Aviation Week and Space Technology

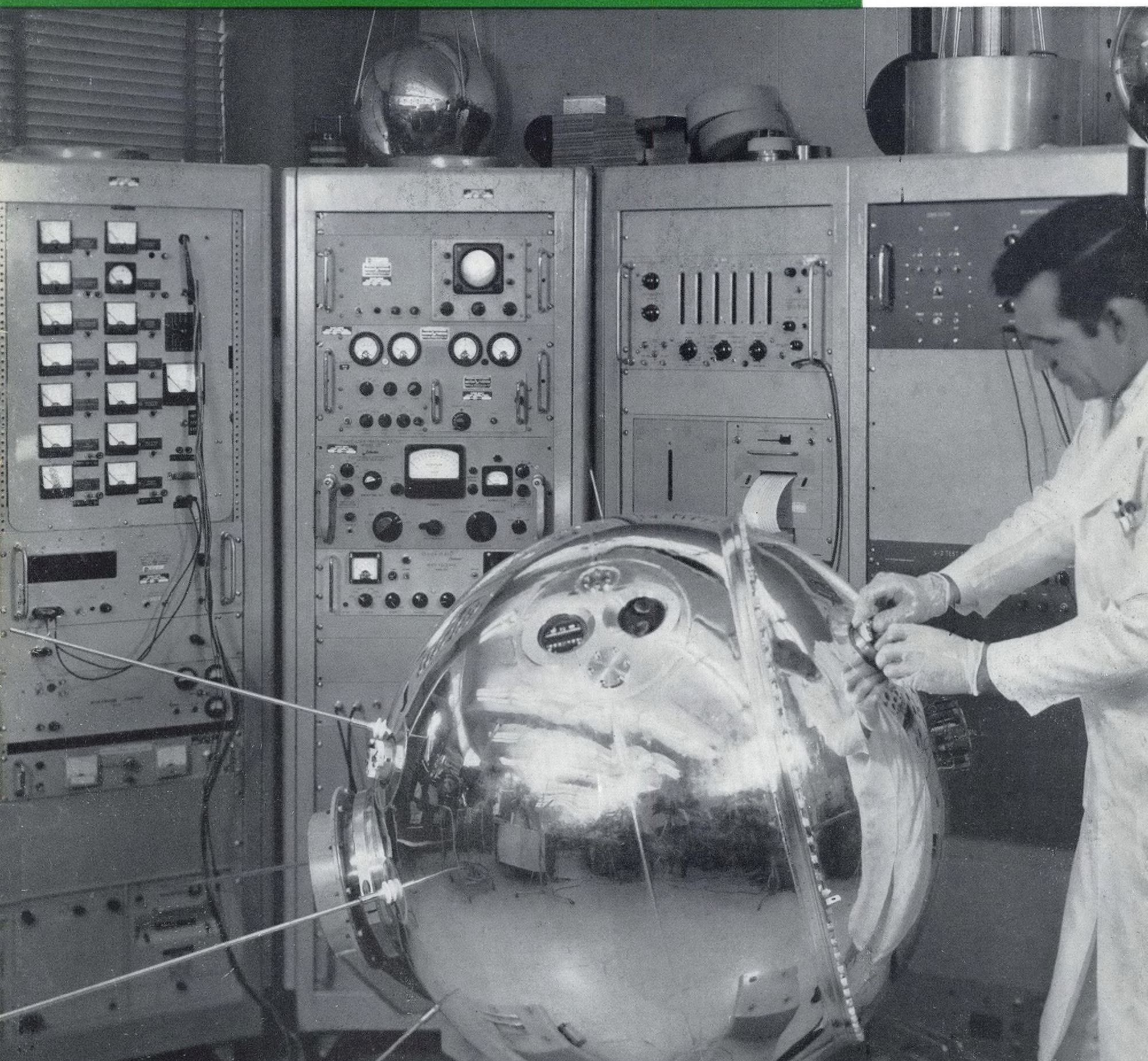
75 Cents

A McGraw-Hill Publication

January 1, 1962

S-6 Satellite Will Study Atmosphere

NASA S-6 Geophysical Satellite Prototype



AEROSPACE CALENDAR

Jan. 8-12—1962 Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit.

Jan. 9-11—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan. 16-18—Eighth Annual National Meeting, American Astronautical Society, Sheraton-Park Hotel, Washington, D. C.

Jan. 21-24—Annual Meeting, Helicopter Assn. of America, Marriott Motor Hotel, Dallas, Tex.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

Jan. 29-Feb. 2—American Institute of Electrical Engineers' Winter General Meeting, Hotel Statler and Coliseum, New York, N. Y.

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Depart-

(Continued on page 6)

AVIATION WEEK and Space Technology

January 1, 1962

Vol. 76, No. 1

Published weekly with an additional issue in December by McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator; Daniel F. Crowley, Vice President and Controller. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

Available only by paid subscription. Publisher reserves the right to refuse non-qualified subscriptions. Subscriptions to Aviation Week solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription orders forwarded to address shown in box below.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada, $8 one year. All other countries, $20 one year.

Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher, upon written request, agrees to refund the part of the subscription price applying to the remaining unfilled portion of the subscription—if service is unsatisfactory.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Aviation Week and Space Technology, 330 West 42nd Street, New York 36, N. Y.

AEROSPACE CALENDAR

(*Continued from page 5*)

ment of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 19-21—Tracking & Command of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section-Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston, Mass. Sponsor: AF Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

Apr. 16-18—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Symposium, Institute of the Aerospace Sciences, Salt Lake City, Utah.

Apr. 25-29—Western Space Age Industries and Engineering Exposition, Cow Palace, San Francisco, Calif.

January 1, 1962

Aviation Week and Space Technology

Vol. 76, No. 1
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) **Washington 4, D. C.**—National Press Bldg., Phones: NAtional 8-3414 REpublic 7-6630 **Los Angeles 17**—1125 West Sixth St., Phone: HUntley 2-5450 **Dallas 1**—1712 Commerce St., Phone: RIverside 7-9721 **European Office**—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63 **London Office**—34 Dover St., London W.1, England, Phone: Hyde Park 1451

COVER: Prototype of the National Aeronautics and Space Administration's S-6 geophysical satellite is being tested at Goddard Space Flight Center prior to launch next summer. The satellite will measure characteristics of the structure of earth's atmosphere. Details of experiments to be performed are on p. 56.

PICTURE CREDITS

Cover—NASA; 19—General Electric; 21—Dept. of Defense (top), Ralph M. Parsons Co. (bottom); 22—Fiat; 23—U. S. Army; 24—Sovfoto; 31—de Havilland; 32, 33—Arkia; 34, 35 (top)—Mohawk; 35 (bottom)—Sud Aviation; 56—NASA; 57, 58—Applied Physics Laboratory; 59—U. S. Air Force (top), U. S. Navy (middle), AT&T (bottom); 63, 66—Collins; 67, 69—U. S. Air Force; 70-72, 83—North American; 78, 79—Howard Levy; 81—R. F. Mackey; 86—Bolkow.

86,935 copies of this issue printed

EDITORIAL

Changing Patterns

This year will be characterized by basic changes in the patterns of business in the aerospace industry that will tax individual managements severely in sniffing out the initial indications of these shifts, and adapting their own operations to mesh with the new demands of their principal customers.

Since about 85% of the aerospace business is transacted with various branches of the U.S. government, the major impact on these changing patterns will come from the emergence of the philosophy, methods and executive personalities in the Kennedy Administration. This Administration, with a full year of grappling with the problems of organizing an effective political machine at the same time it was being belted solidly and repeatedly by international crises ranging from Cuba to the Congo, is now settling down into a pattern of attempting to seize the initiative and programing positive action instead of being confined to reflex responses to the stimuli of continued crises.

The aerospace industry will need considerable intelligence on these developments, swiftly and accurately transmitted, if it is to tailor its operations to meet the new requirements of the customer. At the same time, all of American industry, but the aerospace segment particularly, should be girding now for a tough battle with the Kennedy Administration along the entire front of the government-industry interface, with such key areas as patent policy and procurement regulations likely to be the hottest salients. Unless the aerospace industry develops a strong, legitimate position and effectively projects it to both the Congress and the American people, it is likely to come out of the next round of government battles badly tarnished and in a weakened financial position from which it could become extremely difficult to maintain the blistering technical pace required, with its managements reduced to messenger boys for the Pentagon.

AIA Needs Modernizing

In telling its solid story to the American public, the aerospace industry faces an admittedly difficult task for which there are no quickly conceived or easily executed solutions. But it is a task that must be undertaken immediately or the cumulative results over the next few years could easily be disastrous, both for the aerospace industry and the nation that depends on it. Certainly one of the places to begin this task is in shaking the musty mold out of the Aerospace Industries Assn. organization and adapting it to meet the industry's needs of today and tomorrow, rather than continuing in the well-worn ruts of yesterday. Fortunately, the new AIA president, August C. Esenwein, brings to his post a long background in practical engineering and management in the industry and is free from the constraints that inevitably inhibited the line of retired military officers who preceded him.

But AIA and the other trade associations such as the National Industrial Security Assn., the Electronic Industries Assn., etc., cannot do the whole job. If they have an aggressive and alert staff they can provide a considerable amount of the vitally-needed intelligence and staff work that must be the foundation of any solid industry campaign. But it will also take considerably more attention from the top managements in the aerospace field. In the past, these leaders have been overly concerned with playing a purely defensive game and making their points only when summoned before congressional committees with a hat-in-hand attitude. If this ever was effective strategy, and we personally doubt it, the time for it has long since passed and a more forceful and persistent strategy is required.

It will also require many of these leaders to subordinate their personal rivalries and prejudices in the interest of a more unified and thus more effective industry position behind the key redoubts that must be held against the impending assaults by government.

