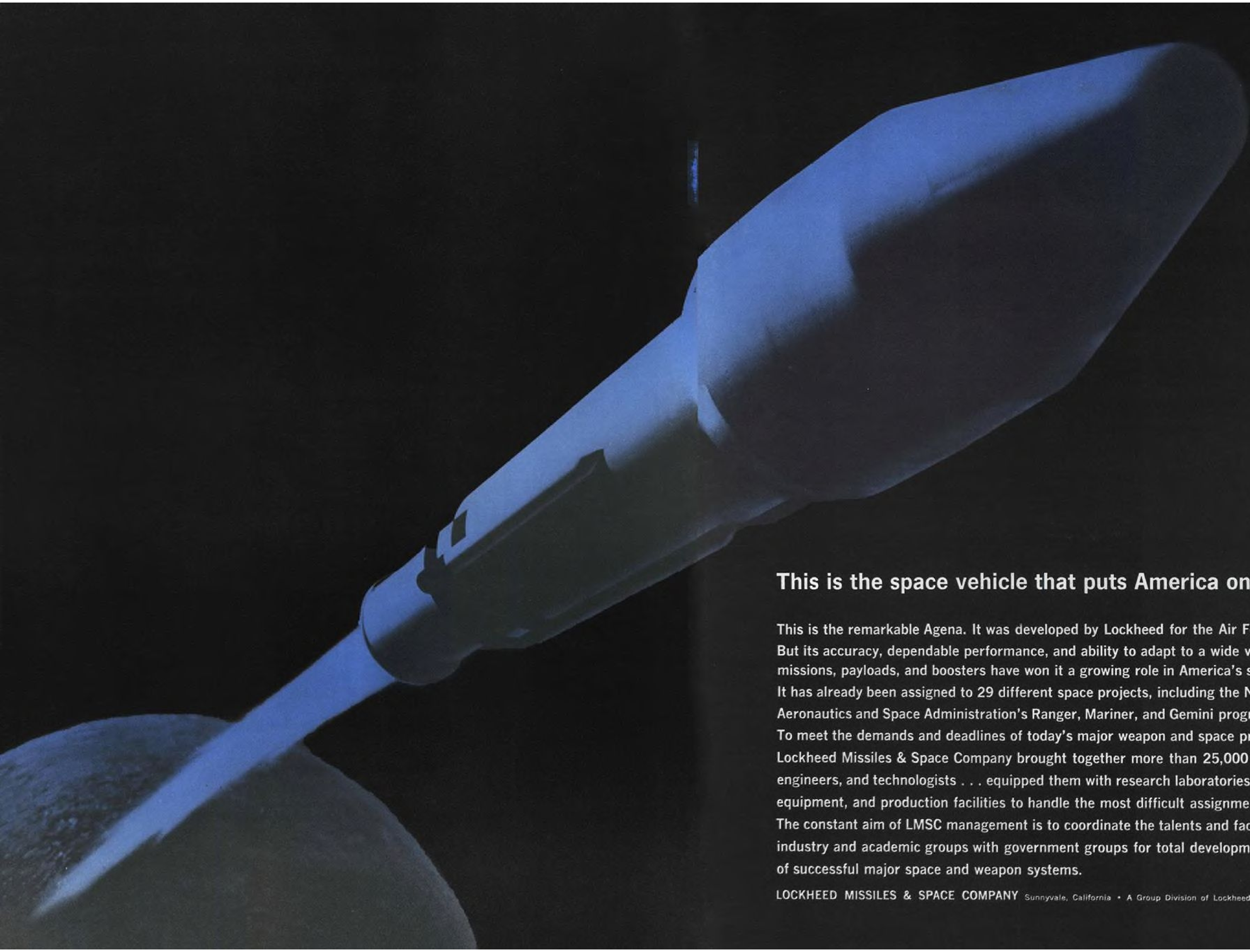


This is the space vehicle that puts America on orbit

This is the remarkable Agena. It was developed by Lockheed for the Air Force. But its accuracy, dependable performance, and ability to adapt to a wide variety of missions, payloads, and boosters have won it a growing role in America's space effort. It has already been assigned to 29 different space projects, including the National Aeronautics and Space Administration's Ranger, Mariner, and Gemini programs.

To meet the demands and deadlines of today's major weapon and space programs, Lockheed Missiles & Space Company brought together more than 25,000 scientists, engineers, and technologists . . . equipped them with research laboratories, test equipment, and production facilities to handle the most difficult assignments.

The constant aim of LMSC management is to coordinate the talents and facilities of industry and academic groups with government groups for total development of successful major space and weapon systems.

LOCKHEED MISSILES & SPACE COMPANY Sunnyvale, California • A Group Division of Lockheed Aircraft Corp.

Potential Failures Detected by RF Noise

By Philip J. Klass

New technique for detecting incipient malfunctions and locating intermittent faults which are difficult to find in avionics equipment has been developed by Minneapolis-Honeywell's Aeronautical Division in Minneapolis.

The technique is based on the discovery that imperfections in solder joints and minute breaks or discontinuities in internal component connections generate a radio frequency (RF) noise which is superimposed on the power supply voltage. The idea is credited to Frank Hagert, an M-H evaluation engineer.

Recently the technique was used to discover 10 faulty components in a group of 140 amplifier-demodulators for the F-104 flight control system. These had successfully passed operational calibration tests and might otherwise have gone undetected until they failed under exposure to mechanical or thermal shock. The faulty components included diodes, transistors, capacitors, transformers and connections, according to Hagert.

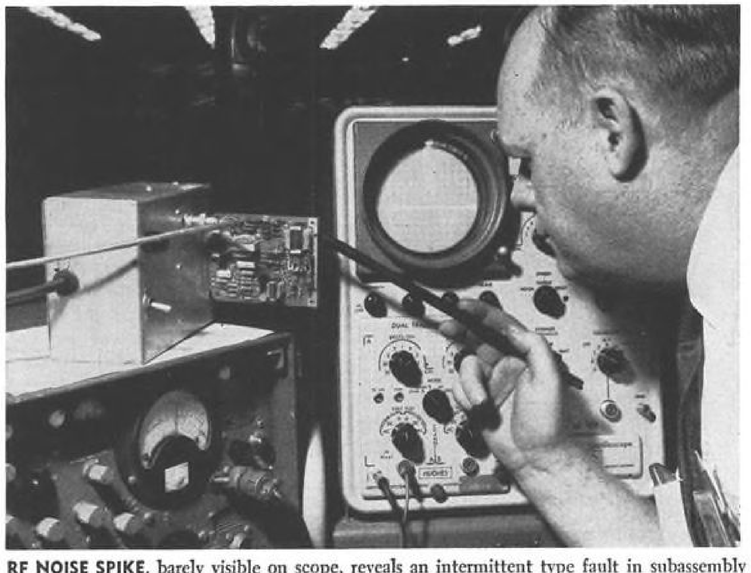
The new technique is being used on the assembly line of Honeywell's F-104 flight control system and is planned for use on the attitude-flight control system, which the company will supply for the Gemini and Apollo spacecraft. The technique is not useful in discovering short or open circuits or components which are drifting in value, but other techniques can serve this purpose.

Hagert devised the technique as the result of mysterious high-noise peaks occasionally observed several years ago during the course of radio interference measurement tests required for all military equipment. Investigation revealed that this resulted from intermittent type faults within such equipment.

Honeywell experimented with the idea for two years on gyro sensors, temperature and guidance control amplifiers and timers, obtaining confirmation that such noise spikes result from an intermittent type fault. Sometimes it is necessary to subject the subassembly to mechanical or thermal shock to aggravate the incipient failure to the point where it reveals itself by RF noise.

Once a defective subassembly has been detected, the faulty component can be located by tapping each component on the board with a phenolic rod to determine which one produces the highest amplitude of noise and thus contains the fault.

A discontinuity in a solder joint or connection generates RF noise across a moderately wide frequency spectrum. But the major portion of the energy is centered at about 25 mc. where it is 5 to 40 db. higher than the steady state background noise of the circuit, according to Hagert.



RF NOISE SPIKE, barely visible on scope, reveals an intermittent type fault in subassembly under test. New technique developed by Minneapolis-Honeywell permits detection of cold solder joints and other unsatisfactory connections in components and printed wiring boards which could not be discovered by other available techniques.

The technique has the advantages of being non-destructive, rapid and easy for semi-skilled technicians to use with little prior training.

The initial test on a subassembly requires less than 2 min. Tracking down the fault to a specific component or connection may then require an additional 10 min.

Honeywell has been using an Empire NF-105 radio frequency interference noise meter, normally used to check for spurious emission from avionics equipment. Honeywell currently is building test stations which will be used on Aeronautical Division production lines as the technique is introduced. The stations are expected to cost about $13,000 each.

The stations will include a special fixture which is designed to administer a calibrated mechanical shock to the subassembly under test to stimulate any potential faulty connections into intermittency, making its RF noise more readily discernible.

The new technique, if its production line performance comes up to early indications, should prove an important tool for improving avionic equipment reliability, since it performs a function not now available by any other known means. In this respect it is comparable to the infrared surveillance technique developed by Raytheon (AW Dec. 3, p. 85).

Both techniques are applicable to components as well as to subassemblies and complete equipment. Both are therefore techniques which component manufacturers can apply to help weed out potentially weak components prior to shipment to equipment manufacturers and to assist in pinpointing basic shortcomings in component fabrication techniques.

FILTER CENTER

► **USSR Claims Avionic Inventions**—Soviet Union's already long-list of claims of first-discovery or invention has been expanded to include aircraft instruments, autopilots, accelerometers and inertial navigation, according to historical paper prepared by G. A. Slomyanskiy, candidate of technical sciences at the Moscow Aviation Technological Institute. He claims that Russia first used flight instruments in 1804, presumably on balloon flights, exhibited the first autopilot in Vienna in 1873, built the first accelerometer in 1913 and proposed the first inertial navigation system in 1932. The Soviet author ignores the work of Germany's Max Schuler, reported in 1923, which set forth basic principles of an inertial guidance system to be utilized aboard ships.

► **Synthetic Aperture Radar Study**—Rome Air Development Center has disclosed plans for program to study feasibility of a ground-based monostatic (single antenna) radar employing synthetic aperture techniques to achieve performance of an extremely large reflector with a much smaller dish. Contractor is to consider application of existing side-looking radar techniques in feasibility study.

► **Microelectronic Engine Indicator**—Navy plans a program to develop a jet engine performance indicating system using vertical bar-graph type indicators employing electroluminescent display techniques with semiconductor microcircuitry used for servo-instrument amplifiers.

► **New Metal-to-Plastic Bonding**—New method for bonding metals to thermoplastic materials using a single layer of molecules as an adhesive has been developed by scientists at Bell Telephone Laboratories. A bond of aluminum-polyethylene-aluminum prepared by the new method, using a monolayer of stearic acid, has withstood a tensile-shear stress of 600 psi. for many months, BTL reports.

► **Sign of the Times**—West Point cadets will receive instruction in the operation of digital computers beginning in their freshman year, with more advanced courses available in subsequent years. The Academy has rented a General Electric 225 computer and also expects to add three more of the digital computers in the future.

► **Challenging Opportunity**—Defense Communications Agency is seeking several top-notch engineers with experience in communications and data processing, with heavy industrial background, for key positions in the development of the National Military Command System, designed to provide reliable communications between the President, Joint Chiefs of Staff and top field commanders in both pre-attack and post-attack period. Program office is headed by Maj. Gen. John Bestic, USAF. Deputy director is expected to be a civilian.

► **Canadians Developing ASW Network**—An anti-submarine warfare network, consisting of large upward looking sonobuoys which would be deployed in a barrier line much like an underwater distant early warning line, is being developed by the Canadian government under Project Nutmeg. The sonobuoy line is attracting U. S. Navy interest.

► **Nonlinear Semiconductors for Millimeter Frequencies**—Two-year research program intended to explore possibility of developing unusual types of microwave components, such as modulators and switches, based on variable conductivities in semiconductors situated in a waveguide or cavity will be initiated by the Army Signal Corps this year. Types of non-linearities to be studied will be those caused by hot electrons or other conduction phenomena. Frequencies of interest will be at and above 70 kmc. (g.c.).

► **Ames Funds Pneumograph Development**—Ames Research Center of NASA has awarded a $25,947 contract to Spacelabs, Inc., to continue development of a device, called an impedance pneumograph (AW June 11, p. 79), for measuring the respiration rate and respiration volume of astronauts.

► **Collins Radio,** Dallas, will build hardened pop-up radio communications antennas for Atlas and Titan missile sites in the U. S. under $3.5 million Air Force contract.

► **Hughes Probes CW Millimeter Amplifiers**—Laboratory models of continuous wave amplifiers capable of operating at 35 and 85 kmc. will be designed and fabricated by the Hughes Research Laboratories, Malibu, Calif., under a contract from USAF's Aeronautical Systems Division. Hughes also will attempt to demonstrate feasibility of CW amplification at 150 kmc. as part of the same contract.

► **Laser Performance Criteria**—Survey aimed at identifying laser parameters which must be specified to accurately describe the performance of laser devices will be placed with industry soon by USAF's Rome Air Development Center. The survey is particularly concerned with those parameters resulting from the application of lasers to optical radar, communications, weapons, machinery and displays. The ultimate aim of the survey is to lay the groundwork for eventual development of a standard group of measurement techniques and equipments for use in operational environments which would adequately determine performance of laser systems.

► **Infrared Cooler Research**—Arthur D. Little, Inc., and AiResearch Mfg. Co. are separately developing long-life space-based coolers using miniaturized components to maintain infrared sensors at low-temperatures required for effective operation. Work is sponsored by the Air Force's Space Systems Division.

Plan Position Radar Console Studied

Plan position display console at Federal Aviation Agency's National Aviation Facilities Experimental Center will be used as a "test bed" to evaluate radar control techniques in the en route, transition and terminal areas. Built by General Precision, Inc., the console has bright display which shows primary radar as well as radar transponder signals. It also can display aircraft identification, altitude and destination.

Come to Northrop and get it off your mind.

A new idea can't mature on uncritical acceptance. It must challenge. It must convince. Its survival and growth depend on an atmosphere of open discussion.

If you enjoy the stimulation of free debate, you'll like working at Northrop. We have more than 70 active projects in work, and we're constantly evaluating new lines of inquiry. Present programs cover such fields as interplanetary navigation and astro-inertial guidance, aerospace deceleration and landing, man-machine and life support systems for space, automatic checkout and failure prediction systems, laminar flow control techniques, undersea technology and world-wide communications.

Why not get in touch with us, and talk things over? Write to Dr. Alexander Weir, Northrop Corp., Beverly Hills, California, and tell us your field of interest. You'll receive a prompt reply. **NORTHROP**

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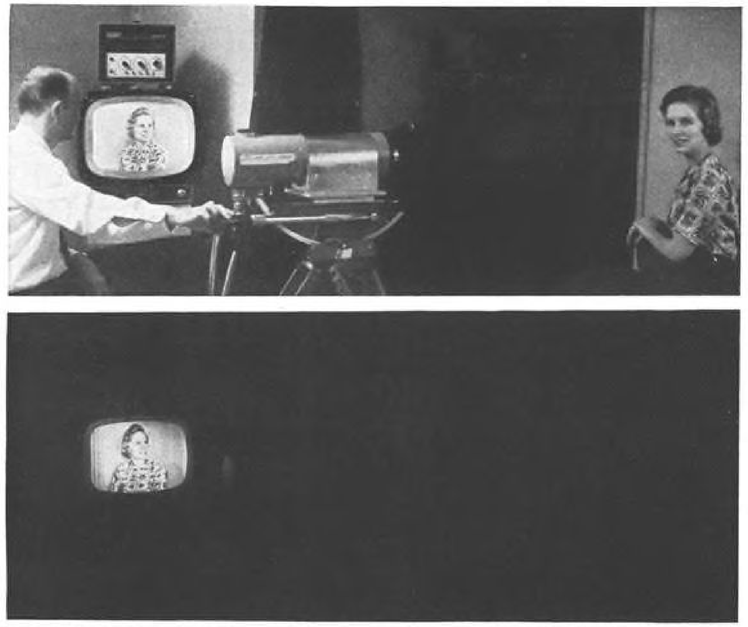

LOW-LIGHT-LEVEL TELEVISION SYSTEM, developed by General Electric for nighttime reconnaissance, needs only one-millionth of a foot-candle illumination. Top photo shows subject and TV picture produced in a dimly lighted room, while bottom photo shows result when there is practically no illumination on the subject.

New Television System Provides Useful Picture During Darkness

Lightweight, closed-circuit television system designed to produce a useful picture of ground objects during a cloudy, moonless night, has enabled airborne observers to spot ground targets not visible to the naked eye, according to General Electric, which developed the new system.