Merger Value in Doubt

Changing patterns loom also for the air transport industry, where the impact of jet technology and the economics of a mass capacity are in search of a matching mass market. We somehow feel that mergers, offered as a panacea for all that ails the air transport industry, do not really offer as much of a solution as they appear to now. The roots of the problems go much deeper and require much more fundamental analysis and action than merely combining individual airline problems under a larger tent.

Jet technology has provided the air transport industry with the finest and swiftest transportation in history, and it is the problem of airline managements and the government regulatory bodies that affect them to strive toward some basically new solutions that are as fresh and revolutionary as the technology that created them. The jet age has confronted the air transport industry with a revolution, not just another of the evolutionary steps that marked its progress for the past four decades. Its problems will not be solved without developing some radically changing patterns in operations, sales and management.

Thus it appears that 1962 truly will be a year of patterns changing horizontally across the entire spectrum of the aerospace field, and vertically within the individual organizations that constitute it as they react with varying vigor and intelligence to the problems that will inevitably confront them.

—Robert Hotz

WHO'S WHERE

In the Front Office

R. F. Ahrens, senior vice president and assistant to the president, United Air Lines, Inc. **C. M. Mason** succeeds Mr. Ahrens as senior vice president-personnel.

Albert J. Morris, president of Radiation at Stanford, Palo Alto, Calif., a subsidiary of Radiation, Inc., elected a director of Radiation, Inc., Melbourne, Fla.

Guy C. Shafer, vice president-planning, Chandler Evans Corp., West Hartford, Conn.

Col. Charles G. Patterson (USA, ret.), a director and vice president, Belock Instrument Corp., College Point, N. Y.

Edwin M. Hall, controller, Robertshaw-Fulton's Aeronautical and Instrument Division, Anaheim, Calif.

Honors and Elections

British European Airways Corp. has received the Flight Safety Foundation's Award of Merit, presented on behalf of AVIATION WEEK AND SPACE TECHNOLOGY for distinguished service in achieving safer utilization of aircraft.

Federation Aeronautique Internationale has been named the recipient of the International Civil Aviation Organization's second Edward Warner Award, given for outstanding contributions to the development of international civil aviation.

Raymond A. Pepping, manager of Advanced Engineering Spacecraft Systems for McDonnell Aircraft Corp., has been appointed to the Advisory Committee on Missile and Space Vehicle Aerodynamics for the National Aeronautics and Space Administration.

Alfred M. Bertolet, president of Reading Aviation Service, Inc., has been elected president of the National Air Taxi Conference for 1962.

Frank McGinnis, director of reliability and quality control for Sperry Gyroscope Co., has been elected 1962 chairman of the Aerospace Industries Assn.'s Quality Control Committee.

Changes

Robert E. Plummer, chief engineer, Radiating Systems Division, Electronic Specialty Co., Los Angeles, Calif.

Dean Barton, chief engineer, and Charles S. Smith, senior project engineer, Instrument Division, American Electronics, Inc., Culver City, Calif.

Roy Myer, manufacturing research manager, The Boeing Co., Wichita, Kan., and **Harold Bales,** chief of tool engineering.

C. P. Ballard, chief engineer, Minuteman Systems Management Division of North American Aviation's Autonetics Division, Downey, Calif.

Martin Marietta Electronic Systems & Products Division, Baltimore, Md., has announced the following appointments: **Jacob C. Rubin,** manager, Standards Engineering Section; **William W. Jacquish,** senior sales engineer-research and development programs; **J. Dean Meyer,** sales manager-manufacturing contracts.

INDUSTRY OBSERVER

► Medium-range ballistic missile (MRBM) development scheme is expected to call for associate contractors for such areas as systems integration, propulsion, guidance, launch control, and re-entry body. At least 500 missiles up to 25 ft. in length are expected to be built. Transporter-launcher vehicle consisting of a truck and a trailer probably will have four-wheel drive for operation over European terrain and will have to include all environmental controls.

► **USAF's Aeronautical Systems Division is planning to initiate an industry study of high frequency masers—devices which could generate continuous wave outputs around 100 kmc. and higher. These devices might provide useful outputs in the high-frequency end of the millimeter wave region well above top oscillating frequencies of present microwave masers and well below those of optical masers.**

► National Aeronautics and Space Administration has tentative plans for a polar-orbiting atmospheric structures satellite but will not make a final decision until results of the flight of its S-6 satellite (see p. 56) have been analyzed.

► **Decision may be made early this year on whether to equip the Shillelagh anti-tank missile with an optical beam-riding guidance system which Aeronutronic Division of Ford is investigating for the Army. Missile would home on the narrow beam of light provided by an optical maser (laser). System of this type would be hard to jam and could provide a fine resolution in selecting targets (AW Oct. 9, p. 19).**

► Industry is submitting proposals to USAF's Aeronautical Systems Division for investigation of dynamic scale model techniques for testing nose cone-type escape systems under high altitude supersonic and re-entry conditions. Test regime probably will use nose capsule models ejected at extreme altitudes.

► **Naval Ordnance Test Station at China Lake, Calif., will award a contract soon for engineering assistance on its multi-million dollar Advanced Research Projects Agency infrared and ultraviolet measurement study, known as Tabstone (target and background signal-to-noise evaluation) (AW July 17, p. 77). Study is aimed at providing useful data obtained from rocket firings on infrared and ultraviolet characteristics of ballistic missile launchings.**

► Despite the compressed time period imposed on Air Force for selecting a contractor for the Air Force-Navy TFX tactical fighter, project office at Aeronautical Systems Division expects to meet the Feb. 1 deadline. USAF has been working on the project in its various forms for more than two years and machinery for evaluation was already in being when six bidder teams made presentations on Dec. 12 and 13. Defense Secretary Robert S. McNamara has flatly ordered USAF to sign a letter contract by Feb. 1.

► **Among the possible backups being considered by NASA's Marshall Space Flight Center for the Saturn C-4 and other large liquid-fueled space boosters is a vehicle using 156-in. dia. solid propellant motors. Tradeoff would be one 156-in. motor for one 1.5-million lb. thrust Rocketdyne F-1 liquid-fueled engine. A cluster of four of these solids would weigh 4 million lb. and could boost 180,000 lb. into a rendezvous orbit, using the same upper staging as the liquid-fueled C-4.**

► Ballistic missile boost intercept (Bambi) studies being conducted for USAF by General Dynamics/Astronautics and Space Technology Laboratories do not allow for experimental verification of satellite's ability to acquire a target missile during its powered phase or its ability to intercept the missile.

► **Proposals for an analytical and experimental program to investigate plasma jet propulsion technologies are being submitted to USAF's Aeronautical Systems Division. Goal is to pinpoint critical problem areas and develop solutions, using the results to lay a foundation for propulsion systems with broad operating characteristics.**

Washington Roundup

Manned Spacecraft

A careful new look is being taken at the military potential of manned, maneuverable space vehicles. A "white paper" on the subject is being prepared now in the office of the Director of Defense Research and Engineering. It will be used by Secretary Robert McNamara in reaching his own decision on how much of a military requirement really exists in this area and to support his discussions with National Aeronautics and Space Administrator James Webb on the general military role in the national space program.

The potential of flyable military spacecraft has been reviewed recently by the Keese Committee (AW Sept. 11, p. 21), which attempted to formulate a unified Air Force position on space, and in a special study done by the Institute for Defense Analyses. The Air Force position was presented to McNamara in November (AW Nov. 6, p. 25), before the joint NASA-Defense committee on large launch vehicles had finished its work. Since the boosters that will be available affect the missions that can be performed, the new review may be somewhat in the nature of a follow-up to the earlier studies.

Two other developments indicate a brighter outlook for manned military spacecraft—Defense Department's acceptance of a partially accelerated Dyna-Soar project (see p. 18) and NASA's intention to cooperate more fully with all levels of the military establishment on manned space flight and rendezvous (see p. 16). They also indicate that the growing pressure from Congress and the Administration may at last be reducing some of the inter-agency rivalry that has been one of the more obvious aspects of the space effort.

Tardy Budget

A few key decisions were still to be made on the Defense Department budget for Fiscal 1963 late last week, in spite of reports that President Kennedy had completed work on it. The budget is now three weeks beyond its normal closing time. Secretary McNamara and the Joint Chiefs of Staff are to meet with the President this week but not primarily on the budget question.

Supplemental Probe

House Armed Services Subcommittee's investigation of military use of the supplemental airlines, which is scheduled to run all next week, is not expected to result in proposed restrictive legislation. Instead, the subcommittee probably will rely on corrective measures by Defense Department and on supplemental airline legislation that already is pending before the House and Senate commerce committees.

But the hearings are bound to influence the legislators, who will decide this year what over-all role supplementals should play in the transportation field. Chairman Mike Monroney of the Senate aviation subcommittee, which fashioned the Senate's pending bill, is expected to argue that the supplementals can become safe only after they are given the type of permanence his bill would provide.

The change in the legislative atmosphere followed the Imperial Airlines crash last Nov. 8, which killed 74 Army recruits. Civil Aeronautics Board's subsequent investigation revealed many questionable practices, particularly in maintenance (AW Dec. 18, p. 103). The crash affected the entire supplemental airline industry at the very time when it was having internal organizational difficulties, and one result is that a number of carriers are leaving the Independent Airlines Assn. to form a new group.

No Imperial witnesses will be called because CAB has thoroughly investigated the airline and because legal claims are pending against it. Air Transport Assn., representing the major scheduled airlines, is prepared to testify. Leadoff witness probably will be Thomas D. Morris, the assistant secretary of defense responsible for transportation policies. He will be followed by Army and Air Force officers, then private groups. The hearings are likely to impel Defense Department to make permanent many of the changes it ordered shortly after the Imperial crash. A major feature of that order gave Military Air Transport Service authority to decide which supplementals the military would use.