With the system installed in a Beechcraft Model 18, observers watching a TV monitor in the passenger compartment were able to spot a man standing beside an automobile from altitudes of 1,000 and 2,000 ft.

Both were invisible to cockpit observers viewing the ground directly, GE reports.

Light Weight

Airborne camera and remote control unit, fully transistorized, weigh 45 lb. and consume 108 watts at 28 v.d.c.

The camera output can be displayed on a standard television monitor or an AN/ADS-4 "heads-up" optical sight display.

During airborne nighttime tests in the Beechcraft, flying at speeds of 150 to 200 kt. and at altitudes of 1,000 and 2,000 ft., cabin observers monitoring the TV display detected a road at a slant range of 25,000 ft. Unaided observers in the aircraft were unable to see the road until it was only about 8,000 ft. away, according to General Electric.

In addition to the nighttime reconnaissance mission, company says the system should find application for terrain avoidance during low-altitude night operations, as well as for aircraft carrier operations.

Orthicon Tube

Heart of the new television chain is a ZL-7806 image orthicon tube. The camera head containing the tube and deflection yoke measures 20 in. long and 6 in. in diameter, weighs 25 lb., exclusive of optical lens. The HTC-1 TV chain can produce a 300-line picture with ambient illumination of only one-millionth of a foot-candle, company says.

Tube, originally developed by GE's Research Laboratory, is produced by its Cathode Ray Tube Dept. The low-light-level closed-circuit TV system, designed for airborne use, was developed by the Advanced Electronics Center of the Light Military Electronics Dept., Ithaca, N. Y.

ASTEK

AIR/SPACE TECHNOLOGY

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SPECIFIED BY BOEING FOR THE "727"

The ASTEK Mach Airspeed Warning Switch is designed to operate a warning device whenever the aircraft speed exceeds the maximum operating limit speed. It can be adjusted to follow the maximum operating limit speed curves for all turbine powered aircraft and allows complete compliance to Part 1(b) of the Federal Aviation Agency Regulation No. SR-450.

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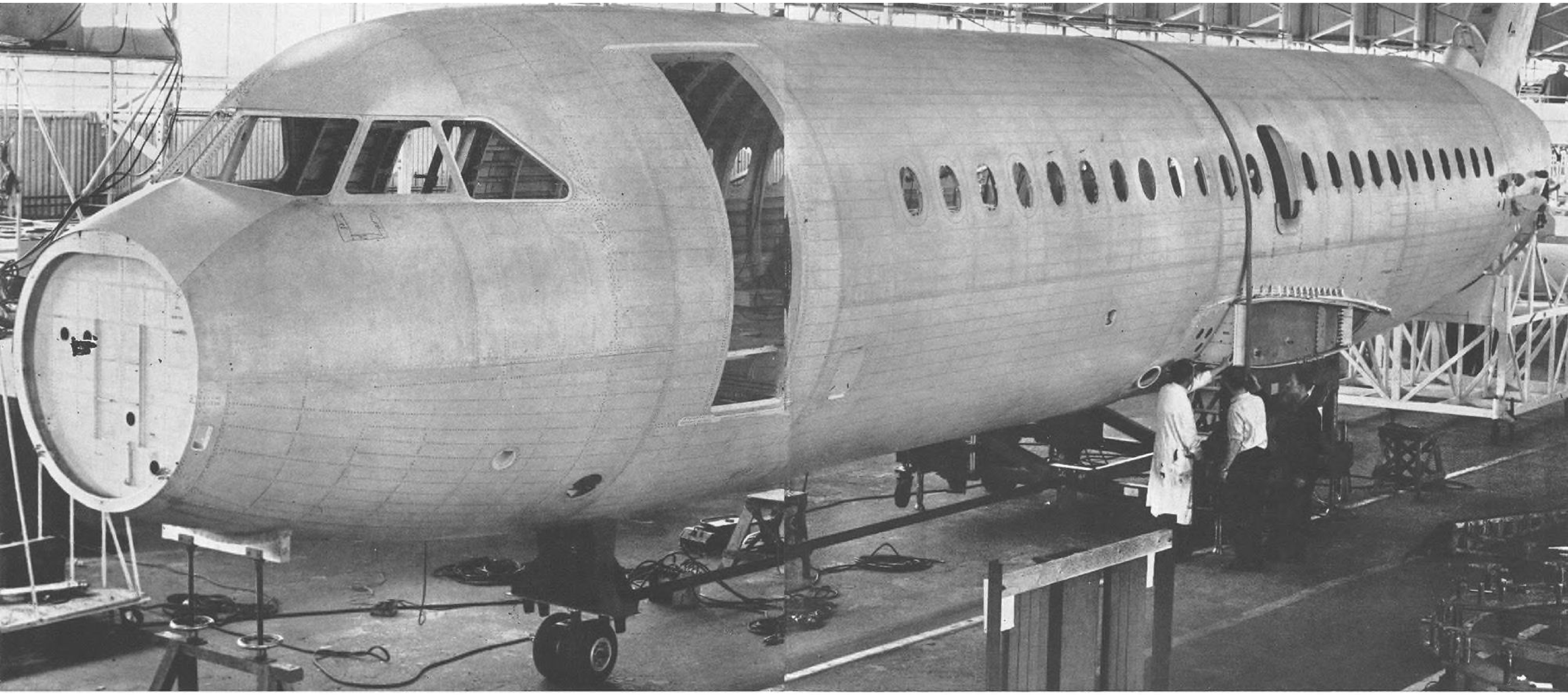

PROGRESS

BRITISH AIRCRAFT CORPORATION

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USA: BRITISH AIRCRAFT CORPORATION (USA) INC.,
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WITH THE SHORT HAUL JET

The BAC One-Eleven will come off the production line in 1963. It has already been ordered by: BRITISH UNITED AIRWAYS, BRANIFF INTERNATIONAL AIRWAYS, MOHAWK AIRLINES, KUWAIT AIRWAYS, CENTRAL AFRICAN AIRWAYS and an undisclosed airline. Passenger appeal and low break-even factors make the BAC One-Eleven the first choice for all short haul operators.

JET SUCCESSOR TO THE VISCOUNT WITH EVEN BETTER THAN VISCOUNT ECONOMICS

BAC ONE-ELEVEN

TWO ROLLS-ROYCE SPEY TURBOFAN ENGINES

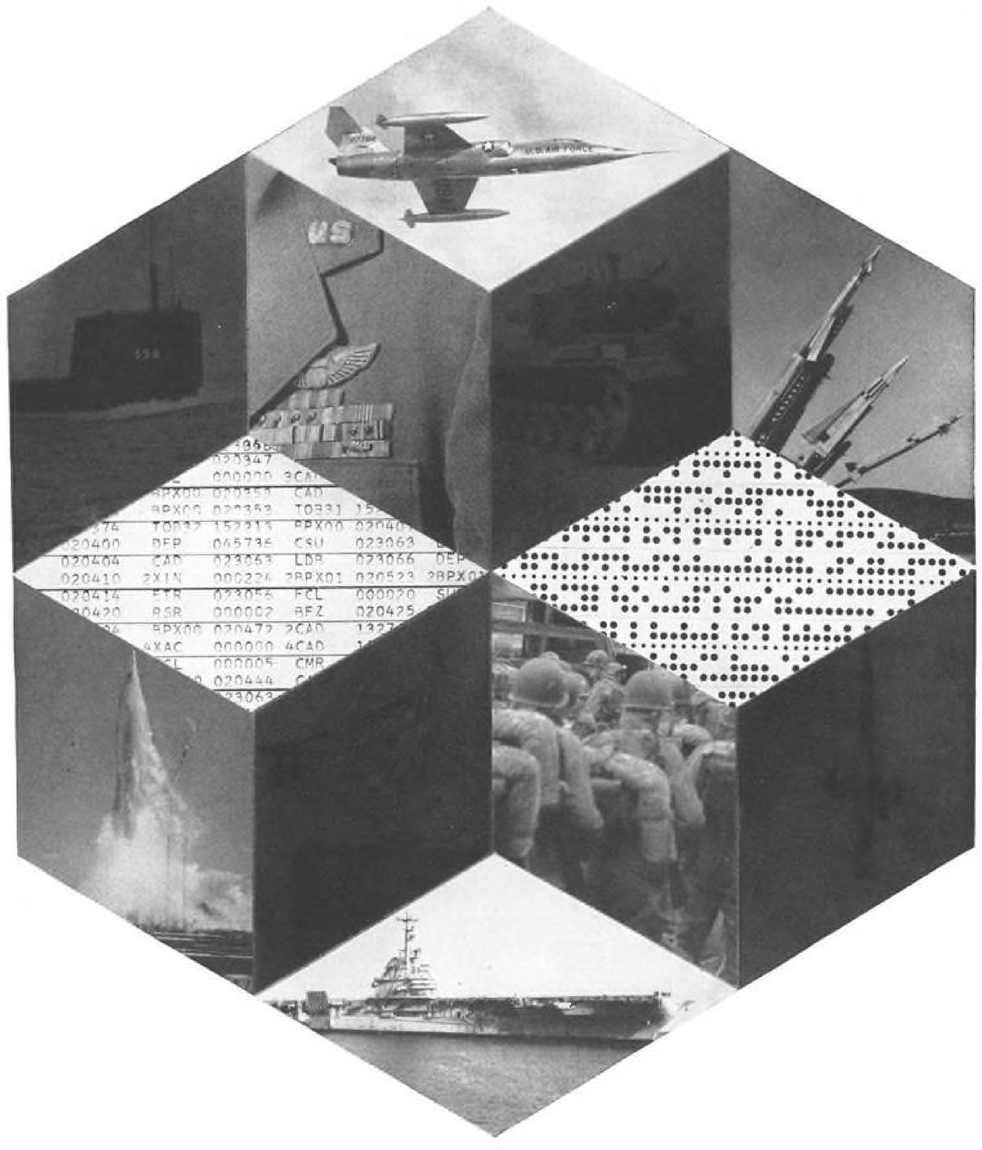
Decision-Making: Deploy or not?...When and where?

The costly, complex weapons systems of today make such a decision far more difficult than in the past. World-wide forces and events are frequently involved. The time for decision has been compressed, the information on which it must be based has been multiplied in volume, variables, interrelationships. This new era of decision-making has led commanders and governmental leaders to make use of man-machine systems which provide information processing assistance. SDC's staff of scientists, engineers and computer programmers have been developing these huge systems for more than eight years. They help develop the system itself, not the hardware within the system. Specifically, they analyze system requirements, synthesize the system, instruct computers which are the core of the system, train the system, evaluate the system, adapt it to the changing needs of its users. And in so doing, they consider the interaction and effect of men, doctrine, tradition, training; of organizations, chains-of-command and chains-of-succession; of communications, traffic centers, command posts, computers and displays. Human factors scientists, operations research scientists, systems-oriented engineers, and computer programmers interested in joining this rapidly expanding field and working in a close interdisciplinary effort are invited to write Dr. H. E. Best, SDC, 2432 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D. C.; Lexington, Massachusetts; Paramus, New Jersey; and Dayton, Ohio. "An equal opportunity employer."

SDC

System Development Corporation

Systems that help men make decisions and exercise control



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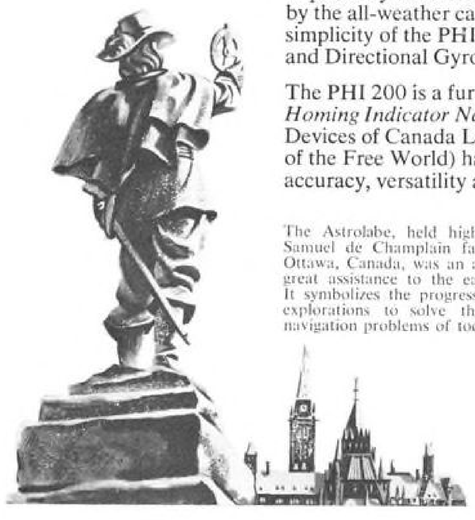
the PHI 200

HELICOPTER NAVIGATION SYSTEM

Navigation problems of Anti-Submarine-Warfare Helicopters are complicated by constantly changing positions of submerged submarines and the movement of base ships or convoy. These problems are efficiently solved with the PHI 200 and its specialized A.S.W. System Options.

The multiplicity and complexity of search patterns plus the difficulties imposed by adverse weather conditions are mastered by the all-weather capability of helicopters combined with the operational simplicity of the PHI 200. Input sources of the PHI 200 are Doppler and Directional Gyro, Tacan and Magnetic Compass or Inertial Platform.

The PHI 200 is a further development of the *Position and Homing Indicator Navigation System* designed and developed by Computing Devices of Canada Limited. The PHI systems (adopted by 10 Nations of the Free World) have received universal acclaim for their reliability, accuracy, versatility and low maintenance costs.



The Astrolabe, held high in the hand of the statue of Samuel de Champlain facing the Parliament Buildings in Ottawa, Canada, was an ancient navigational instrument of great assistance to the early explorers of the new world. It symbolizes the progressive spirit of this company in its explorations to solve the new and vastly complicated navigation problems of today.

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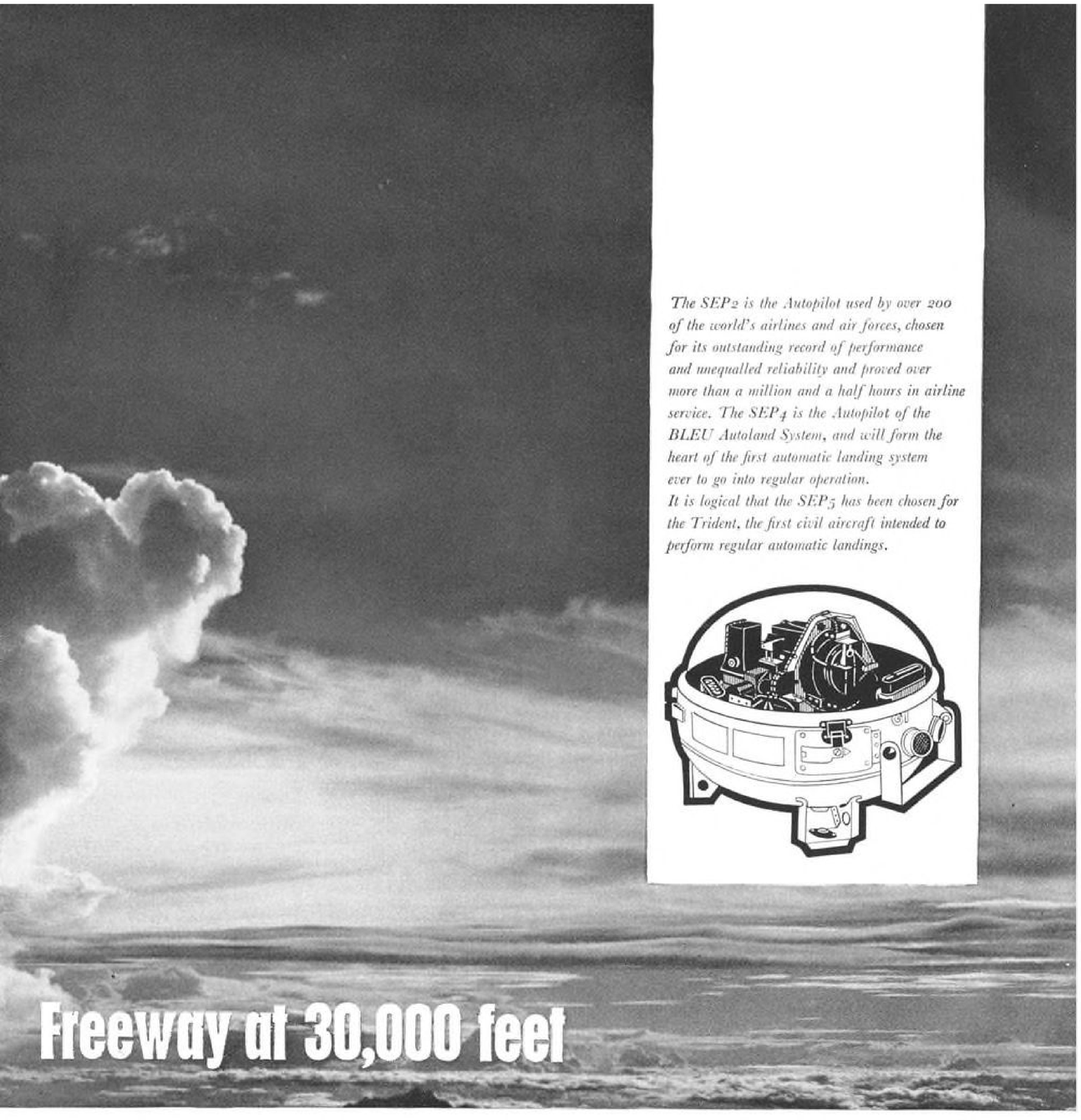

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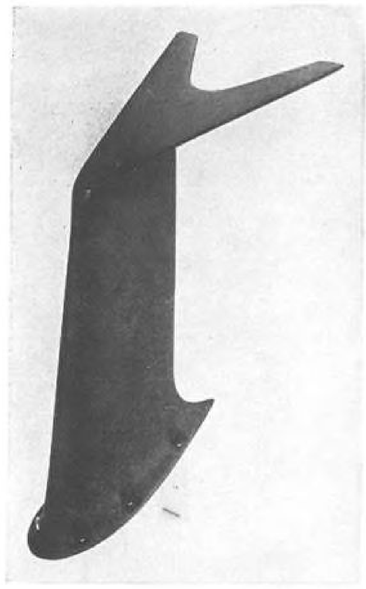
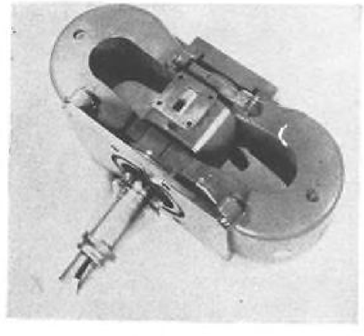


height and has voltage standing wave ratio of less than 2.0/1 in 118 to 156 mc. range. Antenna radiates omnidirectionally, weighs 28 oz. and has aerodynamic shape and narrow airfoil design that permits operation to speeds of Mach 0.95. Manufacturer: Transco Products, Inc., 4241 Gelencoe Ave., Venice, Calif.

• **Magnetron,** Model SFD-303A, a coaxial magnetron capable of generating 1.5 megawatts peak and 1 kilowatt

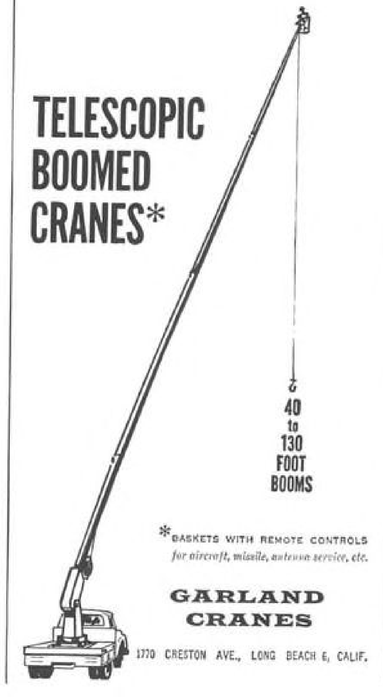


average power in X-band at 9.375 gc. Packaged tube weighs 43 lb., operates with 55% efficiency and is intended for use in search, height-finding, weather and tracking radars. Manufacturer: S-F-D Laboratories, Union, New Jersey.

• **Potentiometric Microvoltmeter,** Model A-61, has full scale linear sensitivities from 3 microvolts to 1 kilovolt and permits d.c. potentiometric measurements from ½ microvolt to 1 v. with infinite null resistance. The potentio-

metric mode has five voltage decade ranges, three digit readout, provides 0.5% accuracy and ±0.01% per hr. stability. Input impedance varies between 100 kilohms and 10 megohms depending on selected range. Price is $595. Manufacturer: Medistor Instrument Co., 1443 No. Northlake Way, Seattle 3, Wash.

• **Micro diode assemblies,** using silicon micro diodes and suitable for high current applications, can handle currents up to 800 ma. and have recovery times as fast as 50 nanosec. Assemblies are available in a variety of circuits and



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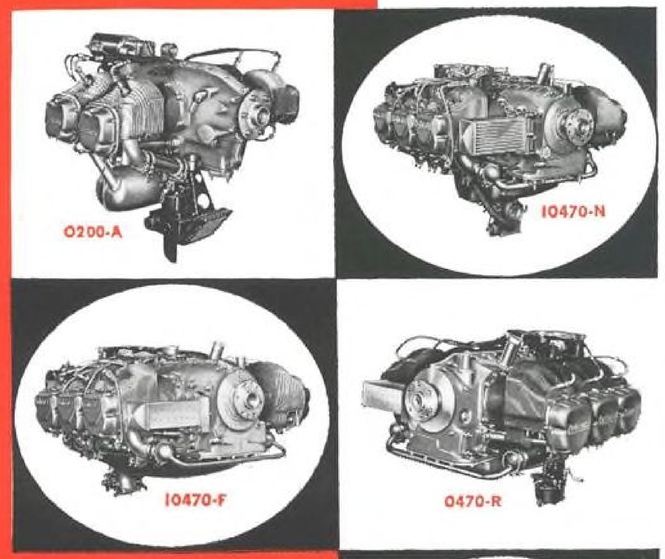

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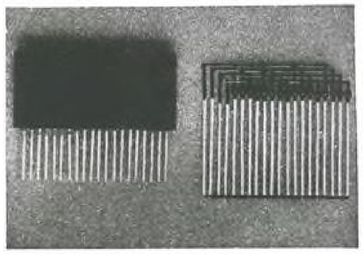
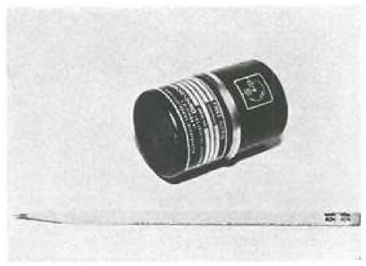


formats, encapsulated if desired, and can meet or exceed MIL-S-19500C and MIL-STD-202 requirements. Typical assembly, a four-quadruple common cathode assembly (shown), measures one inch by 0.45 in. by 0.1 in. Manufacturer: Microsemiconductor Corp., 11250 Playa Ct., Culver City, Calif.

• **Subminiature free gyro,** model FT10A-1, suitable for use in closed loop systems for drones and missiles or adaptable for short-range platforms, has maximum drift rate of 0.25 deg./min.,



weighs 16 oz., and measures 2 in. x 3.3 in. Vibration resistance is 15g at 20 to 2,000 cps., with shock resistance of 150g. Gyro employs inductive pickoff and torquers. Manufacturer: American Gyro, 9320 Lincoln Blvd., Los Angeles 45, Calif.

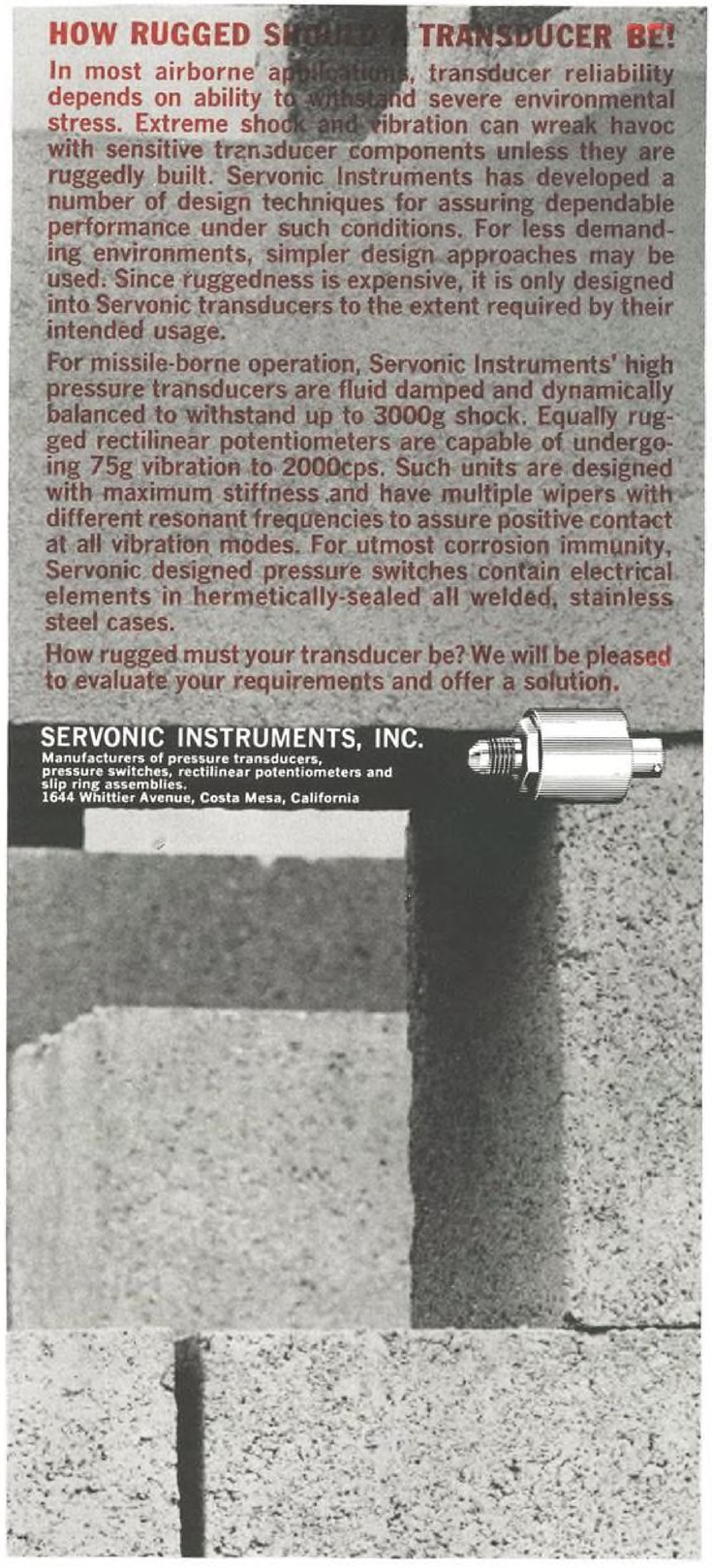
• **Floated vertical gyro,** Model VG45-A-1, which has vertical accuracy of 15 min. of arc and free drift rate of 0.12 deg./min., is designed to withstand

shock resistance of 100g and vibration of 3g. Gyros are available on minimum 60-day delivery. Manufacturer: American Gyro, 9320 Lincoln Blvd., Los Angeles 45, Calif.

Painted first prototype, with one engine mounted on fuselage, nears completion. Movable tail surfaces are still to be installed.

First Jet Commander Prototype Scheduled for January Rollout

First prototype four-to-six-passenger Jet Commander is nearing completion with rollout scheduled this month from company's Norman, Okla., facility. Pilot Wendell Dobbs is expected to begin flight testing in January. Concurrently, a Jet Commander production line is being set up at Aero Commander's nearby Bethany, Okla., plant where most of the machinery to handle parts fabrication already has been installed. Three prototypes are being fabricated at Norman; the fourth airplane—the first production model—will be built at Bethany and will be retained by the factory as a production model. Fifth aircraft will be the first consigned to a customer, with delivery planned to National Aero Sales, Chicago, in late 1963. Aero Commander reports that it has 17 contracts guaranteeing production line positions and delivery dates. Output is scheduled at a four-per-month rate by the latter part of 1963. Planes will cost $475,000, including basic instrumentation, four-place interior. At right, instrument panel is checked out in first prototype. Airplane features Collins Radio solid-state Navcom package. Wing and tail have been joined to number one prototype (below). Streamlined airfoil-shaped fairing for rear-mounted General Electric CJ-610 turbojet (foreground) is visible on upper portion of aft fuselage.



PRIVATE LINES

Federal Aviation Agency and Department of the Interior will jointly finance a public airport near Grand Canyon National Park, Ariz. Airport will be located about 70 mi. northwest of Flagstaff on a 1,093-acre tract in the Kaibab National Forest. FAA has allocated $875,572 in airport funds, and the Interior Dept. has programed $880,000 for the field. In addition to general aviation, it is expected that local service airlines also will use the field, which will have a single 6,800-ft. lighted runway.

Air taxi operations for the year ending Sept. 30 totaled 59,411 revenue trips, an increase of 26.6% over the previous year. National Air Taxi Conference reported 131,716 passengers were flown a total of 58,093,372 passenger miles, an increase of 34.8% over the previous year. There were 56,298 passenger trips reported, 2,432 cargo flights and 328 ambulance trips.

Cessna Helicopter

Cessna Aircraft Co. is discontinuing production of its Skyhook helicopter because a thorough study of the rotary wing aircraft market by the company indicates that use of the helicopter for business and utility purposes has not been developing as anticipated earlier.

Company President Dwane Wallace stated that "while this market may develop into one of greater potential in the future, we do not feel that the program can continue to be sustained on the commercial business presently available."

Cessna entered rotary wing aircraft field in 1952 when it acquired the Siebel Helicopter Co. Cessna instituted an intensive research and development program on the Siebel design and placed its CH-1 helicopter on the commercial market in October, 1961. It has developed about 20 Skyhooks including four or five military versions under the military aid program which went to South America.

Cessna officials last week declined to elaborate further regarding their announcement that the company is going out of the helicopter business. Indications are firm however, that there are no plans to reactivate the Skyhook program in the future. It also appeared that the company does not plan to sell off the rights, tooling and production jigs for the Skyhook program. Personnel working on the Skyhook are being transferred to other activities within the company.

Cessna will continue to provide spares and support for machines in the field.

President Discusses Defense Problems

(In a one-hour television interview with three White House reporters, President Kennedy recently discussed the Cuban crisis, the military-industrial complex, Skybolt, the future of the Nike Zeus and other subjects of great interest to the aerospace industry. Aviation Week & Space Technology is publishing significant excerpts from the transcript of this interview).

Question: . . . Mr. President . . . how does a President go about making a decision, like Cuba, for example?

The President: The most recent one was hammered out really on policy and decision over a period of five or six days. During that period, the 15 people more or less who were directly consulted frequently changed their view, because whatever action we took had so many disadvantages to it, and each action we took raised the prospect that it might escalate with the Soviet Union into a nuclear war. Finally, however, I think a general consensus developed, and certainly seemed after all alternatives were examined, that the course of action that we finally adopted was the right one.

Now, when I talked to members of the Congress, several of them suggested a different alternative, when we confronted them on that Monday with the evidence. My feeling is that if they had gone through the five day period we had gone through in looking at the various alternatives, the advantages and disadvantages of action, they probably would have come out the same way that we did. I think that we took the right one. If we had had to act on Wednesday in the first 24 hours, I don't think probably we would have chosen as prudently as we finally did, a quarantine against the use of offensive weapons.

In addition, that had much more power than we first thought it did, because I think the Soviet Union was very reluctant to have us stop ships which carried with them a good deal of their highly secret and sensitive material. One of the reasons I think that the Soviet Union withdrew the Il-28's was because we were carrying on very intensive low-level photography. Now, no one would have guessed, probably, that that would have been such a harrassment.

Mr. Castro could not permit us to indefinitely continue widespread flights over his island at 200 ft. every day, and yet he knew if he shot down one of our planes, that then it would bring back a much more serious reprisal on him. So it is very difficult to always make judgments here about what the effect will be of our decisions on other countries. In this case, it seems to me that we did pick the right one; in Cuba of 1961 we picked the wrong one.

Question: I would like to go back to the question of the consensus and your relationship to the consensus. You have said and the Constitution says that the decision can be made only by the President.

The President: . . . Naturally the Constitution places the responsibility on the President. There was some disagreement with the course we finally adopted, but the course we finally adopted had the advantage of permitting other steps if this one was unsuccessful. In other words, we were starting in a sense at a minimum pace. Then if that were unsuccessful, we could have gradually stepped it up until we had gone into a much more massive action, which might have become necessary if the first step had been unsuccessful. I would think that the majority finally came to accept that, though at the beginning there was a much sharper division. And after all, this was very valuable, because the people who were involved had particular responsibilities of their own; Mr. McNamara, secretary of defense, therefore had to advise me on the military capacity of the United States in that area, the Secretary of State, who had to advise on the attitude of the OAS and NATO. So that in my opinion, the majority came to accept the course we finally took. It made it much easier.

In the Cuba of 1961, the advice of those who were brought in on the Executive Branch was also unanimous, and the advice was wrong. And I was responsible. So that finally it comes down that no matter how many advisors you have, frequently they are divided, and the President must finally choose.

The other point is something that President Eisenhower said to me on January 19th. He said "There are no easy matters that will ever come to you as President. If they are easy, they will be settled at a lower level." So that the matters that come to you as President are always the difficult matters, and matters that carry with them large implications. So this contributes to some of the burdens of the office of the Presidency, which other Presidents have commented on.

Conversation 'Leaks'

Question: Mr. President, during the Cuban crisis, there was some problem that you are apparently familiar with and bored with by now, about the possibility of a President talking in very private and secret conversations with his advisors, and that somehow leaking out. Do you think that this is going to inhibit the free, frank flow of advice that every President has to have?