New Shelter View

An insight into the responsible opposition that President Kennedy's fallout shelter program may encounter in Congress this year is contained in an American Assn. for the Advancement of Science Committee report presented to its annual convention last week. It said that "any shelter system short of one that places the nation's entire population and industry permanently underground can be negated by a corresponding increase in the attacker's power. . . Our problem is not the prevention of a particular war but the continuous protection of human society from a potential danger that will in the foreseeable future continue to threaten the human species with extinction."

Exploratory merger talks between American and Eastern airlines have not moved to the negotiating stage. Both airlines also have investigated the possibility of merger with other carriers—further indication that Civil Aeronautics Board Chairman Alan Boyd's attitude on mergers and the pressure of declining revenues are being taken very seriously by all the major trunklines.

—Washington Staff

Space Flight Coordination to Be Increased

NASA, Defense to establish parallel groups at all levels on manned effort, exchange rendezvous data.

By Edward H. Kolcum

Washington—National Aeronautics and Space Administration and the Defense Department will establish parallel groups on all working levels in manned space flight and are planning a continuous exchange of information in development of the rendezvous program.

Although the Air Force in the past has questioned NASA's dominant role in manned space flight, Brainerd Holmes, director of NASA's Manned Space Flight Office, believes the two agencies are now on the road to complementing the efforts of the other. Considerable attention was focused on the conflict at the end of the Eisenhower Administration (AW Nov. 28, 1960, p. 26; Dec. 5, 1960, p. 26), and many felt the conflicting issues stemmed from lack of liaison on the working levels (AW Oct. 2, p. 21).

Liaison between NASA and the Defense Department has been limited primarily to the office of the Secretary of Defense, and a common complaint has been a lack of machinery for NASA to deal directly with the services and commands that are actually doing the work in military space research and development.

Holmes, who came to his job Nov. 1, said he is demanding that his staff seek "anything to give us new knowledge," and he views effective management in the manned space program as dictating a working relationship where all NASA and Defense levels can routinely meet and exchange information.

This liaison, Holmes said, is necessary to ensure maximum national effort in all areas. Holmes looks for a true coordination with the Air Force in bioastronautics—which has been another area of conflict—through Brig. Gen. Charles H. Roadman, who is his director for Aerospace Medicine. Gen. Roadman is an Air Force physician who has been detailed to NASA.

An immediate benefit of closer liaison is expected in two rendezvous programs—NASA's two-man Mercury capsule and USAF's satellite interceptor (AW Dec. 18, p. 26). Although Phase 1 of the Air Force program is an instrumented interceptor, the second-generation vehicle is expected to be manned. The essential problems of both missions are identical in launch, intercept, approach, docking and sealing. Logically, development time can be cut and technical manpower conserved if these mutual requirements are accepted by both agencies.

The rapidly developing lunar program, for which more than $2 billion has been committed in the past few months, is bringing firm policy decisions. Holmes told AVIATION WEEK that the primary approach to the lunar landing mission will be with the rendezvous technique. This was the first official confirmation that NASA will follow the fundamental recommendation of the NASA-Defense Department Large Launch Vehicle Planning Group (AW Nov. 6, p. 26).

Recommendations of the group, called the Golovin Committee, are not binding, as was demonstrated by NASA's decision to use a five-engine cluster for the Apollo booster stage, rather than a four-engine cluster which the Golovin Committee suggested (see box).

Although use of the rendezvous technique will save an estimated six months in the lunar landing program, Holmes said, NASA must also develop the direct ascent Nova vehicle with a 12-million-lb. booster because rendezvous has not been accomplished or proven, and the lunar landing mission is not the final manned space flight goal. The Nova vehicle is now seen as the launcher for flights beyond the moon.

Decision to push rendezvous now makes it possible to schedule construction of launch complexes at the Atlantic Missile Range and test stands at the Mississippi Test Site. Test and launch stands will be designed and built for the Saturn C-5 launch vehicle first, and then for Nova. Six large vehicle launching complexes will be built at AMR which, with support facilities and real estate, will cost an estimated $885 million.

NASA plans to build three pads for the C-5, and three for Nova-class vehicles. It is possible that one of the Nova pads will be for solid propellant boosters, but no definite plans are being made for this facility because NASA looks on the solid Nova as a backup vehicle.

It is unlikely that the number of C-5 pads at AMR can be reduced below three for the rendezvous mission, because two will be needed for the mission, and one probably will be a backup and rescue launch facility.

North American Aviation Space and Information System Division, which won the award to construct two Apollo modules and to integrate systems, is now negotiating with NASA's Manned Spacecraft Center on details of the contract including negotiations for the fixed fee.

Holmes pointed out that the command and service modules to be built by North American can be used either for direct ascent or rendezvous. He said modification of the work statement to specify rendezvous will not materially change the work the contractor was to have done, even though direct ascent was specified in NASA's bid request.

Holmes feels that the fundamental problems in manned flight are:

- **Study and development** of rendezvous.
- **Effects on the crew** of prolonged weightlessness, followed by high reentry g-loads.
- **Effects of radiation,** and methods to avoid violent solar storms.

In the Apollo arrangement, most of the equipment will be wrapped around the crew to provide shielding against cosmic radiation, and NASA hopes reliable techniques will be developed to forecast solar storms.

New Space Group

Washington—Management council for the Office of Manned Space Flight has been formed by the National Aeronautics and Space Administration to coordinate work being conducted by field centers and NASA headquarters.

Chairman of the group, which will hold scheduled monthly sessions, is Brainerd Holmes, director of the Manned Space Flight Office. Council members are Robert R. Gilruth, director of the Manned Spacecraft Center, and his deputy, Walter C. Williams; Wernher von Braun, director of Marshall Space Flight Center, and Eberhard F. M. Rees, his deputy director for Research and Development; and the following program directors from Holmes' office: George M. Low, spacecraft and flight missions; Milton W. Rosen, launch vehicles and propulsion; Brig. Gen. Charles H. Roadman, USAF, aerospace medicine, William E. Lilly, program review and resources management, and Joseph F. Shea, deputy director for systems engineering.

Apollo Vehicle

Washington—National Aeronautics and Space Administration is expected to announce soon that the Apollo circumlunar and lunar landing launch vehicle will be a C-5 configuration, with five engines in both first and second stages and a single engine in the third stage.

A single C-5 will be used for circumlunar missions and two C-5s will be used for lunar landing flights after rendezvous and launch from earth-orbit.

First stage of the vehicle will be an S-1B powered by five Rocketdyne F-1 engines which produce a total thrust of 7.5 million lb. Boeing Co. will develop and build this stage. Second stage will be an S-2, powered by five Rocketdyne J-2 engines, with a total thrust of 1 million lb. North American is developing this stage. Third stage, using a single J-2, is designated S-4B and is being developed by Douglas.

The C-5 configuration will provide a moderate payload increase over the C-4, recommended by the Golovin committee, but will greatly increase reliability.

NASA Launch Vehicles

Vehicle	Booster	Second stage	Third stage	Fourth stage	Dia. (ft.)	Ht. (Ft.) (Less payload)	pad. wt. (lb.)	Performance 300-mi. orbit (lb.)	Escape (lb.)
Saturn C-1*	8 Rocketdyne H-1	6 P&W RL-10-A-3	2 P&W RL-10	.....	21.6	162	927,000	19,000	5,000
Saturn C-5	5 Rocketdyne F-1	5 Rocketdyne J-2	1 Rocketdyne J-2	.....	33	230	.....	.....	.....
Atlas D	1 Rocketdyne MA-2	.....	.....	.....	10	72	260,000	3,000	.....
Atlas Agena B	1 Rocketdyne MA-2	1 Bell 8096	.....	.....	10	98	275,000	5,000	750
Atlas Centaur	1 Rocketdyne MA-2	2 P&W RL-10	.....	.....	10	105	291,000	8,500	2,500
Thor Agena B	1 Rocketdyne DM-21	1 Bell 8096	.....	.....	8	86	123,000	1,600	.....
Thor Delta	1 Rocketdyne DM-21	1 Aerojet AJ-10-118	1 ABL X-248	.....	8	92	112,000	500	60
Scout	1 Aerojet Algol	1 Thiokol XM-33-20	1 ABL X-254	1 ABL X-248	3.3	65	36,000	150	.....
Advanced Scout	1 Aerojet Algol	1 Thiokol XM-33-20	1 ABL X-259	1 ABL X-258	3.3	65	36,000	250	.....
Titan 2	1 Aerojet XLR-87-AJ-5	1 Aerojet XLR-91-AJ-5	.....	.....	10	105	.....	6,000	.....