The President: No, I think it is unfortunate there are that sort of conversations, but there are what, 1,300 reporters accredited to the White House alone, there are I suppose 100 or 150 people who are familiar with what goes on in the Security Council meeting in one way or another. You have the people who are actually there. Then you have got the others who are given instructions as a result of the decisions there, and I suppose people do talk. And then as I said at the time of the Cuban disaster in April of 1961 that success has a hundred fathers and defeat is an orphan. I suppose when something goes well, there is more tendency to talk at all levels, and frequently the reports are inaccurate. I would say the security is pretty good at the National Security Council. It is unfortunate when it is breached.

Question: You once said that you were reading more and enjoying it less. Are you still as avid a newspaper reader . . .?

The President: Oh, yes. No, no, I think it is invaluable, even though it may cause you —it is never pleasant to be reading things that are not agreeable news, but I would say that it is an invaluable arm of the Presidency, to check really on what is going on in the Administration, and more things come to my attention that cause me concern or give me information. So I would think that Mr. Khrushchev operating a totalitarian system which has many advantages as far as being able to move in secret, and all the rest, there is a terrific disadvantage not having the abrasive quality of the press applied to you daily, to an administration, even though we never like it, and even though we wish they didn't write it, and even though we disapprove, there isn't any doubt that we could not do the job at all in a free society without a very, very active press.

Now, on the other hand, the press has the responsibility not to distort things for political purposes, not to just take some news in order to prove a political point. It seems to me their obligation is to be as tough as they can on the Administration but do it in a way which is directed towards getting as close to the truth as they can get and not merely because of some political motivation . . .

Military-Industrial Complex

Question: Mr. President, your predecessor, President Eisenhower, in his farewell message to the people just before he left office, warned of the dangers of a possible military-industrial complex that might threaten the very nature of the democracy. Have you felt this threat at all while you were in office?

The President: Well, it seems to me there is probably more in that feeling some months ago than I would say today. Of course, every time you cancel a weapons system, it affects a good many thousands of people, the interests of a community, the interests of members of Congress, the interests of the state, and we have had a long fight, for example, over the B-70, which we have felt is a weapon that isn't worth the money we would have to put into it. But it is a very difficult struggle with the Congress. Twice now Congress has appropriated the money for the program, twice we have not spent that money. But I must say as of today I don't feel that the pressure on us is excessive.

Question: Well, I was particularly attracted, sir, by an advertisement, a two-page color advertisement this week in one of the national magazines, for the Project Skybolt missile.

The President: Yes, I saw the ad.

Question: And it claimed only successes for the missile, it mentioned no failures, though you had pointed out five, and it said that this system would save billions of dollars in tax dollars if developed. Now, did you regard that as pressure on you?

The President: Well, I think it was an attempt to influence our decision. I see nothing wrong with that. The fact of the matter is that this Skybolt is very essential to the future of the Douglas Co. There are thousands of jobs that are involved. There are a good many people in the United States who feel that this program would be useful, and of course the British feel very strongly about it. So I think the ad was an attempt to bring what the Douglas Co.

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Landing struts for lunar excursion craft and landing skids for manned re-entry vehicles. □ Other people at Bendix are working on engine control systems, landing gear, rocket equipment, high temperature composite materials and nuclear mechanisms. An Aerospace team of skilled and experienced people . . . skilled in all phases of program management, backed up by complete engineering and production facilities, give Bendix the capabilities to undertake many varied Aerospace programs. □ To find out what this Bendix team can do for you, write: General Sales Manager, South Bend 20, Indiana.

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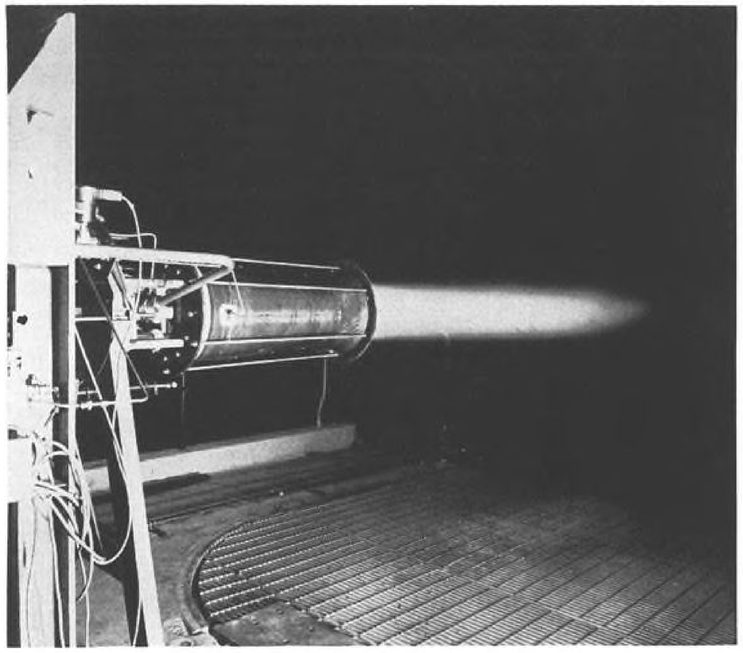

Uncooled Glass Fiber Rocket Fired

Lightweight glass fiber rocket engine has been fired by United Technology Center for 1,147 sec. without conventional cooling equipment. Engine also was fitted with recently developed throttling system. Rocket weighs 95 lb. and can develop 16,000 lb. of thrust, according to UTC scientists. Firing was at Sunnyvale, Calif.

feels are the facts to my attention, to Mr. McNamara's, in a different form. In fact, I saw that ad today.

The only thing that we ought to point out is we are talking about two and a half billion dollars to build a weapon to hang on our B-52s, when we already have billions invested in Polaris, and Minuteman, we are talking about developing new Titan 3 and other missiles. There is just a limit to how much we need, as well as how much we can afford to have a successful deterrent. Your submarines in the ocean, we have Minutemen on the ground, we have B-52 planes, we still have some B-47's, we have the tactical forces in Europe.

I would say when we start to talk about the megatonnage we could bring into a nuclear war, we are talking about annihilation. How many times do you have to hit a target with nuclear weapons? That is why when we are talking about spending this $2.5 billion, we don't think that we are going to get $2.5 billion worth of national security.

Now, I know there are others who disagree, but that is our feeling.

Question: As we move forward technically, Mr. President, new weapons systems and new devices which may be vital to the future of the country seem to get more and more expensive, and to involve more and more thousands of men working on them. Are we coming to a point where perhaps we are going to be so involved that once you start a new weapons system into the works, you will be almost bound to continue it, because to discontinue it would dislocate the economy, put thousands out of work again, and so forth?

The President: Well, that is a problem. In addition, these systems are always two or three or four times more expensive then they look like they are going to be. One of the problems that we have now is the question of whether we should begin to put out the Nike-Zeus system, which is an anti-missile missile system, around this country. We hope sometime to develop a system which will permit us to fire a missile at a missile coming towards us and destroy it, and thereby prevent an atomic attack on the United States. But it will cost billions. There is no sense going ahead until that system is perfected. Some think now is the time, but we are going to wait for a further period of investigation.

But there isn't any doubt that if you don't build the B-70 or you don't build the Skybolt, this involves thousands of jobs, and the welfare of communities, and this one of our toughest problems. On the other hand, we can't have our defense budget go out of sight. We are now spending $52 billion a year, which is a tremendous amount of money, and we could go up to 60 or 65 billion if we didn't tighten as much as we can.

Anti-Missile Missile

Question: Did the Nike-Zeus program get any impetus from Mr. Khrushchev's boast that he can hit a fly in the sky at the moment?

The President: He might hit a fly, but whether he could hit a thousand flies with decoys—you see, every missile that comes might have four or five missiles in it, or would appear to be missiles, and the radar screen has to pick those out and hit them going thousands of miles an hour, and select which one is the real missile and which are the decoys, when there might be hundreds of objects coming through the air. That is a terribly difficult task. You can hit one. What you are trying to do is shoot a bullet with a bullet. Now, if you have a thousand bullets coming at you, that is a terribly difficult task which we have not mastered yet, and I don't think he has. The offensive has the advantage.

Question: You think he has mastered the art of hitting one bullet?

The President: Yes; so have we.

U.S.-Russia Communications

Question: Mr. President, you spoke the other day of the dangers and difficulties of of slow communications between here and the Soviet Union, as it exhibited itself during the Cuban crisis. I suppose this would be an even graver problem if your radar screen were to pick up missiles or at least what appeared to be missiles in any substantial number?

The President: Yes. Well, there is—one of the arguments for the continuation of the airplane is that if you picked up missiles coming toward you, you could have your planes take off and be in the air. Then if it proved to be a false alarm, then you could call them back. For missiles, you can't do that, and the President might have to make a judgment in a 15-min. period, and the information would be incomplete. You recall that incident where the moon came up, and it appeared to be a whole variety of missiles coming in. Of course, it was picked up several years ago. I think that is over-simplified.

The fact of the matter is that the United States could wait quite long because we have missiles in hardened sites, and those missiles, even if there was a missile attack on the United States, those missiles could still be fired and destroy the Soviet Union, and so could the Polaris submarine missiles. So that I don't think there is a danger that we would fire based on incomplete and inaccurate information, because we were only given five or six minutes to make a judgment.

I think the Polaris alone permits us to wait to make sure that we are going to have sufficient in hand that he knows that we could destroy the Soviet Union. Actually that is the purpose of the deterrent. Once he fires his missiles, it is all over anyway, because we are going to have sufficient resources to fire back at him to destroy the Soviet Union. When that day comes, and there is a massive exchange, then that is the end, because you are talking about Western Europe, the Soviet Union, the United States, of 150 million fatalities in the first 18 hours. Now, you could go on, if everybody aimed at cities in order to have as many killed as possible in all these communities with all the weapons you could fire, you could kill, and you might be having more fire. So that the nuclear age is a very dangerous period, and that is why I frequently read these speeches about how we must do this and that. But I think they ought to just look at what we are talking about.

Question: How urgent is this need for quicker communication between here and the Soviet Union?

The President: It is desirable. It is not—if he fires his missiles at us, it is not going to do any good for us to have a telephone at the Kremlin. But I do think that—and ask him whether it is really true. But I do think that it is better that we should be quicker than we now are. It took us some hours in the Cuban matter, and I think that communication is important. In addition to the communications with the Kremlin, we have very poor communications to a good deal of Latin America, and we don't know what is going on there very frequently. So we are trying to improve our communications all around the world, because that knowledge is so vital to an effective decision.

Nuclear Age Hazards

Question: Mr. President, have you noted since you have been in office that this terrible responsibility for the fate of mankind has, notwithstanding the differences that divide you, has drawn you and Mr. Khrushchev somewhat closer in this joint sense of responsibility? He seems to betray it, especially in his speech to the Supreme Soviet earlier.

The President: I think in that speech this week he showed his awareness of the nuclear age, but of course, the Cuban effort has made it more difficult for us to carry out any successful negotiations, because this was an effort to materially change the balance of power, it was done in secret, steps were taken really to deceive us by every means they could, and they were planning in November to open to the world the fact that they had these missiles so close to the United States; not that they were intending to fire them, because if they were going to get into a nuclear struggle, they have their own missiles in the Soviet Union. But it would have politically changed the balance of power. It would have appeared to, and appearances contribute to reality. So it is going to be some time before it is possible for us to come to any real understandings with Mr. Khrushchev.

But I do think his speech shows that he realizes how dangerous a world we live in. The real problem is the Soviet desire to expand their power and influence. If Mr. Khrushchev would concern himself with the real interests of the people of the Soviet Union, that they have a higher standard of living, to protect his own security, there is no real reason why the United States and the Soviet Union, separated by so many thousands of miles of land and water, both rich countries, both with very energetic people, should not be able to live in peace.

But it is this constant determination which the Chinese show in the most militant form, and which the Soviets also have shown, that they will not settle for that kind of a peaceful world, but must settle for a communist world. That is what makes the real danger; the combination of these two systems in conflict around the world in a nuclear age is what makes the Sixties so dangerous.

Question: Ambassador Kennan, who has some knowledge of the Soviet Union, wrote in one of his recent books that what you are dealing with here is a conditioned state of mind, that there is no misunderstanding here, that the only thing the Soviets really understand is when you present them with a set of facts and say to them, "This is what we are going to do." This they understand. Have you found that there is any way to break through to Mr. Khrushchev, to make him really aware that you are quite sincere and determined about what you say, sir, or is this a total—

The President: Well, it is difficult. I think, looking back on Cuba, what is of concern is the fact that both governments were so far out of contact, really. I don't think that we expected that he would put the missiles in Cuba, because it would have seemed such an imprudent action for him to take, as it was later proved. Now, he obviously must have thought that he could do it in secret and that the United States would accept it. So that he did not judge our intentions accurately.

Well, now, if you look at the history of this century, where World War 1 really came through a series of misjudgments of the intentions of others, certainly World War 2, where Hitler thought that he could seize Poland, that the British might not fight, and if they fought, after the defeat of Poland they might not continue to fight, Korea, where obviously the North Koreans did not think we were going to come in, and Korea, when we did not think the Chinese were going to come in, when you look at all those misjudgments which brought on war, and then you see the Soviet Union and the United States so far separated in their beliefs, we believing in a world of independent sovereign and different diverse nations, they believing in a monolithic communist world, and you put the nuclear equation into that struggle, that is what makes this, as I said

WANTED: Decoys that will fly with the "ducks"

How to maximize an ICBM's probability of penetration of enemy defenses is an area of technology under investigation at CAL.

Studies cover the entire spectrum of penetration aids, as well as the other side of the coin — ways to distinguish the decoys from the "ducks." Roy W. Johnson, former director of ARPA, indicated the magnitude of the problem in 1959 when he told the House sub-committee on appropriations that the ICBM "defense system may be forced to deal with objects with behavior exceedingly complex and erratic, which may appear in great numbers, and which may embody great quantities of warheads... There are other concepts, less well defined, which also need further work..."

The complexities of extending the penetration threat and the corollary problem of postulating an effective defense to that threat, pose some of the most challenging problems confronting military planners and scientists alike.

CAL is proud that its research is making important contributions to this imagination-stimulating work, knowing full well that time is of the essence.

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before, such a dangerous time, and that we must proceed with firmness and also with the best information we can get, and also with care.

There is nothing—one mistake can make this whole thing blow up. So that, one major mistake either by Mr. Khrushchev or by us here, so that is why it is much easier to make speeches about some of the things which we ought to be doing, but I think that anybody who looks at the fatality lists on atomic weapons, and realizes that the communists have a completely twisted view of the United States, and that we don't comprehend them, that is what makes life in the Sixties hazardous.

Kennedy-Gromyko Talk

Question: Your discussion of contact with the Soviet Union, of operating and acting with care, leads me irresistibly to the picture of Mr. Gromyko sitting right here . . . There was an occasion when you were in contact, he spoke to you, he told you his very interesting version of the absence of all missiles in Cuba, of the absence of all offensive missiles in Cuba. Now, you were in contact. What did you have to do? Did you have to get up and grit your teeth and walk around the chair?

The President: No, I read to him my September statement, in which we said we would take action if they put missiles in. He did not respond. That is why I say, we are quite a long way from being —Mr. Khrushchev and I are in the same boat in the sense of both having this nuclear capacity, and also both wanting to protect our societies. Where we are not on the same wave is that the Soviets expand their power and are determined to, and have demonstrated in Cuba their willingness to take great risks, which can only bring about a direct collision.

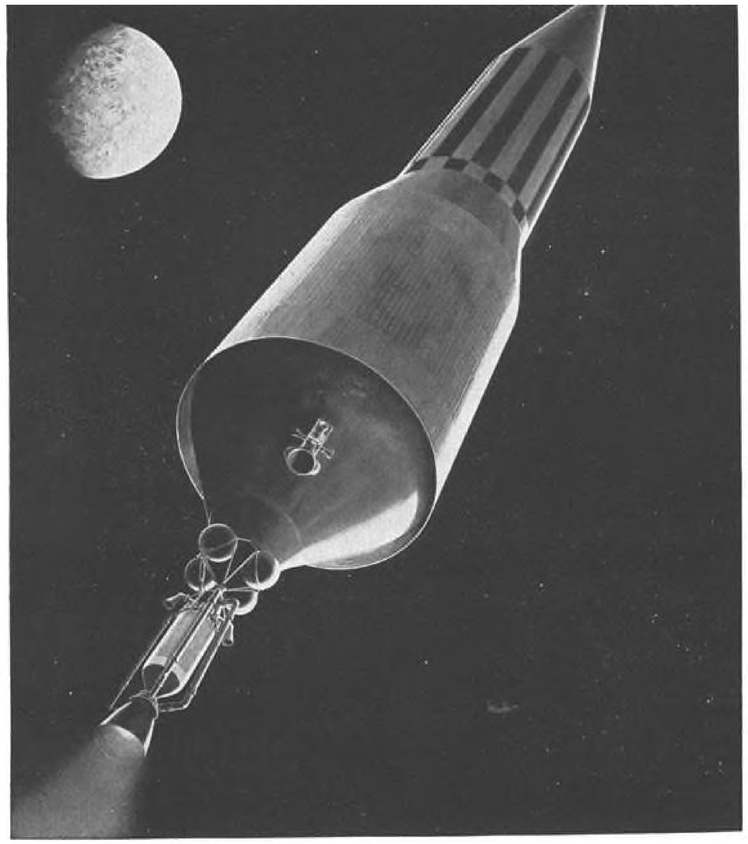
Now, I spent a whole day at Vienna talking about his speech he made on Jan. 6, 1961, in which he said he was going to support wars of liberation, and I said this is the way for the United States and the Soviet Union to end up in direct confrontation, which is what happened in Cuba. You can't have too many of those, because we are not sure on every occasion that the Soviet Union will withdraw as they did in the case of Cuba. And the United States finds it difficult to withdraw when our vital interests are involved.

Question: Mr. President, were you tempted at any time when Gromyko sat there open-faced and said that there were no offensive weapons, to just get up and go to your desk and pick up a photograph—

The President: No, because our information was incomplete and we had not completely determined what our policy would be. The information came in Tuesday, our conversation was on Thursday. We were carrying out intensive reconnaissance. We were still considering the advisability of another course of action. And therefore, it would have been very unwise for us to inform him in detail what we knew. We did not want to give him the satisfaction of announcing what he was doing. I think it was very important that the United States announced it before he did.

Question: We might have lost the initiative then?

The President: Yes. He might have announced it, and we would have been responding then to an initiative of theirs. This way we held the initiative. So it was very important that we not tell him, although I did not mislead him, because as I say, I read my September statement, and he must have wondered why I was reading it. But he did not respond.



RIFT Vehicle Concept Shown

Artist's concept shows nuclear-propelled RIFT vehicle in flight. Without a nose cone, vehicle will be 85 ft. high, 33 ft. in diameter. First flight testing is scheduled for 1966-67 from Cape Canaveral with an advanced Saturn as the launch vehicle. RIFT vehicle will be built by Lockheed Missiles and Space Co. and the nuclear engine by Aerojet-General Corp.

Khrushchev's Successor

Question: Mr. President, a lot of people have said that it is necessary, and these are a lot of the demonologists who have some knowledge about the Soviet Union, that it is necessary for an American President to protect Mr. Khrushchev, because he is the best Soviet prime minister we will ever get. Do you feel that is really the duty of an American President or it is the duty of an American President to protect the national interest?

The President: No, I don't think it is our duty to protect Mr. Khrushchev. This argument that his successor would be worse, I don't know what his successor will be like. What I think is our duty is to try to protect our vital interests, protect the security of the free world, and have Mr. Khrushchev understand our intentions clearly enough so that he can proceed about his business in a way which does not threaten our security, and does not bring a war. We don't want to have to protect our security by means of war.

But Mr. Khrushchev has to understand that there are vital interests in the United States for which we will fight, and if he will come, he and the Communists and the Soviet Union will come to devote their energies to demonstrating how their system works in the Soviet Union, it seems to me his vital interests are easily protected with the power that he has, and we could have a long period of peace. Then we could make a judgment which system does do the job. We believe ours does. He has argued that his does, internally. But instead, by these constant desires to change the balance of power in the world, that is what, it seems to me, introduces the dangerous element.

Now, I do think in fairness, if you read his speech this week, you can see that we would be far worse off—the world would be—if the Chinese dominated the communist movement, because they believe in war as the means of bringing about the Communist world. Mr. Khrushchev's means are destruction, but he believes that peaceful coexistence and support of these wars of liberation, small wars, will bring about our defeat.

The Chinese Communists believe that by constantly hitting, and if war comes, a nuclear third world war, they can survive it anyway with 750 million people. So we are better off with the Khrushchev view than we are with the Chinese Communist

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view, quite obviously. But Mr. Khrushchev does not wish us well, unfortunately. . . .

Question: During the Cuban crisis when there was an offer of inspection inside Cuba by Premier Khrushchev, did you have any hope that there might be a breakthrough, a start to achieving some kind of peace between our two systems, so that we can work on our own problems?

The President: No, I don't think that is there yet. Now, it may come in time.

Question: Did you have hope when it was offered that it might actually come about?

The President: No, but I do think at least that Cuba, as I think the Khrushchev speech . . . which was an important speech, has made Mr. Khrushchev aware of the dangers of the United States and the Soviet Union clashing over an area of vital importance. So that I think is a very salutary fact. But I don't think we are about to see a whole change in Communist policy.

Inspection Breakthrough

Question: Would there have been any breakthrough if there had been international inspection of Cuba allowed, do you think, a start, a thin edge of a wedge?

The President: No, I don't think that would have materially affected it, because I don't think we would have gotten the kind of inspection which really is necessary, because a totalitarian system cannot accept the kind of inspection which really is desirable. What you are really saying is that Cuba be opened, the Soviet Union be opened. They are not going to open it, because a totalitarian system must exist only in secrecy.

Question: Have the inspections that we have had anywhere in the world, for example, in North Korea, or any place else, given you any hope that it will work as a system?

The President: No, the camera I think is actually going to be our best inspector.

Question: Mr. President, is there anything in the end of the Cuban crisis or the substantial end of it, at least getting off a fever pitch, and other problems around the world that would lead you to think that a summit meeting would be useful any time in the near future?

The President: No, not just now. . . . As I say, this is too dangerous a period for us to be or to want to have a tension between the Soviet Union and the United States, and therefore I think we should encourage any relaxation of their policy of supporting those causes hostile to us. But until we see some breakthrough in some one area, I don't see there is much advantage in Mr. Khrushchev and I meeting. . . .

Berlin Situation

Question: Many expected, Mr. President, that Berlin would "hot up" right after our elections. That seemed to be the timetable, perhaps incorrectly. Is there any feeling on your part that what happened in Cuba has led to greater caution in Berlin in so far as the Soviet and East German governments are concerned.

The President: Oh, I think the Chairman—nobody wants to go through what we went through in Cuba very often, and I think they realize that West Berlin is a vital interest to us, and that we are committed there, and that we are going to stay there.

On the other hand, he has a very vital interest in East Germany, in trying to prop up that regime, and trying to solidify his position in Eastern Europe.

So Berlin is a dangerous position always, particularly because of its geography, because we have to keep communications to an area which is 120 mi. behind their lines, so this always gives them a chance to tighten the grip on our windpipe there. But I would think he would proceed with some care, because I think he realizes it is the combination of a vital interest and one which has the chance of a direct encounter.

So that I think that, as I say, Mr. Khrushchev's speech showed that he knows. And those who are attacking Mr. Khrushchev in the Communist camp, particularly the Chinese, as being too soft, I think Mr. Khrushchev realizes the care with which he must proceed now, as do we.

Question: Would you explain, sir, why you said in your toast to Chancellor Adenauer that this was a turning point, a new era in history.

The President: I think it is a climactic period. We have had a number of them. It is not *the*, but it is; after all, Cuba was the first time that the Soviet Union and the United States directly faced each other with the prospect of the use of military forces being used by the United States and the Soviet Union, which could possibly have escalated into a nuclear struggle. That is an important fact.

Secondly, the Chinese-Indian struggle, between these two enormous countries, the two largest countries in the world. When the Soviet has devoted so many years to building its policy of friendship with India, the fact that China then attacked them. And third, the relation between the Soviet Union and China, as a result of the Sino-Indian dispute, as a result of the United States dispute with the Soviet Union over Cuba. I would say that that makes this a very important period.

NATO Military Problems

Question: How do you as the leader of the Western alliance, of the strongest member nation, how do you get the European countries, which are becoming increasingly more independent, increasingly more prosperous, which is what you said you hoped they would become, how do you get them to follow your lead? Apparently Secretaries McNamara and Rusk have not come back with an altogether satisfactory report from the NATO meeting, the Europeans seem unwilling to build conventional forces. Do you have any great power to determine—

The President: No, in the first place you can do your part. We are doing our part. We have our troops in Western Europe—are the best equipped, we have six divisions, which is about a fourth of all of the divisions on the western front. They are the best equipped. They can fight tomorrow, which is not true of most of the other units. So we are doing our part there, and we are also providing the largest naval force in the world. We are also providing the nuclear force in the world, and we are also carrying out the major space program for the free world, as well as carrying the whole burden in South Vietnam. So the United States is more than doing its part. We hope Western Europe will make a greater effort on its own, both in developing conventional forces, and in assistance to the under-developed world.

Now, we can't force them to do it. We can't say, "Well, if you won't do it, we are going to withdraw our forces and leave Europe naked." But I think the United States has done pretty well in carrying its burdens, and we hope that Western Europe, now that it is prosperous, will do its part. We put $12 billion in Western Europe in four years, from '48 to '52. The amount of assistance we have given Latin America for the Alliance for Progress is a fraction of that.

So we have a right, it seems to me, as we have done and proven that we are not sunshine soldiers with respect to Europe itself, there isn't a country in Europe that is putting, of the countries that we are talking about, that is putting as many men and as large a proportion of its population and its gross national product into defense as we are.

Question: Well, sir, do you reach a point where you have to say, "Fish or cut bait; I can't go to the American people and ask them to assume this burden if they know that you are going to do this?" For example, the Skybolt.

The President: Well, look at the Skybolt. The United States has developed the Skybolt. We put in $350 million into Skybolt. No other country has put anything into the actual manufacture of Skybolt. If we completed it, the British would have bought a hundred missiles, we would have bought a thousand. It would have cost us $2.5 billion.

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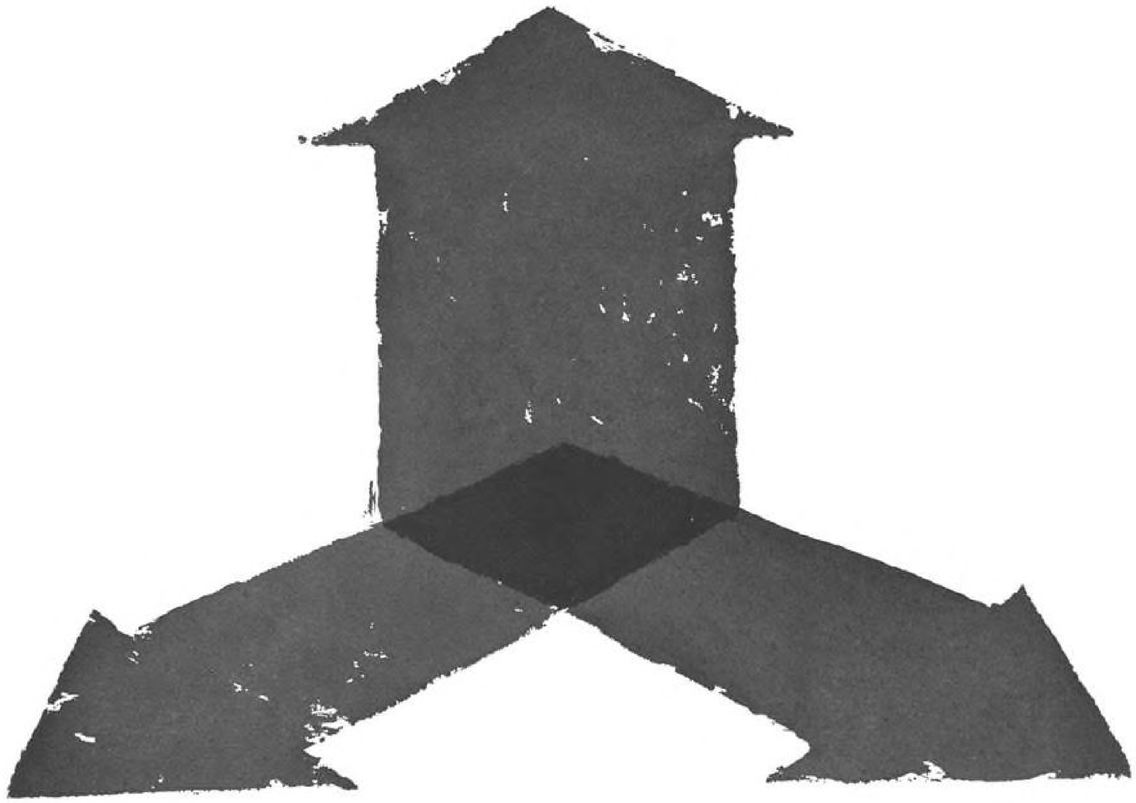
French Carrier Has 60 Aircraft

French aircraft carrier Clemenceau carries a total of 60 aircraft, including Breguet Alize anti-submarine craft lined up at left and Dassault Etendard 4-M strike fighters, four of which are moving along the flight deck. Carrier has 843-ft. flight deck. Angled deck is 542 ft. long. Two steam catapults launch aircraft.



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costs of NATO, the supply lines to the depots in Europe. It costs us about $3 billion in our balance of payments. The aid we give around the world is—you know, the American people are very critical, and the American press prints a lot of bad news, because bad news is news and good news is not news, so they get an impression always that the United States is not doing its part.

U.S. Global Role

When I just think of what we have done for 15 years, since '45, the countries we have sustained, the alliances of which we are the whole, the center, the willingness of the United States to accept burdens all around the world, I think it is a fantastic story. We have one million Americans today serving outside the United States. There is no other country in history that has carried this kind of a burden. The other countries who had forces serving outside of their own country but for conquest. We have two divisions in South Korea, not to control South Korea, but to defend it. We have a lot of Americans in South Vietnam. Well, now, no other country in the world has ever done that since the beginning of the world—Greece, Rome, Napoleon, and all the rest, always had conquest. We have a million men outside and they are trying to defend these countries. Now what we are saying is that rich Western Europe must do its part, and I hope it will.

Question: Nothing that a President ever says is without effect, Mr. Kennedy. Aren't you sure that these words that you have just uttered will come back to you when the appropriations bill starts through the Congress, that you will hear yourself quoted?

The President: No, I think the American people ought to know what they are doing, and I think Western Europe—Western Europe's success, after all, represents the greatest success of American foreign policy, since World War 2, the rebuilding of Europe. It is just what we want. They are bound to have differences of opinion with us.

But all we ask Western Europe to do is not look in and just become a rich, careful secluded group, but to play their role in this great world struggle, as we have done it. We are going to continue to do it in the United States, but we ought to recognize how much we have done, and not always be feeling—whenever I read a dispatch from Europe, it is usually rather critical, even in the Skybolt stories that come out are critical of the United States. My goodness, we have done a tremendous job in this country.

Nuclear Deterrent

Question: But can they play their role without developing their own nuclear weapons and their own nuclear deterrent, and isn't it against our policy to have this proliferation?

The President: Well, we don't want six or seven nuclear powers in Europe diverting their funds to nuclear power, when the United States has got this tremendous arsenal. But if these countries want to do it, we are not stopping them from doing it. If the French decide they want to become a nuclear power themselves, that is their decision. The question is whether the United States should join in helping make France a nuclear power, then Italy, then West Germany, then Belgium. How does that produce security when you have 10, 20, 30 nuclear powers who may fire their weapons off under different conditions? That isn't in our interest, or in my opinion in the interest of peace, or the interest of Western Europe. And it is awfully expensive. Why duplicate what we have already done, and are doing in Western Europe today, as long as our guarantees are good?

Question: Mr. President, back before you were elected, your father used to have a favorite story he told reporters. He asked you once why do you want the job, and he cited the reasons why you shouldn't want it, and you apparently gave him an answer—I don't know whether it satisfied him, but apparently you satisfied yourself. Would you give him the same answer today after serving in this office for two years?

The President: Oh, you mean that somebody is going to do it?

Question: Yes, sir.

The President: Yes. I think that there are a lot of satisfactions to the Presidency, particularly, as I say, we are all concerned as citizens and as parents and all the rest, with all the problems we have seen talking about tonight. They are all the problems which if I was not the President, I would be concerned about as a father or as a citizen. So at least you have an opportunity to do something about them. And if what you do is useful and successful, then of course that is a great satisfaction.

Communist Domination

When as a result of a decision of yours, failure comes, or you are unsuccessful, then of course that is a great setback. But I must say after being here for two years, and having the experience of the Presidency, and there is no experience you can get that can possibly prepare you adequately for the Presidency, I must say that I have a good deal of hope for the United States. Just because I think that this country, which as I say criticizes itself and is criticized around the world, 180 million people, for 17 years, really for more than that, for almost 20 years, have been the great means of defending first the world against the Nazi threat, and since then against the communist threat, and if it were not for us, the communists would be dominant in the world today, and because of us, we are in a strong position.

Now, I think that is a pretty good record for a country with 6% of the world's population, which is very reluctant to take on these burdens. I think we ought to be rather pleased with ourselves . . .