NASA Launch Vehicle Stages

Stage	Contractor	Propellant	Nominal Thrust (lb.)	Dia. (ft.)	Ht. (ft.)	Pad Wt. (lb.)
S-1	Chrysler	LOX-RP	1.5 million	21.6	81.6	1.5 million
S-1B	Boeing	LOX-RP	7.5 million	33	80	5 million
S-2	North American	LOX-H_2	1 million	21.5	74	.....
S-4	Douglas	LOX-H_2	90,000	18	40	.....
S-4B	Douglas	LOX-H_2	200,000	18.5	75	.....
S-5	GD/Astronautics	LOX-H_2	30,000	10	29	30,800
Centaur	GD/Astronautics	LOX-H_2	30,000	10	29	30,800
Delta:	Douglas					
AJ-10-18	Aerojet	WIFNA/UDMH	7,700	2.1	8.3	4,600
X-248 (Altair)	ABL	Solid	3,100	2.1	8.3	525
Algol	Aerojet	Solid	120,000	3.3	30.8	23,600
Castor (XM-33-20)	Thiokol	Solid	55,000	2.6	20.7	9,600
Antares (X-254)	ABL	Solid	13,000	2.55	11.1	2,700
Adv. Antares (X-259)	ABL	Solid	19,000	2.55	11.1	2,700
Adv. Altair (X-258)	ABL	Solid	5,000	2.1	8.3	525
Agena B:	Lockheed					
8096	Bell	UDMH	15,000	5	26	15,000
Atlas:	GD/Astronautics					
MA-2	Rocketdyne	LOX/RP	362,000	10	72	260,000
Thor:	Douglas					
DM-21	Rocketdyne	LOX/RP	165,000	8	63	108,000
Titan 2:	Martin					
	Aerojet	NO_2/Hydrazine-UDMH	430,000	10	....	.....
	Aerojet	NO_2/Hydrazine-UDMH	100,000	10	....	.....

* Saturn C-1 normally will be flown as a two-stage vehicle, with the S-5 third stage added for escape missions.

Propellants: LOX-RP—kerosene and liquid oxygen; LOX-H_2—liquid hydrogen and liquid oxygen; WIFNA/UDMH—white inhibited fuming nitric acid/unsymmetrical dimethylhydrazine.

Saab Developing GEM Prototype

Stockholm—Saab Aircraft Co. is developing a ground-effect machine for the Royal Swedish Navy with prototype delivery scheduled before the end of the year. Development cost is being borne by the navy, air force and the armed forces research establishment.

Designated the Saab 401, the vehicle will be used for investigation of operational problems connected with amphibious applications of ground-effect machines in Scandinavian waters, both summer and winter, according to the Swedish firm. It is intended for operation over water, ice and fairly smooth ground with gradients up to 15%.

The vehicle's enclosed cockpit will carry a normal complement of two. At maximum gross weight, however, it can accommodate a crew of four or two persons plus a stretcher.

Powerplant for the prototype will be a single 180 hp. Lycoming O-36-A1A engine. Maximum design speed is approximately 50 kt. Length will be about 21 ft., over-all width almost 7 ft.

Saab also has received formal air force sponsorship for development of its Saab 105 jet trainer which also will be marketed as a four-to-five place executive aircraft (AW July 3, p. 79). A company spokesman says the military plans to order more than 100 Saab 105s if the prototype meets specifications.

The Saab 105 will be an all-metal, high-wing aircraft powered by two Turbomeca turbofan engines of 1,540 lb. thrust each. The military version would be designed to carry 1,550 lb. of armament externally, and could be used as a light ground attack aircraft. Maximum speed at takeoff thrust will be 500 mph.; normal cruise speed, 400 mph. and range, 1,450 mi. at normal cruise.

Dyna-Soar Decision Ends Long Impasse

By Larry Booda

Washington—Decision to go directly to orbital flights with the USAF Dyna-Soar boost glider has ended six months of controversy in which Congress voted an extra $85.8 million to accelerate the project, the Defense Department withheld funds while it decided the project's fate, and Boeing Co., the prime contractor, used its own funds to keep the project alive.

Dyna-Soar, the most often reoriented project in the military space program, will now use the Titan 3 booster, whose exact configuration has not yet been completely determined (AW Dec. 25, p. 17).

The project is unique in one respect. It has received a go-ahead at the Defense Department level without the Air Force having to prove a military requirement for it. About a year ago, USAF was forced to try to justify the project by stating a military mission in order to keep the project alive, although it preferred to consider Dyna-Soar as an applied research project leading to future manned space flights in maneuverable vehicles.

Attempted Justification

This attempted justification was not well received by Defense officials, and further delay resulted. Now the project is being considered a research effort only, and any military missions, such as reconnaissance, that may result will be considered a bonus.

To speed the project, Air Force and Boeing earlier this year proposed a "Project Streamline" which eliminated the suborbital flights. The Titan 2 booster planned for these flights was not powerful enough to put what is now a 15,000-17,000 lb. vehicle into orbit, however.

NASA proposed use of its Saturn S-1 booster, a cluster of eight H-1 liquid propellant engines. Air Force, which wants a relatively uncomplicated workhorse booster, proposed a modified Titan 2 with a high energy stage added, or a Titan 2 with solid propellant boosters strapped to it as a first stage, which is now being called Titan 3.

Funds for study of the detailed design of Titan 3 were released in October. The study was begun by Martin Marietta on Nov. 1 and is expected to be completed by the end of this month. The exact configuration is not yet firm, but it appears that two five-segment solid propellant motors will be fastened to a Titan 2.

One reason for Air Force insistence on using the Titan 2 is that the upper stage has a re-start capability, which will permit adjustment of the orbit. Titan 2 also is relatively simple because it uses storable liquid propellants.

Some NASA officials pointed out that the Saturn S-1 is closer to operational status and that it has engine-out capability.

Air Force did not consider the engine-out capability an advantage because it said the orbit and speed of the Dyna-Soar vehicle will have to be so exact that any deviation would affect the re-entry angle, taking the vehicle out of the narrow temperature-speed corridor for which it is designed.

Program Reorientation

Reorientation of the program will delay a first flight somewhat but will permit an orbital flight two years earlier than originally estimated. The vehicle will require very little modification for use with the Titan 3. It will weigh more, principally because attitude control will be necessary over a greater period of time.

Work on Titan 2 booster concepts for use with Dyna-Soar has been performed by about 1,000 persons at Martin Marietta's Baltimore plant. They now are performing the Titan 3 booster study and are continuing work on Titan 2 space applications for NASA and Air Force.

Although the Titan 2 has been dropped as a Dyna-Soar booster, it still will be used by USAF for space missions, especially in conjunction with the Lockheed Agena D stage. This booster is sometimes called Titan 2½ because of the high energy upper stage it uses.

The Dyna-Soar program began in 1954 with studies. Early in 1958, Air Force chose teams headed by Boeing and Martin to perform detailed studies that would lead to a development contract. This lasted until the spring of 1959.

In November of that year Boeing was chosen to develop the glider and Martin the booster.

Although both teams had proposed use of a glider, Defense Department's research and engineering office raised the question of whether the vehicle should be a glider or a semi-ballistic shape and whether technical aspects had been studied carefully enough.

To determine which shape was preferable, Phase Alpha was interjected into the program ahead of any development work.

Ballistic shapes with a lift-drag ratio of zero, semi-ballistic shapes with some lift, and gliders were extensively investigated. Re-entry suggestions included folding wings, inflatable structures and use of a modified X-15.

Phase Alpha Documents

Phase Alpha produced a stack of documents 13 ft. high and concluded that the vehicle should be a glider weighing approximately 10,000 lb., with a lift-drag ratio of between 1.5 and 2.5 to 1.

After development began, it became apparent that the weight of the vehicle would not permit the Titan 2 to boost it into orbit. Project Streamline was proposed and accepted by Congress, but the extra $85.8 million was rejected by the Defense Department. This was followed by the most recent reorientation, which accelerates the project to some degree but without benefit of the extra money.

Handley Page Denies Merger Talk

London—Handley Page last week discounted rumors that it would join forces with another British aircraft firm in line with the United Kingdom's policy of grouping the industry.

A Handley Page official told stockholders at the annual meeting that no negotiations are under way at the present time.

Handley Page has been approached by both British Aircraft Corp. and Hawker Siddeley Aviation with merger offers. Objective has been a possible Royal Air Force order for Handley Page Dart Heralds as a military transport. Russell said no offer has been satisfactory for the board to put to stockholders.

In another grouping move, Bristol Aeroplane Co., essentially a holding company with interests in Hawker Siddeley and Bristol Siddeley Engines, Ltd., joined with Westland Aircraft, the lone helicopter manufacturer, to offer about $12 million for share capital of the Fairey Co.

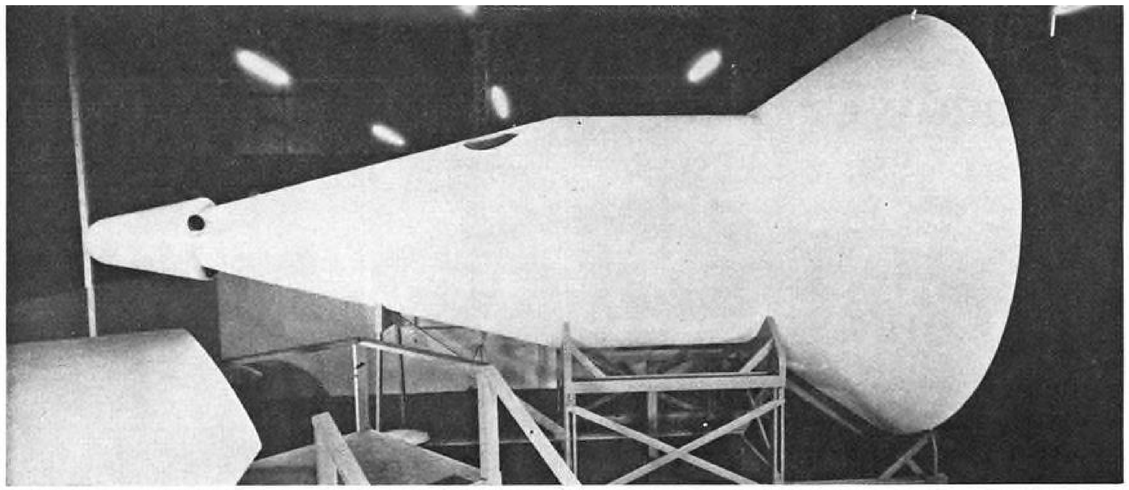
Proposed Deal

Deal would involve two Bristol Aeroplane common shares and two Westland commons for three Fairey common shares.

Fairey last year divested itself of its United Kingdom subsidiary, builders of the Rotodyne VTOL transport, to Westland.

Firm has other world-wide interests, including Fairey Aviation Co. of Canada and Australia, and Avions Fairey, of Belgium.

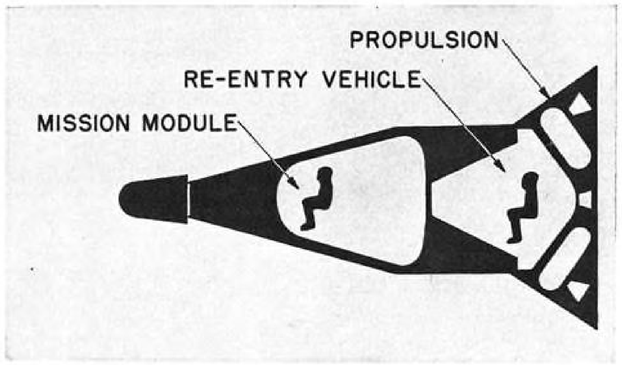
Offer is under advisement by Fairey directors.



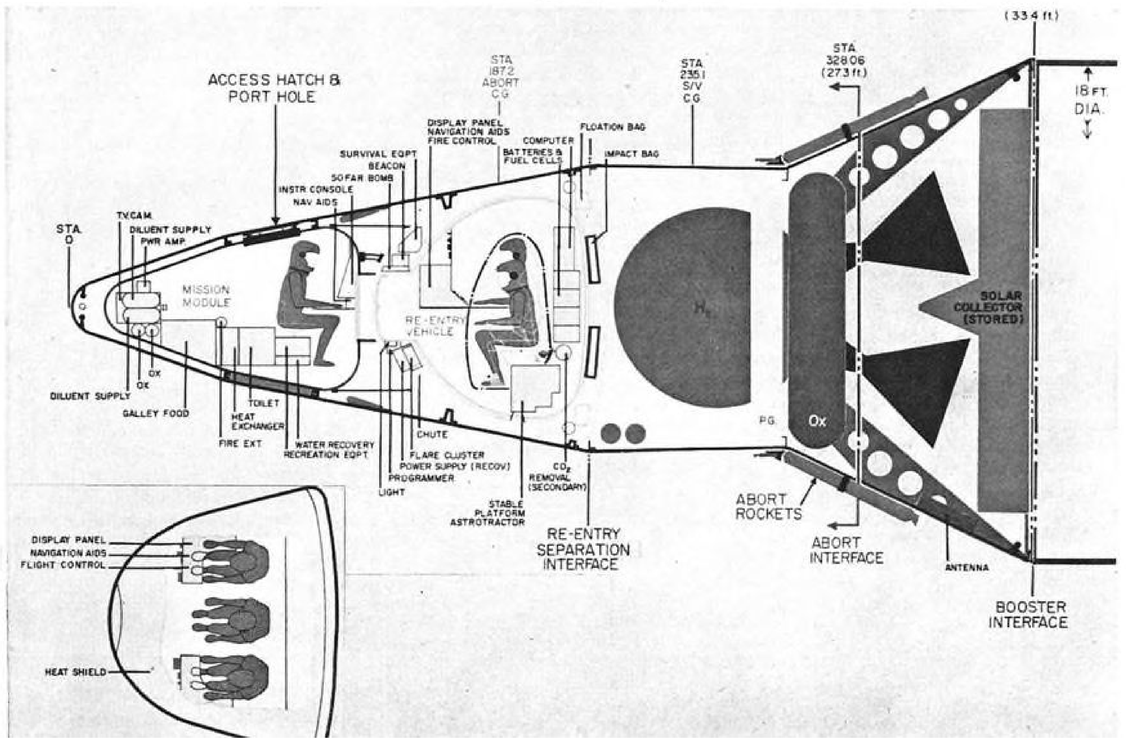
Full-scale mockup of General Electric Apollo configuration is 34 ft. long with an 18-ft. diameter at the flared skirt. Operational spacecraft would weigh approximately 18,000 lb.

GE Apollo Mockup And Configuration Detailed

Mockup and shadow drawing show configuration proposed by General Electric for the Apollo three-man spacecraft, one of a number of lunar spacecraft designs described by Dr. George R. Arthur at the American Astronautical Society Symposium on Manned Lunar Flight held Dec. 29 in Denver. The line drawing is a generalized spacecraft inboard profile. GE was one of three companies to conduct studies which contributed to Apollo specifications. Dr. Arthur managed the GE study effort.



Inboard profile of one lunar spacecraft design shows arrangement of equipment and subsystems. Cone cylinder flare configuration is stable during an abort maneuver. Torus fuel tanks take advantage of limited space, with abort rockets housed in forward section.



Kennedy Prepares Comsat Compromise

By George C. Wilson

Washington—President Kennedy is expected to plunge deeper into the communication satellite controversy within the next few weeks by sponsoring a bill designed to provide a middle-ground for the private vs. public ownership forces.

The bill, drafted by the National Aeronautics and Space Council and now awaiting the President's final approval, would allow private companies to operate the global communication system at a profit but would impose federal controls on them.

These controls are designed to protect the public interest as well as give the federal government authority to handle dealings with foreign governments. Guidelines for the measure were contained in President Kennedy's communication satellite policy statement of July 24, 1961.

That statement called for a communication satellite system with a "structure of ownership or control which will assure maximum possible competition." Those who drafted the bill for the President felt this ruled out the Federal Communications Commission recommendation to limit ownership to existing U. S. international telephone and telegraph common carriers. (FCC qualified its position by stating this ownership plan was "deserving of consideration and exploration as an effective means of promoting the orderly development and effectuation of such a system.")

The Administration's draft bill would broaden the ownership base beyond the international carriers and would limit the amount of stock any one company could own in the communication satellite corporation. These provisions are designed also to allay fears that the American Telephone and Telegraph Co., because of its very size, ultimately would gain control of the system.

Although the Administration bill is still subject to revision, indications are that broadening of the ownership base will be accomplished by selling communication satellite corporation stock to the public. Unlike the bill sponsored by Chairman Robert S. Kerr (D.-Okla.) of the Senate Aeronautical and Space Sciences Committee, the Administration measure would not empower the FCC to decide who should own the system. However, the FCC under the Administration bill, would have certain suppervisory powers over the corporation.

Patent Rights

Another controversial point—patent rights of those participating in the communication satellite system—is not covered in the draft bill. Administration leaders felt such a provision would only put new obstacles in the already rough road the President's bill must travel in Congress.

First, congressional leaders must decide what committees will have jurisdiction over communication satellite legislation. Sen. Kerr wrote his bill as an amendment to the National Aeronautics and Space Act of 1958, so it would be referred to his own committee. But the Senate and House Commerce Committees, which have jurisdiction over the Federal Communications Commission, contend they have jurisdiction over communication satellite legislation.

Once this jurisdictional question is decided, the congressional committees will have to consider proposals ranging from completely private to completely public ownership of the communication satellite system. And even though the issue is tremendously complicated, the space race with Russia is prompting demands for an early decision so the U. S. system will be the first in operation.

The House Science and Astronautics Committee, after holding hearings on communication satellites last year, issued a report stating that "being first with this practical application of space technology will result in great international prestige for the U. S. Accordingly, the research and development programs for space communications should be pursued with vigor. . . . The committee considers the rapid development of an operational system to be a fundamental national objective, the accomplishment of which must not be retarded pending final resolution of admittedly complex but nevertheless secondary considerations. . . . Questions bearing upon ownership and operation of a commercial system, such as business and financial arrangements, should not be permitted to delay the research and development phase."

So far, Administration and key congressional leaders have not met to help pave the way for the President's bill. The meetings probably will be held soon after Congress returns on Jan. 10.

An industry ad hoc committee recommended on Oct. 13, 1961, that a non-profit corporation of carriers be established to own and operate the communication satellite system (AW Oct. 23, p. 28). Chairman Emanuel Celler (D.-N. Y.) of the House Judiciary Committee said at the time that "by excluding domestic carriers, equipment manufacturers and other potential participants from ownership in the satellite portion of the system, these recommendations create the risk—indeed, the probability—of ultimate domination of the projected system by AT&T." He added that the proposal would conflict with President Kennedy's policy statement on competition.

Although the ad hoc committee proposal is still under consideration by the FCC, the fact the Kennedy Administration has written a far different proposal indicates the industry recommendations have been rejected by the White House.

Blast Detection Theory

Washington—Secret underground tests of nuclear weapons may be detectable because of the peculiar sound waves they create, according to Prof. F. Don Leet, director of Harvard University's seismological station.

Dr. Leet told Aviation Week the sound waves from the Dec. 10, 1961 underground explosions conducted in Carlsbad, N. M., as part of Project Gnome showed up differently on his seismograph than those from such natural disturbances as earthquakes.

He said this may lead to a breakthrough in detecting underground nuclear explosions. The next logical step, he said, would be to record these waves from nuclear explosions at varying distances to determine how reliable an indication they are.