AFOSR Grants

Air Force Office of Scientific Research recently awarded 57 grants and contracts totaling approximately $3,000,000 to universities and non-profit research institutions in the United States and Europe:

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EE; PhD desirable, with 4 years' experience in sophisticated microwave communications and tracking receivers using coherent detection and signal processing — frequency range, 1,000 mc through 10 kmc; power range, 1-through 50 kw. In addition, at least 2 years' background in communication systems design.

EE, with heavy design experience in high power amplifiers for communications; background in design of solid state control circuitry and amplifier circuitry in UHF through SHF ranges.

ME or EE, with at least 2 years' experience in electrical design and testing of coaxial, power, and communication cables and conductors to mil specs. If an ME, must be familiar with basic principles of electrical engineering such as attenuation, impedance, etc.

Project responsibility on microwave communications equipment development. Must be capable of supervising design of transistorized transmitters, receivers and modulators . . . able to handle all phases of proposal preparation.

BSEE or equivalent, with 5 to 10 years' experience in test equipment design and engineering re-design of equipment for manufacturing radio transmitters and receivers in UHF and VHF regions.

EE or Physics — MS or PhD. 3 to 7 years' experience in R&D with supervisory ability. To assist in direction of R&D projects involving Microwave systems, transistor analog and digital systems, antennas and propagation, Quantum Electronics.

Senior Scientist, theoretically oriented, experienced in communication networks, troposcatter and line-of-sight radio communication and system analysis.

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Programming Analysts — intermediate and senior level, for design assistance and program production. Experience in real time operational programs, computer simulation, machine checkout programs for systems acceptance tests. 2-5 years' experience required.

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Mechanical College, Baton Rouge, La.—$26,865 for study of some problems on Bescharanktartige functions and approximations.

Univ. of California, Los Angeles, Calif.—$12,628 for study of problems in Tchebycheff approximations.

Univ. of Southern California, Los Angeles, Calif.—$33,028 for research in computer decision processes.

Indiana University Foundation, Bloomington, Ind.—$12,550 for study of probability and statistics in the areas of multidimensional problems.

Univ. of North Carolina, Chapel Hill, N. C.—$81,124 for study of statistical and mathematical theory of communications and automata.

Northwestern Univ., Evanston, Ill.—$12,550 for study of probability and statistics.

Univ. of California, Los Angeles, Calif.—$48,596 for study of chemical compositions of gaseous nebulae and hydrogen-deficient astronomy.

Univ. of New Mexico, Albuquerque, N. M.—$26,300 for 1963 Summer Scientific Seminar on Topics in Optics.

Univ. of Utah, Salt Lake City, Utah—$60,000 to conduct a study of the electrical and plasma phenomena accompanying detonations.

California Inst. of Technology, Pasadena, Calif.—$32,063 for study of absolute intensity measurements and gas emissivities occurring at elevated temperatures and pressures.

California Inst. of Technology, Pasadena, Calif.—$29,582 for study of selected problems in the theory of EM radiation.

Univ. of Delaware, Newark, Del.—$21,947 for study of quantum limitations to electromagnetic signal measurements.

Univ. of South Carolina, Columbia, S. C.—$28,530 for study of nonwaveguide methods of millimeter wave transmission.

Univ. of Chicago, Chicago, Ill.—$66,172 for study of quasi-elastic proton-proton scattering in light nuclei.

Univ. of Wisconsin, Madison, Wis.—$49,128 for surface studies by slow electron diffraction.

Univ. of Arizona, Tucson, Ariz.—$250,000 for study of physical properties of solids at high pressure.

General Dynamics Corp., General Atomic Div., San Diego, Calif.—$46,929 for study of interactions between hydrogen and oxygen atoms and surfaces.

General Dynamics Corp., General Atomic Div., San Diego, Calif.—$54,879 for research on chemical reactions using modulated free-radical beams.

Amoco Chemicals Corp., Seymour, Ind.—$61,920 for study of new high energy propellant.

Midwest Research Inst., Kansas City, Mo.—$48,713 for determination of mixed virial coefficients.

Radio Corp. of America, RCA Labs, Princeton, N. J.—$25,464 for research on automatic-theory formation.

System Development Corp., Santa Monica, Calif.—$24,353 for studying information-processing potentials in large-scale operations.

Stanford Research Institute, Menlo Park, Calif.—$28,255 for the continuation of its study on "visual information processing in insects."

University College, London, England—$20,000 to conduct a study of high energy physics.

Austrian Study Group for Atomic Energy, Vienna, Austria—$34,500 for study of atomic vibrations in stressed crystal lattices by inelastic scattering of neutrons.

University of Aarhus, Aarhus, Denmark—$4,200 for study of multivariate problems of numerical analysis.

Training Center for Experimental Aerodynamics, Rhode St. Genese, Belgium—$9,320 to conduct a study of kinetic theory of gases.

Royal Institute, Stockholm, Sweden—$43,500 to study solution chemistry.

Training Center for Experimental Aerodynamics, Rhode St. Genese, Belgium—$14,750 for study of laminar separation in supersonic flow.

Institute of Psychiatry, London, England—$12,040 for study of chemical factors in cerebral excitations.

University of Keele, Staffordshire, England—$17,900 to conduct a study of new methods of analysis of electrophysiological responses.

University of Goteborg, Goteborg, Sweden—$28,000 for the study of the biochemistry of CNS cells during learning.

Medical Research Laboratory, Blackrock, Dublin, Ireland—$14,500 to study the active transport of ions.

University of Pisa, Pisa, Italy—$30,000 for study of comparative neurophysiology of vision.

Karolinska Institute, Stockholm, Sweden—$34,000 for studies on the functional and structural organization of the compound eye.

Univ. of Stockholm, Stockholm, Sweden—$13,500 for study of long range navigation in animals.

Univ. of Uppsala, Uppsala, Sweden—$13,350 to study the genesis of action potentials in excitable tissues.

Technicke Hochschule, Munich, Germany—$6,000 for the studies of the catalytical effects of light on the efficiency of photosynthesis.

Karolinska Institute, Stockholm, Sweden—$8,317 for study of sympathetic vasodilator outflow.

University of Goteborg, Goteborg, Sweden—$12,600 for the study of the biochemistry and physiology of Dopamine in the brain.

Univ. of Stockholm, Stockholm, Sweden—$25,000 to study the neural mechanisms involved in instinctive behavior.

University of Lund, Lund, Sweden—$8,000 for a study of chemical sensitivity of skeletal muscle.

University College, London, England—$20,750 to study the anatomical localization of target learning and memory.

System Research, Ltd., Richmond, England—$16,275 to perform a cybernetic investigation of learning perception.

Instituto Nazionale di Ottica, Arcetri-Florence, Italy—$9,000 to carry out basic research on retinal mechanisms and responses.

University College of Wales, Aberstinyth, Wales—$16,480 to conduct a study of the reactions of free radicals containing nitrogen.

Kings College, Strand, London, England—$6,835 to study the displacements in an elastic-plastic cylindrical shell.

University of Siena, Siena, Italy—$7,500 to study the differential influence of several brain stem systems on diencephalic and rhinencephalic mechanisms involved in animal behavior.

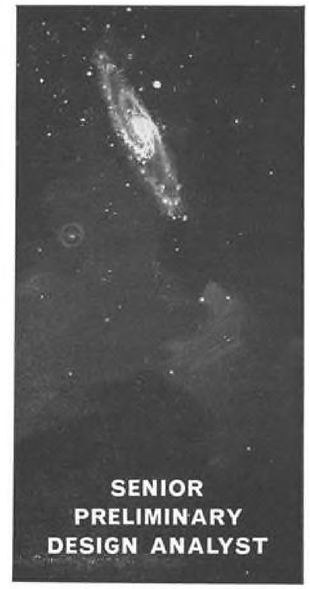
University of Naples, Naples, Italy—$22,000 to conduct a study of the non-equilibrium flows.

Financial Briefs

Northrop Corp. reports sales of nearly $347.5 million for the fiscal year ended July 29—a 30% increase over last year's sales. Northrop's net earnings for the same period totaled approximately $9.05 million or about $378,000 more than last year.

United Aircraft Corp. reports shipments, including domestic subsidiaries, of nearly $304.2 million with earnings of almost $2.8 million for the third quarter 1962. Shipments for the first nine months 1962 totaled $887 million with net earnings of over $12 million, compared with shipments of $796.5 million with earnings of almost $7.8 million for the same period last year. Order backlog, including letters of intent totaled $1 billion on Sept. 30 compared with $1.025 billion on the same date last year.

Lockheed Aircraft Corp. had third



FOR SPACE GUIDANCE & CONTROL

Senior Management position involves supervision of a staff group of about 10 engineers in a preliminary design organization.

Challenging assignment is to conduct preliminary design investigations in the fields of space guidance and control.

The man we need will probably have an advanced degree from an accredited university, U.S. Citizenship and at least 12 years' professional experience including Systems Engineering, Space Navigation, Guidance, Control Systems, Orbital Dynamics, Radar Systems, Inertial Components, Computers.

He must have a personality which enables him to work easily and well with a variety of people—plus intellectual speed which permits him to react quickly to any situation. He must be inventive and imaginative, will probably hold several patents and will have had papers published in professional journals. His present position might be that of a preliminary design section head or staff head in an equipment design group.

If you feel that you qualify by training, experience and interest—and wish immediate consideration, please airmail your resume to:

MR. ROBERT A. MARTIN
Head of Employment
Hughes Aerospace Divisions
11940 W. Jefferson Blvd.
Culver City 27, California

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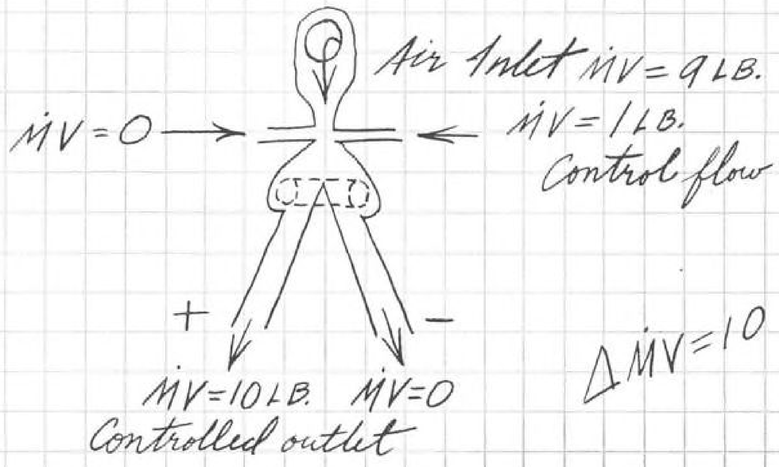
Of interest to engineers and scientists



PNEUMATIC CONTROL RESEARCH

...one of the more than 500 R&D programs under way at Douglas

This Douglas sponsored program seeks to provide the aerospace industry with an all pneumatic control system which has no moving parts.

Under investigation are pneumatic amplifiers, flip-flops, proportional flow devices and logic elements—the building blocks for digital computers. Experiments are being conducted in the Douglas Aerophysics Laboratory on advanced techniques in vortex control and the effects of scaling and Reynolds Number.

Important progress has been registered. Success in this field will provide simple, light weight, low cost control systems that will operate under extremes of temperature and radiation.

Of career interest to engineers and scientists

Douglas has entered into a period of greatly expanded activities in programs (like the above) which relate to tomorrow's technology. Outstanding positions are now open in a wide variety of fields.

We urge you to contact us regarding an important position if your background relates to any of the following: electronics, communications, aerodynamics, astrodynamics, thermodynamics, structures, propulsion or mechanical.

Send us your resume or fill out and mail the coupon. Within 15 days from the receipt of your letter, we will send you specific information on opportunities in *your* field at Douglas.

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Missile and Space Systems Division
Douglas Aircraft Company
3000 Ocean Park Boulevard
Santa Monica, California

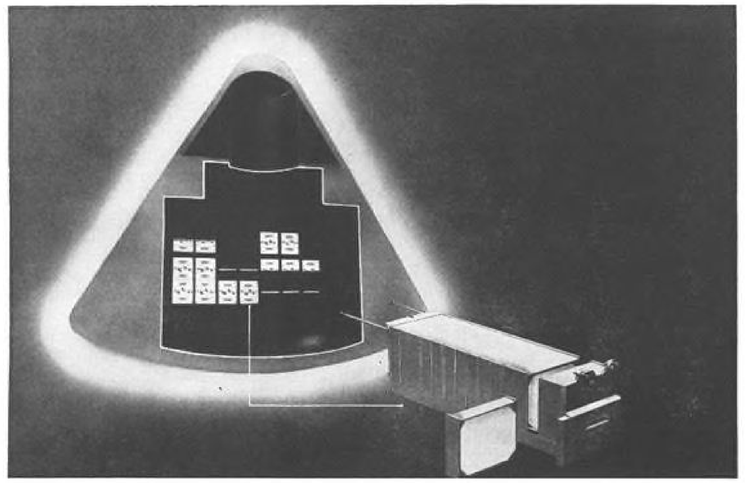
Please send me full information on professional opportunities in my field at Douglas.

Name_____

Engineering or scientific field_____

Address_____

City_____ State_____



Collins Designing Apollo Telecommunications

Space electronics package concept for telecommunications equipment of the Apollo space capsule is shown in drawing above. Collins Radio Co., which has $40-million contract for design, positioning and testing of the equipment, will use easily replaced modules and spares. Full-scale Apollo mockup is being used by Collins for telecommunications work.

quarter 1962 profits of nearly $9.99 million on sales of $412.2 million. Earnings for the same period last year were almost $7.28 million on sales of $316.3 million. Profits for the first nine months 1962 were $26.5 million—$3.40 a share—on sales of $1.26 billion. Comparable figures last year were earnings of $16.5 million—$2.20 a share—on sales of $995.4 million.

Fairchild Stratos reports third quarter 1962 earnings of $725,000 on sales of $14.6 million—$0.24 per share. Figures for the same period last year showed earnings of $757,000 on sales of almost $17.8 million—or $0.25 per share. First nine months 1962 showed earnings of $2.2 million—$0.74 per share—on sales of nearly $50.5 million compared with $2.4 million earned—$0.79 per share—on $57.5 million in sales for the same period last year.

Republic Aviation Corp. and its subsidiaries showed a $3.4 million consolidated net income for the first nine months of 1962, equalling $1.19 per share. Sales for the period totaled $187.8 million. Comparable figures for last year showed $7.5 million—$2.60 a share—on sales which totaled nearly $256.8 million.

Ling-Temco-Vought, Inc., had third quarter 1962 earnings of more than $2 million—$0.75 per share—on sales of $75.8 million. First nine months 1962 earnings were more than $6.6 million on sales of $249.8 million—equal to $2.39 per share.

North American Aviation, Inc., had earnings of almost $34.6 million on sales of $1.6 billion for the fiscal year ended Sept. 30. Last year's figures were $27.8 million earned on sales and other income of nearly $1.3 billion. Fourth quarter sales and other income totaled $489.8 million with earnings of $10.1 million. Fourth quarter sales last year were $372.3 million with earnings of $9.2 million. Fiscal 1962 per share earnings were $4.15 compared with $3.38 the previous year. Sept. 30 order backlog was $1.01 billion compared with $931 million on Sept. 30, 1961.

New Jersey Airwork Corp. had net earnings of $502,778—about $0.64 per share—on sales of nearly $17 million for the fiscal year ended July 31. Earnings for the previous fiscal year were $233,880—$0.30 per share—on sales of $13.7 million. First quarter Fiscal 1963 earnings were $198,746 on sales of $4.9 million—figures are 80% and 27% increases respectively over comparable figures for the same period last year.

Texas Instruments Inc. showed third quarter 1962 earnings of $1.04 million or $0.26 per share on sales of over $55.7 million. Comparable figures last year showed $689,000 or $0.17 per share earned on sales of $52 million.

B. F. Goodrich Co. had earnings of $19.8 million or $2.16 per share, on sales of $607.5 million for the first nine months of 1962. Figures for the same period last year were $23 million earned —$2.52 per share—on sales of nearly $559.7 million.

Responsible assignment is immediately available for a Senior Engineer to supervise Hughes participation in the SURVEYOR Program —including operation of the spacecraft on the lunar surface.

Location: Goldstone, California, deep-space tracking station.

Requirements: Maturity, a degree in E.E. or Physics from an accredited university; U.S. Citizenship; about 10 years' experience in communications, telemetry, video systems (including field work on tracking and/or radar sites); demonstrated ability to work with other contractors and the customer and to supervise the activities of a group of other engineers and technicians.

For immediate consideration, please airmail complete resume to:

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DEFENSE CONTRACT AWARDS

Fourth Fiscal Quarter Summary—1962

Now available free from AVIATION WEEK & SPACE TECHNOLOGY are summary reports of defense contract dollar awards covering the fourth fiscal quarter of 1962. These reports show defense dollars awarded in 174 product/system categories as compiled by Frost & Sullivan, Inc. Information is also available on the fourth fiscal quarter of 1961 (limited quantity); first fiscal quarter of 1962 (limited quantity); second fiscal quarter 1962; and third fiscal quarter 1962.