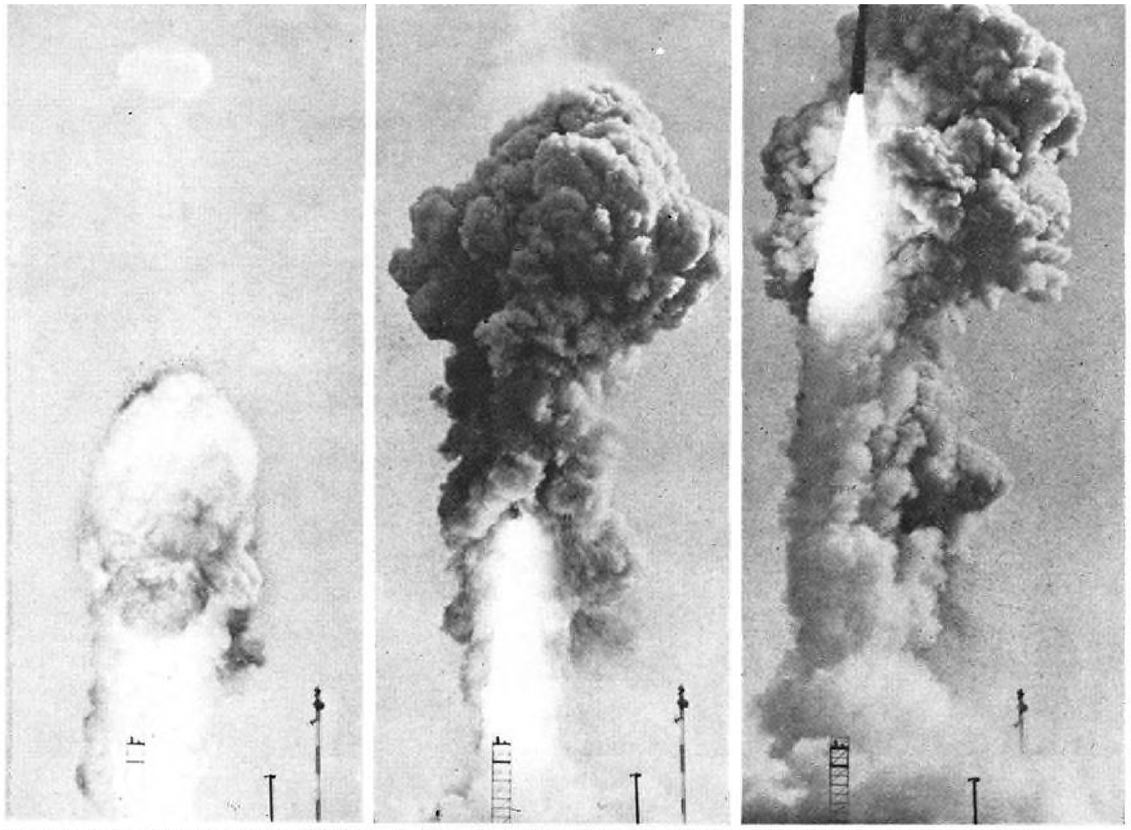
Current government detection efforts are concentrated on complex methods, he said, while this relatively simple and inexpensive approach is being ignored. He said the $225,000 it would take to evaluate this new detection possibility "is peanuts in comparison to what they've wasted already."

A spokesman for the U. S. Disarmament and Arms Control Agency said scientific officials in that body are interested in such detection possibilities. However, the agency has not yet hired its scientific director who ultimately will weigh such proposals.

Fallout Advice

Washington—Defense Department is to begin distributing 25 million copies of its booklet "Fallout Protection" this week. Free copies will be available to individuals at post offices and civil defense offices.

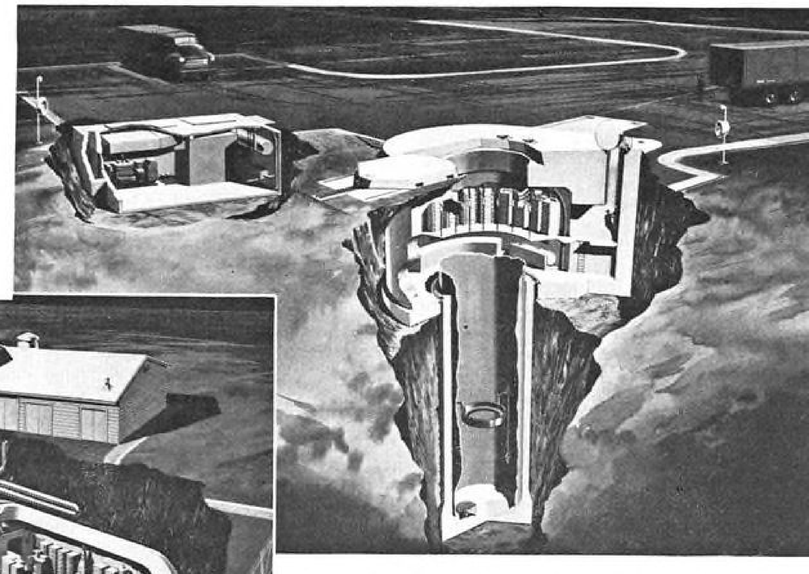
All calculations on blast, fire damage and fallout in the booklet are based on a bomb yield of five megatons. The booklet describes types of nuclear weapon explosions and their effects and suggests measures to protect survivors. The emphasis is on community shelters.

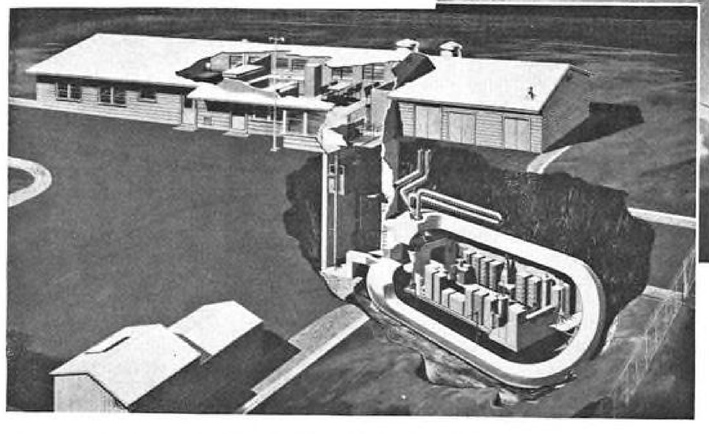


Sequence photos show Minuteman ICBM launch from silo at Cape Canaveral. Note exhaust gas smoke ring in first picture.

Minuteman Launch Silo Details, Test Firing Shown

Cutaway artist's drawing of Minuteman silos designed by Ralph M. Parsons Co. shows missile support ring about ⅔ of the way down the tube in drawing at right. Vertical member attached to one of the brackets is one of three spring and linkage connections to silo wall. Shock-mounted support equipment room is above launch tube. Below it are a motor generator set and bank of batteries. Separate building to left contains environmental control equipment and standby power. Normal power is from commercial source. The silo is about 78 ft. deep.





Launch control center is shown at left. It contains communications and monitoring gear and is shock mounted on four pneumatic spring cylinders. Access shaft at left contains both ladder and elevator. U-shaped pipe closes in the event of a blast so there is no air connection to the surface.

West German Fiat G.91T Trainer Displayed

Fiat G.91T two-seat trainer now being delivered to the West German Luftwaffe has configuration and armament of reconnaissance version of the NATO light tactical fighter. Vertical tail area has been increased slightly to balance nose area increase forward of the aerodynamic center. Vortex generators are installed at intersection of horizontal and vertical tail surfaces to improve local flow conditions and prevent separation due to expansion along the intersection. Armament is a pair of .50-cal. Browning machine guns. Trainer version first flew May 31, 1960 and is in production for both Italian and German air forces. Trainer performance is within a few percentage points of the fighter. Modifications to standard G.91 structure were made in forward fuselage only, involved no changes in primary structure elsewhere.

Economic Benefits of Disarmament Cited

By Katherine Johnsen

Washington—United States stated that "the freeing of research and development resources could be one of the most important economic benefits of disarmament" in a report submitted last week to the Secretariat of the United Nations.

The report is considered a preliminary document by the U. S., drawn with some haste in an unsuccessful effort to meet a Dec. 15 deadline. It will be part of the world-wide study on the economic repercussions of disarmament now under way by a 10-member consultative group appointed by the UN Secretary-General (AW Dec. 4, p. 32).

For the most part, the U. S. document presented to the UN basic statistics on defense employment and expenditures over the past decade, which have long been public information in the U. S. It noted that until the contours and timing of disarmament and the requirements of an international peace force are known, studies of the economic impact of disarmament can only be tentative and indicative.

The Soviet Union has stated that it will submit a similar document to the UN.

"Because the uses of the research and development resources which would be freed by disarmament are so important and so many, in this field, certainly, the economic benefits of disarmament would dwarf the problems," the U. S. report stated.

"The civilian economy would benefit especially from increased long-range research and experimentation with advanced technological possibilities of the sort that the research teams presently employed by defense industries have conducted so successfully."

The report noted that less than 10% of the U. S. gross national product is now for defense, compared with 40% during the height of World War 2, and stated that with sensible policies and advance planning, the possibility of any severe impact on the U. S. economy can be solved satisfactorily.

Specific Measures

Specific measures suggested in the report were widespread tax reductions ranging from personal income taxes to excess business profits taxes, a nationwide employment information service, and increased federal expenditures for public works, education, and social benefits.

The civilian space program was viewed as particularly suitable for the men and resources freed by disarmament.

"Strong programs to ease the problems of transition of labor and plant from defense to non-defense uses, combined with effective fiscal and monetary policies to maintain an aggregate demand, together would be able to keep the economic costs of disarmament small," the report declared.

The report noted that the state of Washington has a program to survey the dependence of industry in that state on military spending, to encourage firms to make plans for diversification, to develop plans for public works, and to evaluate the need for special assistance to firms and individuals in the event of disarmament.

"The planning for programs to ease the process of disarmament is the responsibility of state and local governments, business firms, labor unions and other organizations, as well as the federal government," the report said.

Since the U. S. could accomplish a transition to a peacetime economy without any serious drop in national income, the report said, the world economy would not be threatened by a loss of U. S. markets due to a recession in this country.