Reports are available on an individual request basis in the following system areas:

Data Processing
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Meteorological Systems & Components
Vehicles, Ordnance, Vessels
Services
Electronic Warfare
CBR Warfare
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Missiles & Space
Aircraft
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AVIATION WEEK & SPACE TECHNOLOGY
RESEARCH DEPARTMENT
330 West 42nd Street, New York 36, N.Y.

Aviation Week
& Space Technology
A McGraw-Hill Publication

WHO'S WHERE

(*Continued from page 23*)

Changes

Robert W. Sabel, director of sales and marketing, United Control Corp., Redmond, Wash.

Carl W. Chambers, manager-administration, Douglas Aircraft Co.'s new Corporate Advanced Research Laboratory which will be located in Huntington Beach, Calif.

William F. Harrison, manager of the Federal Aviation Agency's National Aviation Facilities Experimental Center, Atlantic City, N. J., replacing **Capt. Alden C. Packard** (USN, ret.). Also: **Capt. Hugh K. Laing,** USN, deputy assistant administrator of FAA's Pacific Region with headquarters in Honolulu.

Albert J. Kullas, director of engineering, Martin Co.'s Denver (Colo.) Division, succeeding **William G. Purdy** (AW Dec. 10, p. 121).

Fred I. Brown, marketing manager, General Electric Co.'s Small Aircraft Engine Department, Flight Propulsion Division, Lynn, Mass., succeeding **James M. Krebs,** now manager of the division's Advanced Product Planning Operation.

Capt. A. G. Russell (USN, ret.), formerly head of Naval Aviation Training Branch, Chief of Naval Operations, now director of Flight Research for Bell Aerosystems Co., Buffalo, N. Y.

Al M. Carnesciali, manager-contract administration, Electro-Optical Systems, Inc., Pasadena, Calif. Also: **John J. Rowlette,** supervisor, Fuel Cell Laboratory, Advanced Power Systems Division of Electro-Optical Systems.

George L. Downs, deputy program manager, and **Hunter C. Harris,** technical director, Minuteman ground electronics program, Sylvania Electric Products, Inc., Waltham.

Robert Laughlin, head of the newly established Electro-Optical Laboratory of HRB-Singer, Inc., State College, Pa.

Dr. Paul Kisluik, head of the Quantum Electronics Department, Aerospace Corp., El Segundo, Calif.

Robert O. Maze, director of engineering, Minneapolis-Honeywell's Ordnance Division, Minneapolis, Minn.

Morton S. Klein, director of the newly established Directorate of Command and Control Systems of Electronic Communications, Inc., St. Petersburg, Fla. Named assistants to Mr. Klein: **Kenneth L. Carlson** for systems engineering; **Thomas H. Hardin, Jr.,** for planning and military requirements.

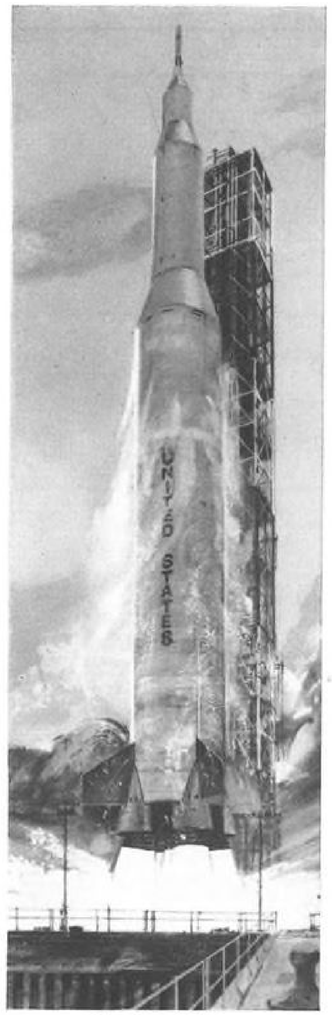
Jerry H. Werlin, product manager-digital systems, Canoga Electronics Corp., Van Nuys, Calif.

E. P. Klein, executive manager of engineering, Ling Electronics Division of Ling-Temco-Vought, Inc., Dallas, Tex.

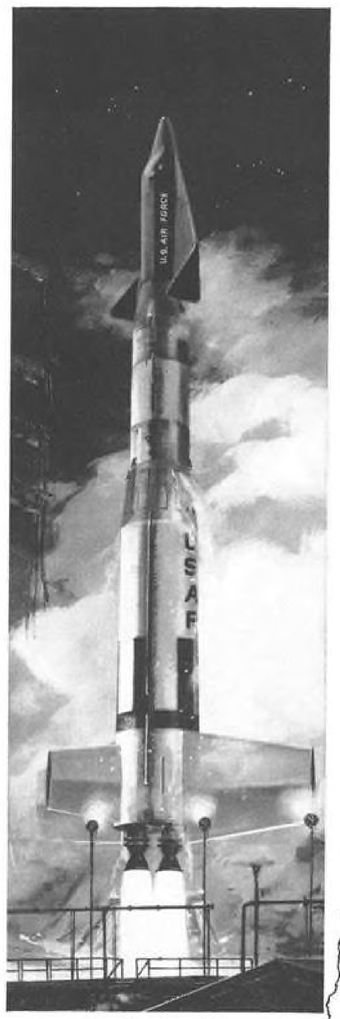
Dr. Howard S. Coleman, head, Physics Research, Melpar, Inc., Falls Church, Va.

I. R. Rector, district manager, Burroughs Corp.'s District Marketing Office, Washington, D. C., succeeding **Raymond W. Barry,** retired.

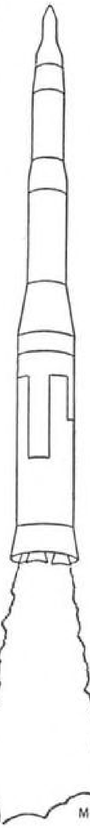
Dr. Roland H. Tanck, senior human factors engineer, Riverdale (Md.) Plant, ACF Electronics, a division of ACF Industries, Inc., and **E. G. Riley,** director of advanced planning.



Saturn Launch Vehicle



Dyna-Soar Space Glider


Minuteman ICBM

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Skiing near mild, evergreen Seattle

Beautiful homes line Seattle's 200 miles of shore

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The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.
Look in the forward section for additional Employment Opportunities advertising

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Selling Opportunities Wanted
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Communications electronics, commercial Pilot SMEL inst. 4400 hours diversified flying experience, 15 years experience in communications and electronics, experimentation to staff management. Resume on request. PW-1263, Aviation Week.

MBA (Marketing), BME (Aero), Naval Aviator, Flight Instructor. Seeking responsible opportunity. Aircraft or component marketing, technical sales, base operation, etc. Age 28, married, available June 1963. PW-1205, Aviation Week.

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AIRCRAFT FASTENER SALES DEVELOPMENT ENGINEER
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We make this suggestion in a spirit of helpful cooperation between employers and employees.

This section will be the more useful to all as a result of this consideration.

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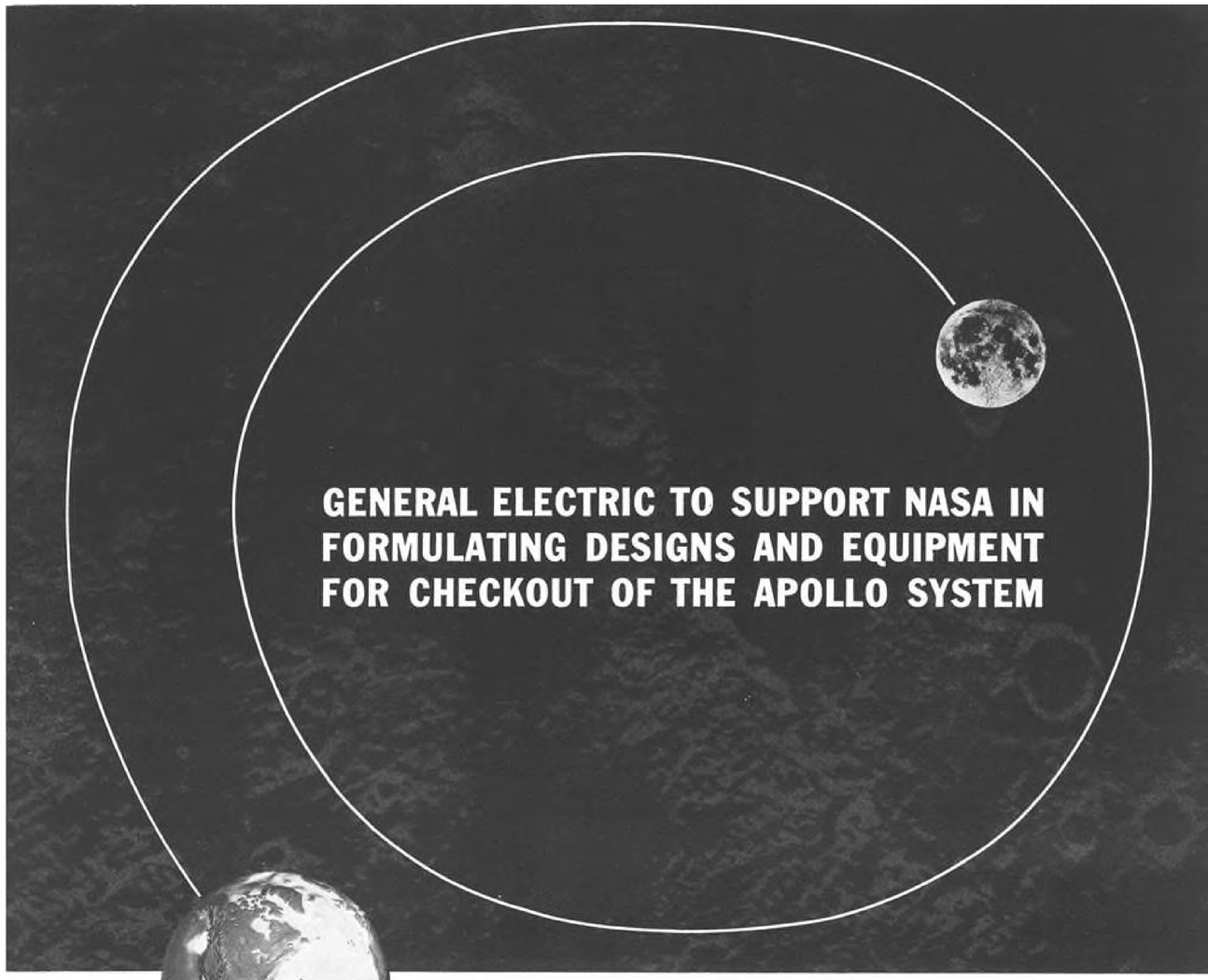
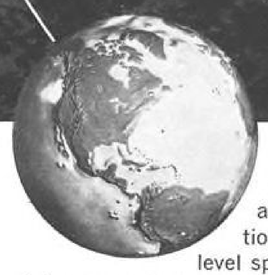
330 West 42nd St., New York 36, N. Y.



GENERAL ELECTRIC TO SUPPORT NASA IN FORMULATING DESIGNS AND EQUIPMENT FOR CHECKOUT OF THE APOLLO SYSTEM



The National Aeronautics and Space Administration has assigned to General Electric a major role in designing and developing integrated, automatic checkout and test equipment for the APOLLO program, in addition to supporting NASA in overall reliability of the entire system. High level specialists and systems people are being drawn from many components of the company to contribute to the design and development of computerized semi-automatic and automatic checkout systems. Additional highly qualified engineers and scientists are needed now.

Assignments at HUNTSVILLE, ALABAMA and CAPE CANAVERAL, FLORIDA

Engineering experience required in
SYSTEMS and SUB-SYSTEMS CHECKOUT and TEST PLANS, DESIGNS and OPERATIONS

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If you have experience in any of the listed areas, write us today (include salary requirements). Your inquiry will be held in strict confidence. Write to: Mr. P. W. Christos, Professional Placement, Section 64-WF, Apollo Support Department, General Electric Co., Administration and Engineering Bldg., Daytona Beach, Florida.

APOLLO SUPPORT DEPARTMENT

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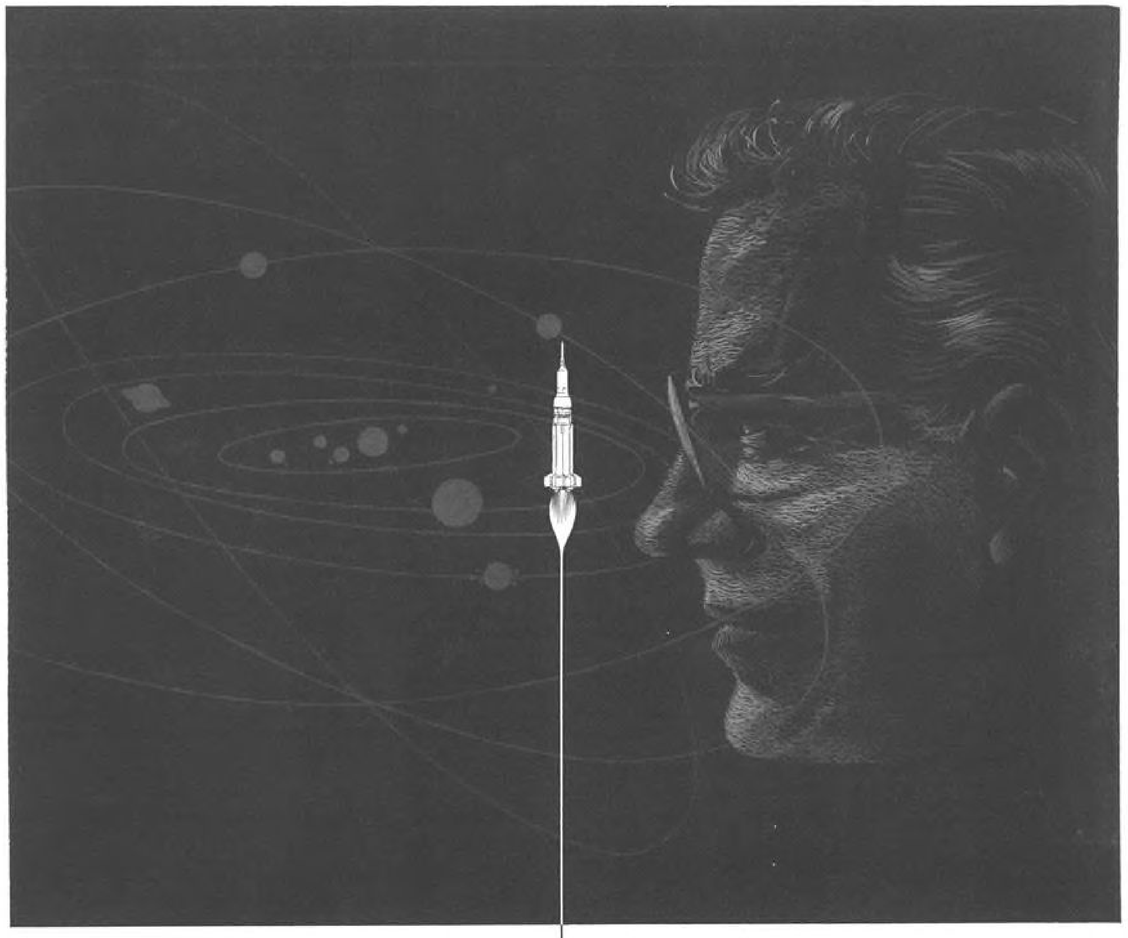

. . . challenge . . .

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The CHRYSLER Corporation SPACE Division, as a prime contractor in the SATURN S-I, C-1 Space Program, has responsibilities which include a broad spectrum of engineering technology. To these have been added tasks in ADVANCE ENGINEERING and PRODUCT IMPROVEMENT.

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- Excellent career advancement potential.
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CHRYSLER CORPORATION **SPACE** DIVISION

CAPE CANAVERAL, FLA. HUNTSVILLE, ALA. NEW ORLEANS, LA.

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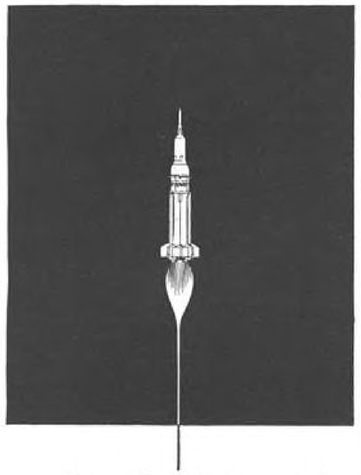

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ADVANCE ENGINEERING

. . . analyzing existing and proposed space systems designs to establish requirements and feasibility for initiating and developing new design concepts for future missions. Included are:

AEROBALLISTICS—to analyze launch, orbiting, re-entry, lunar and planetary systems by trajectory optimization, multi-stage vehicle performance analysis, flight evaluation and aerothermodynamic analysis. Disciplines include:

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SYSTEMS ANALYSIS—
OPERATIONS RESEARCH to establish requirements and missions for advanced space studies.

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SPACE DIVISION

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LEWIS RESEARCH CENTER

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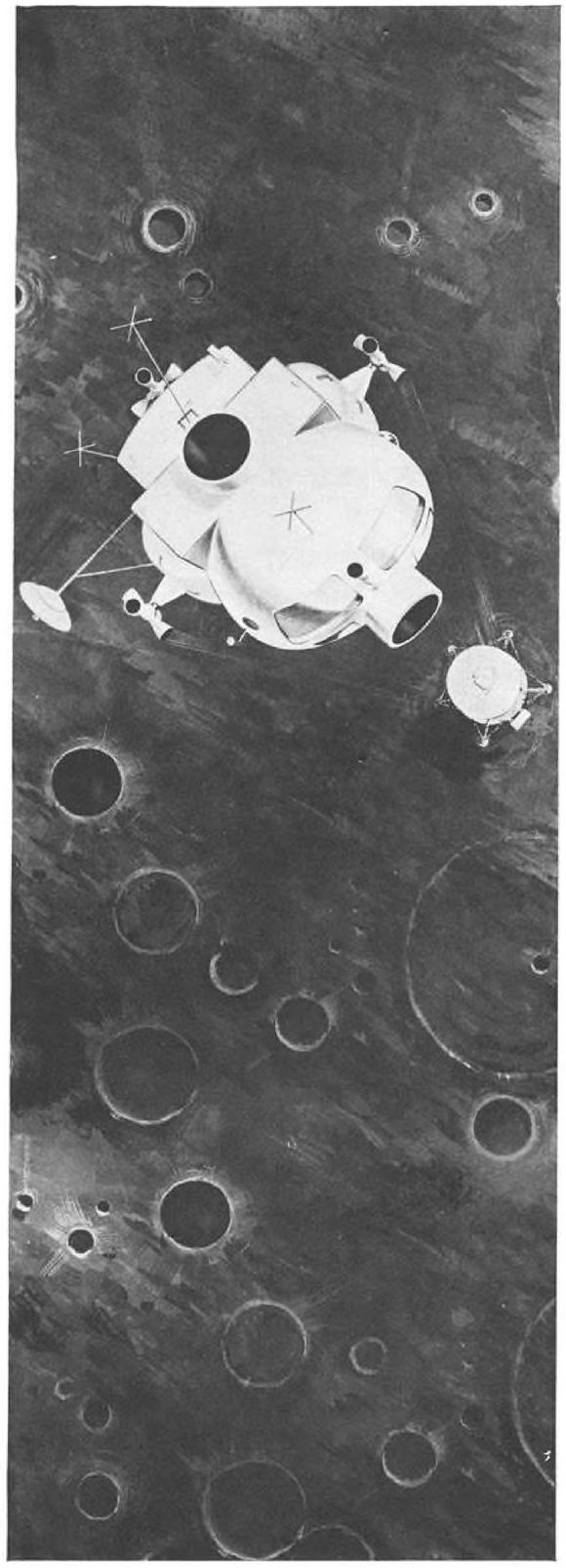

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LETTERS

Award Policy

Since it is increasingly apparent that major defense contracts are not awarded to the company whose proposal evidences superiority of design, management capability, or cost effectiveness, but rather are doled out on a geographical area basis for maximum political gain, I suggest the following change in government contracting policy:

1. Select the winning company before the Request for Proposal is circulated to the eligible bidders.

2. Immediately notify the selected company of the impending contract award.

Benefits to be derived from this plan are:

a. The companies not so notified would immediately realize that the Administration, in its Infinite Wisdom, had decided it is not in the "National Interest" for them to "win," this time. They would, therefore, submit only token proposals, thus saving millions of dollars in wasted effort.

b. The government could then award the contract to the selected company with a clear conscience, since they would, in fact, have submitted the best proposal (hopefully).

c. The incentive of the industry would not be crushed, since true sincerity on the part of the customer would be assured.

In all fairness, however, I must point out one drawback to this plan. The opportunities would be reduced for the government to extract the best ideas from the superior proposals (their companies' stock-in-trade) and pass them on to the "winner" for use in his design.

S. E. Smith
La Canada, Calif.

Technical Meetings

For some time now I have watched the barrage of opinion being voiced against the number and quality of technical meetings, most of which have been out of balance and lacked recognition of the main purposes of attending meetings.

A technical meeting is the only occasion which forces some of us to take the time to hear and recognize what is going on outside a specialized sphere of work, which is limited simply by the fact that you as a person or company are isolated from the rest of the field. Can anyone visualize a responsible person being able to otherwise isolate himself from the daily grind for days, let's say? Of course not.

I have found by attendance at meetings that there has yet to be an ocassion on which I did not come back with a gold nugget, of value—in some new technique, idea, or understanding new acquaintance. It was at such an occasion, for example, that I finally recognized an Air Force captain's needs for help on a major technical problem which subsequently resulted in an RFP of technical and monetary significance.

At times there simply are no other ways in which you can hear the policies of or meet responsible people. Even if an invitation were extended, the money and time required for individual appointments would be far in excess of that required for meetings.

As long as statistical distribution exists, the quality of material presented at meetings also will vary. That is not to say that nothing can be done to improve the level of papers; the technical level is clearly the responsibility of the review committee, as should be the quality of presentation. The technical societies are surely not unaware of audio visual media techniques. A compulsory review of this phase would do much to raise the general acceptability of papers. The horrors committed upon audiences by accomplished scientific workers but unaccomplished speakers are well known to all of us.

The "politicking" phase of meetings is sometimes also labeled objectionable. This is a legitimate, inescapable, valuable and desirable part of meetings. We are all individuals and our personal progress is foremost. The opportunity for high professional association is what a company implicitly promises you and which you as a member of the technical community are entitled to.

Finally, it is one of the easiest things, if a company wishes, to check for value received. How many people in decision-making levels request, get or use written or oral trip reports or briefings; you can easily tell if you are getting your money's worth in reasonably tangible terms.

William Nagy
Seattle, Wash.

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.

Crash Corrections

The comments concerning the Malev Il-18 accident of Nov. 23, carried in your magazine (AW Dec. 3, p. 50), require us to point out several mistakes.

The article indicates the aircraft was making an instrument approach at Orly. No doubt a typing error explains this error since, in fact, it is at Le Bourget airport that Malev centers its operation, and it was on the main East-West runway at this airport that the approach was being made.

The meteorological conditions at the time of the accident were as follows: 2.8 km. visibility and 170 meters ceiling, that is to say 550 ft. and not 150 ft. as erroneously indicated in the article. Here again the error probably resulted from a conversion error or a mistake in transmission of the information.

The article states that the pilot "reportedly radioed, while on final approach, that he had doubts about landing conditions." In fact, the recorded tape shows that no such statement was made by any member of the crew.

Moreover, the aircraft which was making a non-monitored ILS approach was never warned that he was too low, contrary to your article. Finally, the aircraft struck the ground at 3.5 mi. from the runway threshold and not at 5 mi. as the article indicates.

I think these corrections might be worth pointing out to your readers.

G. Guillemin
Public Relations Director
Paris Airport Authority

Matter of Degree

Thank you for your fine review of our November, 1961, special issue, printed in the Dec. 3 issue of Aviation Week on p. 28. However, it would be appreciated if you would also print a correction to a very misleading and inaccurate statement caused by a typographical error here. Our presentation of maximum glide path angle, caused by the mountains, was intended to be the approximate value 5 deg., but was printed as 15 deg. The correct value is 3 deg. 22 min., but the practical, safe glide path angle for a landing approach on a heading of 90 deg. to 120 deg. into the landing site is about 5 deg., a value consistent with most foreseeable requirements.

I suggest that you print a correction, if possible, in order that NASA and Pentagon planners, who will more likely read your presentation than any we might make, can be informed.

J. R. Foote, Editor
Holloman Section
American Rocket Society, Inc.
Holloman AFB, N. M.

'Groundling' XF5U-1

I would like to set the record straight, from a historical standpoint, concerning a statement in your Dec. 10 issue (p. 26) that the Chance Vought XF5U-1 flew. Although a prototype was completed, and in 1948 successfully underwent engine runs, it never flew. The aircraft was about to be prepared for shipment to Edwards Air Force Base via the Panama Canal when budgetary problems plus the on-rushing jet age caused the Navy to cancel the project. A steel ball swung by a wrecking crane reduced one of the strangest fighter aircraft ever designed to a twisted mass of wreckage.

Another Vought project, the V-173, which embodied the same circular airfoil principle as the XF5U-1, did fly, however. This wood and fabric aircraft, powered by two 80-hp. Continental engines, was tested in the full-scale tunnel at Langley Field early in 1942 to determine its aerodynamic characteristics. Later that year, on Nov. 23, the aircraft was flown for the first time. During its 131-hr. total flight time the V-173 was landed at speeds between 30 and 35 mph. and attained a maximum speed of 150 mph. These flights proved the feasibility of Mr. Charles H. Zimmerman's radical theories on circular airfoils and contributed greatly to the subsequent design of the XF5U-1.

Daniel A. Nebrig
American Aviation Historical Society
Orlando, Fla.

∫ INTEGRATED CAPABILITIES FOR SPACE-AGE CRYOGENICS

"COLD NOSE"

The "cold nose" of this Air Products cryostat has achieved near-absolute-zero environments as low as 2.5°K (−455.2°F). Cryostat pictured is part of an Air Products closed-cycle helium refrigerator developed for Bell Telephone Laboratories under contract with the Army Ordnance Missile Command. The completely self-contained refrigeration system provides maser cooling without need for external supply of cryogenic liquids that boil away in open-cycle systems.

Today, Air Products manufactures a complete line of single- and multi-fluid cryogenic refrigerators. Applications range from the creation of ultralow-temperature environments for space chamber "cryopumping"... to cryogenic cooling of masers, infrared detectors, superconducting magnets, computer memory planes, and other electronic sensing devices.

Miniaturization of components — pioneered by Air Products — makes possible the application of cryogenic electronics coolers where compactness and light weight are prime requisites. Ability to engineer standard and custom components into "critical-performance" systems gives added flexibility in meeting specialized requirements of industry and government customers.

Customers benefit, too, from Air Products depth of experience in all phases of cryogenics . . . from initial development and design through on-site operations of large-scale cryogenic production facilities.

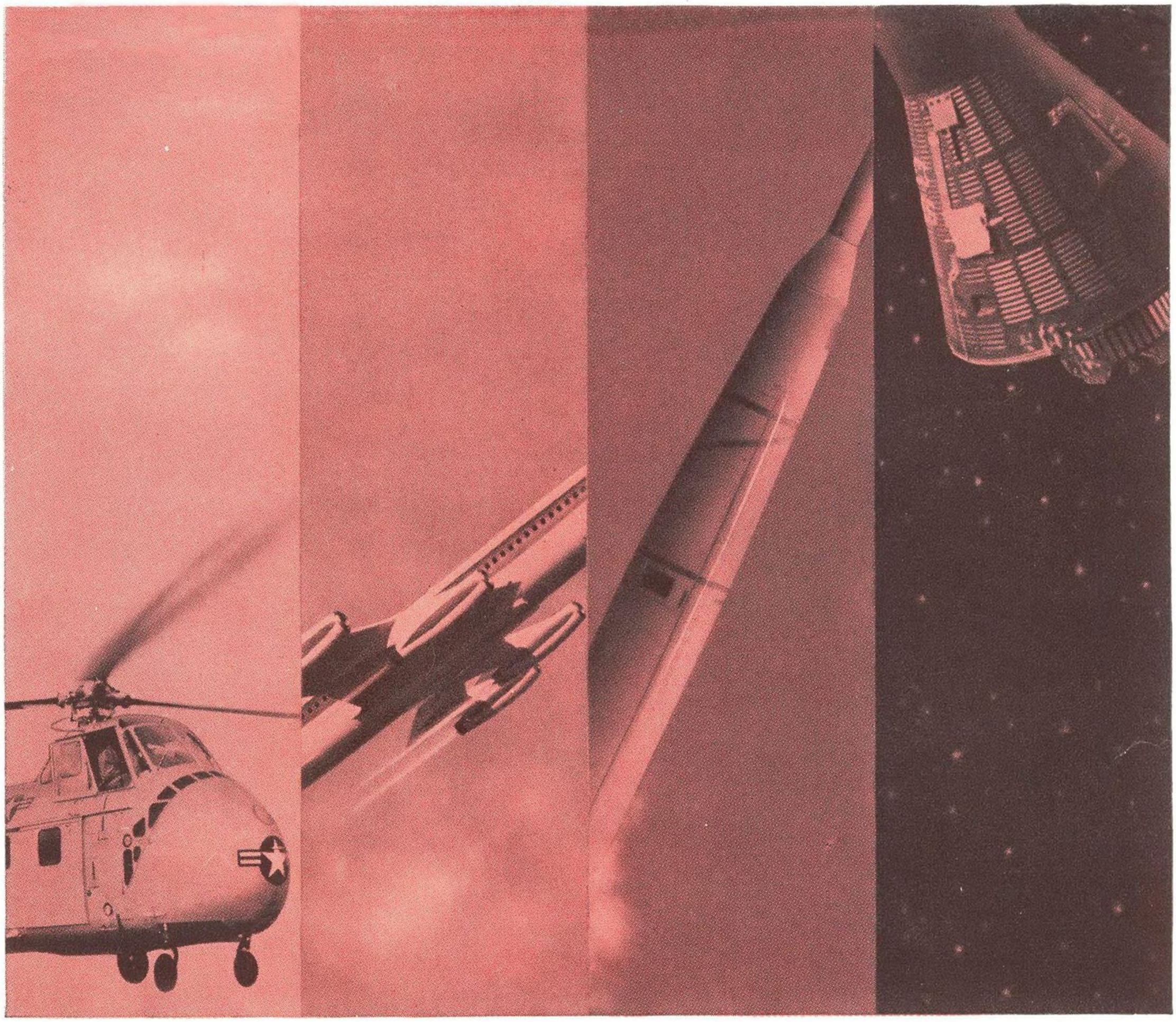
Whatever your requirements for cryogenic cooling, it pays to contact Air Products first.

Air Products and Chemicals INC.
Allentown, Pennsylvania

DEFENSE AND SPACE DIVISION

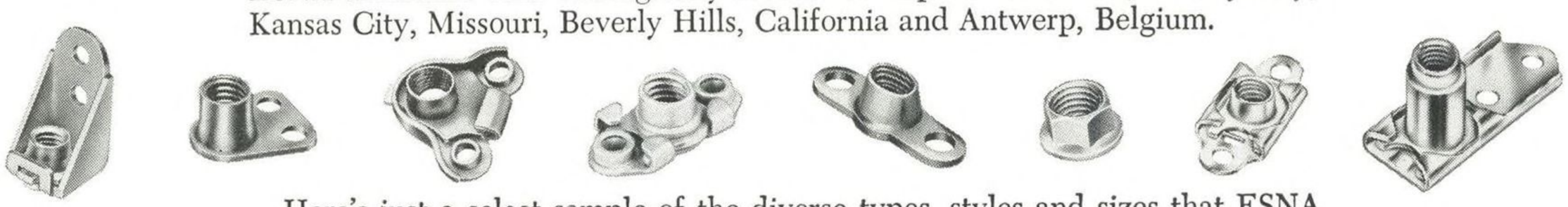
RESEARCH AND DEVELOPMENT
SYSTEMS ENGINEERING
DESIGN AND FABRICATION
CONSTRUCTION AND OPERATIONS
MANAGEMENT

JAN. 9 1963



There is an approved lightweight Elastic Stop® nut for whatever goes up!

ESNA, the innovators and world's largest manufacturer of self-locking fasteners for the aerospace industry, stocks over 80,000,000 pieces of lightweight Elastic Stop nuts (including all MS, NAS, AN types) for every type of air and space craft or avionic equipment. A complete product line that offers the economy and convenience of one source to meet the full range of fastener shape and size requirements of most design engineers! And, to assure constant availability, ESNA maintains four strategically located stockpiles in: Union, New Jersey, Kansas City, Missouri, Beverly Hills, California and Antwerp, Belgium.



Here's just a select sample of the diverse types, styles and sizes that ESNA produces and stocks as standards! To see the full ESNA line, write for your copy of the new ESNA VISUAL INDEX of miniaturized lightweight designs; high temperature designs and guaranteed high performance high tensile parts. (Nothing like it in the industry!) Dept. S78-125.

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