While anticipating an over-all increase in U. S. overseas programs with resources released by disarmament, the report observed that the elimination of U. S. military programs in continental Europe would be of net beneficial economic effect by wiping out the U.S. payments deficit with the region, thereby easing the current payments imbalance. The 1960 U. S. payments deficit with Europe was $870 million, compared with net military expenditures there of $1.4 billion.

The report noted that elimination of receipts from U. S. defense transactions to Canada—which amounted to $343 million in 1960—would have a substantial effect on Canada's fiscal position, but suggested that this situation, as well as adverse repercussions in other countries, could be alleviated by compensatory programs such as economic aid.

Three Nike Zeus Tests Include Intercept

Army's Nike Zeus anti-missile missile was fired three times within one hour from widely separated points in mid-December. One test included the intercept of another missile.

Features of the three tests, which the Army says were successful, were the following:

- **Intercept of a Nike Hercules** anti-aircraft missile over the White Sands, N. M. Missile Range.
- **Longest and highest flight** to date by a Nike Zeus, made over the Pacific Missile Range from Pt. Mugu, Calif.
- **First announced launch** of the missile from Kwajalein Island in the South Pacific.

The White Sands test pitted the Nike Zeus against the much slower Nike Hercules, whose top speed is 3,000 mph. After firing, the Hercules was tracked by ground radar and the Zeus launched to intercept it.

The intercept occurred after the Hercules had reached its apogee and was descending in a southeasterly direction. A direct hit was not scored but the miss distance was close enough that if the Zeus had been carrying a nuclear warhead it would have destroyed the incoming rocket, the Army said.

Interception of an intercontinental ballistic missile traveling five or six times as fast and which could possibly deploy decoys will pose a much more difficult situation for the Zeus. Next summer a Kwajalein-based Zeus will be launched against an Atlas ICBM launched over the Pacific Missile Range.

Nuclear Warhead

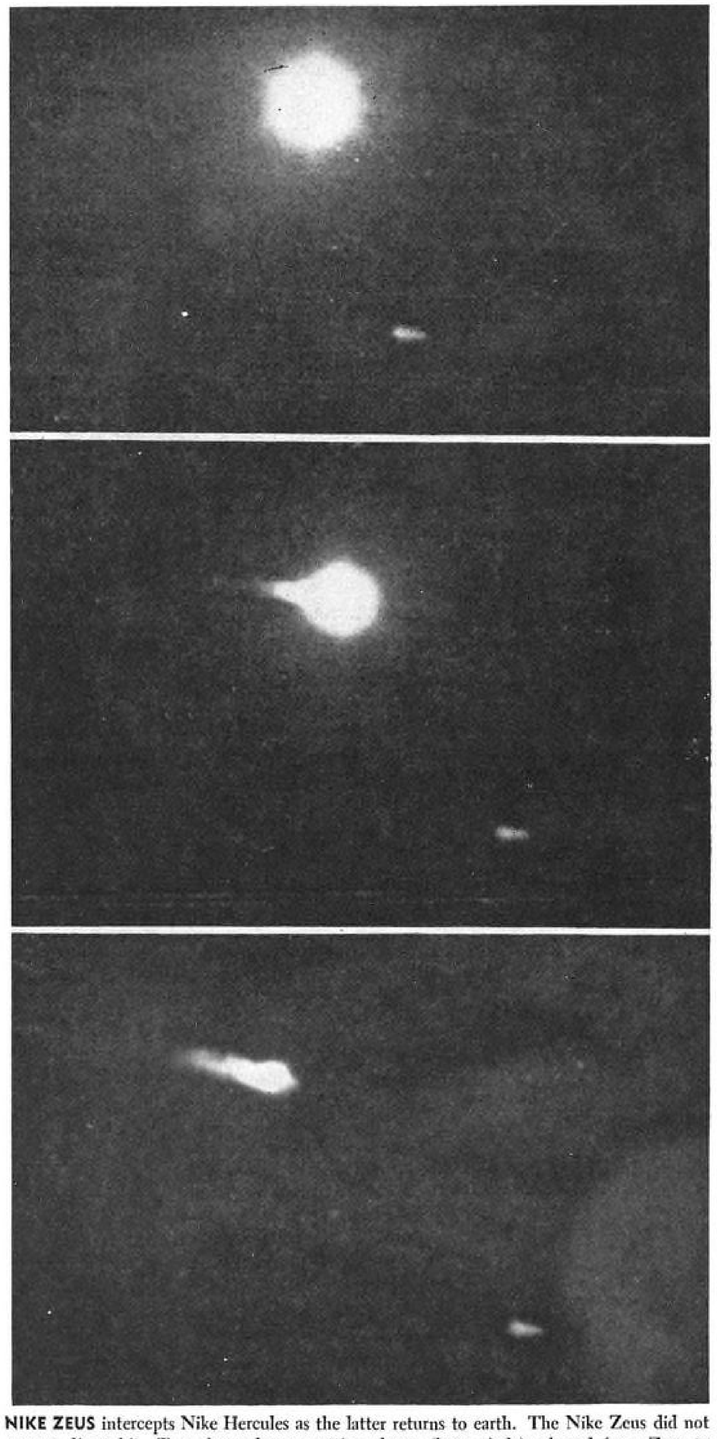
If the U. S. has authorized atmospheric testing of nuclear weapons by that time, it is believed that the Nike Zeus will carry a nuclear warhead when tested against the Atlas. If testing has not been resumed, conventional explosives will be carried in the warhead.

Zeus measures 45 ft. in length and has a solid propellant booster which develops 450,000 lb. of thrust.

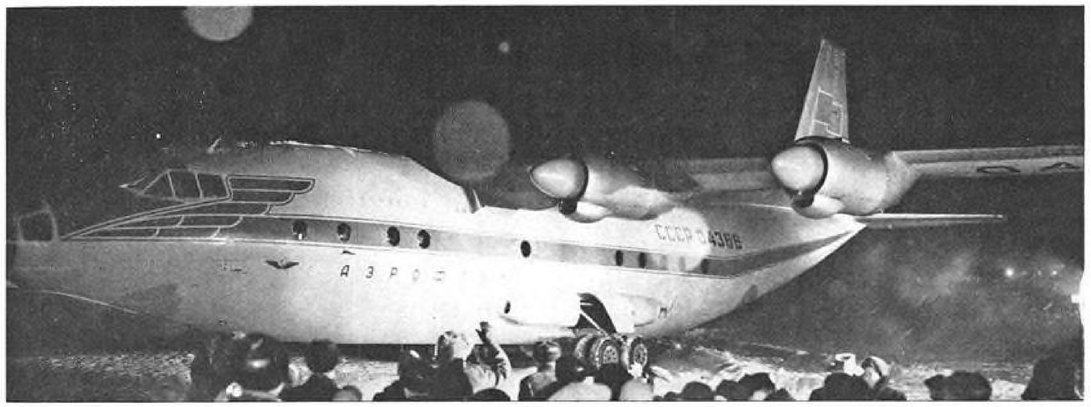
Scoring of the intercept at White Sands was made with electronic computer equipment. Altitude of the intercept and the miss distance were not revealed.

The Kwajalein installation will be used by the Army for the final development cycle of Zeus, in which ICBM nose cones will be intercepted.

System manager for Zeus is the Army Ordnance Missile Command, Redstone Arsenal, Ala. Prime contractor is Western Electric Co. System development is under Bell Telephone Laboratories, Douglas Aircraft Co. builds the missile and the solid propellant fuel is made by Thiokol Chemical Corp.



NIKE ZEUS intercepts Nike Hercules as the latter returns to earth. The Nike Zeus did not score a direct hit. Top photo shows spotting charge (large circle) released from Zeus to indicate closest point of intercept; lower photos show subsequent flight of Nike Hercules.



Russians Send Cargo An-10, Il-18 to Antarctic

Aircraft identified by the Russians as a cargo version of the An-10 (top), one of two aircraft sent by the Russians last month to establish a direct air service from Moscow to support Russian Antarctic bases (AW Dec. 25, p. 22), shows design variations with previous An-10 versions. Chin radome is about twice as large as those on either the An-10 or An-10A. The tail has greater upsweep, presumably to provide rear loading, and there are fewer fuselage side windows. Nacelles are similar to the An-10A, but the cargo version is missing the outrigger fins which the An-10A mounts on its horizontal stabilizer. The cargo version resembles the An-12 military version in general size and fuselage configuration, but does not appear to have the An-12's bulky tail turret. The Il-18 resembles Czech and Hungarian airline versions with three passenger windows ahead of the forward loading door instead of the reverse as seen on some Aeroflot airplanes. Bulges on engine nacelle inspection panels, partly open in photo, are new. Both aircraft carry markings of Aeroflot's polar service. Scene is prior to takeoff at Sheremetyevo Airport, Moscow. Il-18 landed in Antarctica Dec. 27 after a 16,000 mi. flight.

$15 Billion in Sales Are Forecast For Aerospace Industry in 1962

Washington—Sales by the aerospace industry are expected to total approximately $15 billion this year, according to USAF Gen. Orval R. Cook (ret.), outgoing president of the Aerospace Industries Assn.

Military aircraft sales and sales of turbojet-powered commercial transports are expected to continue to decline, as they did in 1961, but sales in all other categories are expected to increase, Cook said in the association's annual forecast and year-end review.

In the past, AIA has based its year-end statements primarily on sales of the 12 major airframe manufacturers. This year's statement does not mention these firms. Instead, it notes that "there are 51 companies identified as aerospace manufacturers by the Securities and Exchange Commission. Sales [for 1961] for these manufacturers, which parallel those for the industry as a whole, are estimated to show a $500 million increase to $13.5 billion.

"Earnings of these companies are estimated at $240 million for the year, compared with $184 million in 1960," AIA said. "The lower figure in 1960 was largely due to the write-off of losses suffered on commercial turbine-powered transports."

Average net profit, as a percentage of sales, continued to be about 2% compared with an estimated 4.3% average for all manufacturing industries, AIA said.

Backlog of unfilled orders continued to drop in the first half of 1961, reaching $14.1 billion as of June 30, but a reversal of this trend is expected either for the last half of 1961 or early this year, AIA said.

The industry is still "in a transition phase from serial production of aircraft to low-volume production of highly diversified and sophisticated flight devices for use both in and beyond earth's atmosphere," despite its continuing achievements, the association said.

More than one-third of the industry's effort now is devoted to research and development, AIA said. It also said that 50% of earnings after taxes for the first two quarters of 1961 was retained for investment in research and development facilities.

Other highlights of the annual report included the following:

- **Military aircraft production** declined from 2,700 units in 1960 to about 2,500. Missile procurement spending rose to an estimated $4.6 billion and this and space spending partly offset the drop in military aircraft sales.
- **Commercial aircraft, engines,** propellers and parts were estimated at $2.2 billion, compared with $2.5 billion in 1960.
- **Total commercial aircraft** production including helicopters is estimated at 7,050 units for 1961, compared with 8,181 in 1960. About 215 jet transports were delivered, compared with 241 in 1960.
- **Aeronautical exports** are expected to total $1.2 billion for 1961, based on statistics for the first eight months, but are not expected to reach the 1960 high of $1.4 billion, primarily because jet re-equipment of world airlines was completed in 1959 and 1960.
- **Utility and executive aircraft** shipments for 1961 will total about 6,800 units valued at about $180 million, compared with 7,588 for 1960, valued at about $200 million. AIA blamed this on the general business slump of early 1961.
- **Helicopter operators in Canada** and the U.S. increased from 193 in 1960 to 265 in 1961. The 265 operate 882 helicopters.
- **Employment,** which has been declining since April of 1957, reached 674,600 in September and is expected to remain at about that level this year.
- **Wages increased** from an annual average of $2.70 per hour in 1960 to $2.80 in 1961. Average weekly wages increased from $110.48 to $115.92.

Swissair 990s

Zurich—Swissair announced last week that it will take delivery on all seven of the Convair 990 medium-range jet transports it originally ordered in September, 1959, despite delivery delays and a present performance that falls somewhat below specifications.

Two of the aircraft will be leased for an initial four-year period to Scandinavian Airlines Systems as part of the team agreement under which the Swiss carrier has been operating four SAS-owned Sud Caravelle jet transports since the summer of 1960. SAS, however, is canceling its order with Convair for another two 990s as part of its effort to cut deficit spending commitments.

With deliveries originally scheduled for last April, the first aircraft is now due to arrive here next week. Another three will be delivered in January; the fifth and sixth, which will go to SAS, in February and March, and the seventh in July. To bolster range and speed performance, a series of Convair-proposed modifications will subsequently be made here by Swissair.

The Swiss airline will use the aircraft on flights to South America, the Middle and Far East; SAS on its southern route to Japan.

Boeing, Consortium Plan NATO Bids

Paris—Boeing Co. is joining France's Marcel Dassault Aviation Co. in a broad technological collaboration pact including common proposals in the North Atlantic Treaty Organization competitions for a V/STOL strike-reconnaissance fighter and medium-range transport as an initial step. Implementation of the agreement is subject to formal approval by the U.S. and French governments.

Specifically, Boeing will team with Dassault, Sud Aviation and the British Aircraft Corp. in supporting Dassault's proposal for the Mirage 3-5 in the NATO competition for a V/STOL strike-reconnaissance fighter. Dassault's transport bid, which Boeing presumably also will back, is a 70,000 lb. high-wing aircraft with a maximum speed of 400 kt. (AW Dec. 11, p. 23). Envisoned vertical-lift powerplants for both designs are Rolls-Royce RB.162s.

A joint statement by the two companies said licensing options are included in the agreement as well. No details were disclosed, however.

Atlas Shot Furnished Van Allen Belt Data

Washington—Scientific instrument pod carried on board Atlas 6F returned considerable data on characteristics of the lower Van Allen radiation belt. The data is being reduced and analyzed by Lockheed Missiles and Space Co.

The vehicle was launched Dec. 20 from the Atlantic Missile Range and contained a variety of sensors built with company funds. Objectives of the instruments were to measure the nature of charged particles, determine from what direction they come, and measure their velocities.

Lockheed furnished two proton counters, an electron counter and a magnetometer. The pod also carried a radiometer, electric structure sensor, micrometeorite detectors, and sensors for ultra-violet plume, alpha proton, fast neutron and charged particles.

Data from the flight, according to Lockheed, will contribute to the shielding design of manned space vehicles.

News Digest

Defense Department was expected to announce late last week that the McDonnell F4H turbojet fighter will become the standard strike-reconnaissance fighter for the armed services. It will be redesignated the RF-110 and supplant procurement of the Republic RF-105 in Fiscal 1963.

First USAF-Martin Titan 2 missile, which will be used as the booster for the two-man Mercury capsule and the core of the Titan 3, was captive fired under simulated flight conditions, including all elements of the ground and airborne equipment systems, at Martin Marietta's Denver test facility on Dec. 28.

Allison YT63-A-1 turboprop version of the 250-hp. free turbine engine completed its 50-hr. preliminary flight rating test Dec. 20. The engine mounted an Aeroproducts AF205F-272 propeller. The test followed by a month the 50-hr. PFRT of the engines turboshaft version (AW Dec. 25, p. 46).

Bell Telephone Laboratories last week reported continuous operation of a solid-state optical maser capable of generating infrared energy (10,650 angstroms). Device, which employs a single crystal rod of calcium tungstate with trivalent neodymium, could be forerunner of a series of high-power, continuous-wave optical masers suitable for space communications.

Elmer P. Wheaton vice president-engineering of the Douglas Aircraft Co., is resigning from the company, effective today. Wheaton was named to the position last July after serving as vice president-engineering, technical and vice president-engineering, missiles and space systems.

Bids will be opened Jan. 10 at the Jacksonville Army Engineers Office for extending the Saturn Complex 34 umbilical tower from the 27-ft. level to 240 ft. The project, expected to cost $900,000, is the final construction job for the Atlantic Missile Range Saturn pad.

Hi-Plains Rejected

Washington—Civil Aeronautics Board last week rejected the application of Hi-Plains Airways for temporary authorization to serve 32 Midwest cities, mostly in Nebraska. Board spokesmen indicated the denial will have no effect on the carrier's application for permanent certification as a new, third class of scheduled air service for the same area.

Future of Warsaw Convention in Doubt

International air law system periled by fight over accident liability limit; U. S. may denounce treaty.

By L. L. Doty

Washington—Fear is spreading through airline legal circles that the controversy within the Kennedy Administration over whether the U.S. should denounce the Warsaw Convention (AW Dec. 25, p. 25) may result in the dissolution of this first major uniform system of international air law.

The Convention, drawn up at Warsaw, Poland, on Oct. 12, 1929, and ratified since by 60 nations including the Soviet Union, sets international standards for passenger tickets, cargo waybills and other travel documents. It also establishes liability limits for passengers' death or injury and damage to baggage and cargo.

Most Convention opponents admit that their chief objection to the covenant is the liability clauses. They charge that the limit of $8,300 liability which the Convention imposes for the loss of life is unfair to the average American passenger; that it is far below standards of liability normally acceptable in U.S. courts.

Nearly all carriers of the International Air Transport Assn. back the Convention. But not all carriers support the Hague Protocol of 1955, which, if ratified by 30 nations, would amend the Convention to raise passenger liability limitations from $8,300 to $16,600.

Only 20 nations thus far have ratified the Protocol, since a number of countries feel $16,600 is too high. U.S. airlines, on the other hand, are firmly behind the Hague Protocol, since it not only doubles the liability limit but retains the uniformity of international law provided by the Convention.

President's Recommendation

The Kennedy Administration became interested because the President must recommend to the Senate whether or not that body should ratify the Hague Protocol. Failure to ratify the Protocol would not abrogate the Convention, in which case the lower liability limits would be retained. Neither of the opposing groups in the U.S., wants this.

Consequently, the Administration is exploring the practicability of denouncing the Convention, which would remove the liability ceiling entirely. Lawyers here say that there is no legal way in which the U.S. can adhere to the Convention and exempt itself from the liability limit.

The Administration's decision on denouncing the Warsaw Convention will be based in part on the recommendations to be submitted soon to the State Department by the Intra-agency Group on International Aviation, which has been studying the issues. The State Department will have its own recommendations to make to the President.

U. S. Carriers' View

U.S. airlines have been waging a vigorous campaign against denunciation. They have emphasized that U.S. leadership in the development of international agreements would be seriously undermined if the Convention were abrogated and that U.S. prestige in both economic and foreign policy fields would be impaired.

They further stress that, without the protection of the Warsaw Convention, passengers, consignors and the airlines themselves would become entangled in costly red tape because of conflicting local laws, procedures and requirements involved in international damage suits. Lack of uniformity provided by the Convention would multiply both the indirect and direct expenses of reaching a settlement in liability cases, they say.

A number of international carriers cite these problems as typical of what a passenger would face if the Warsaw Convention ceased to exist:

- **Burden of proof** of negligence would shift from the carrier to the passenger. The Convention presumes negligence by the carrier.
- **Passengers would lose** certain legal procedural and jurisdictional advantages. Under the Convention, a passenger has a choice of four jurisdictions to bring his case: the carrier's corporate domicile, principal place of business, passenger's destination or passenger's point of departure. Without the Convention, court actions arising from accidents occurring abroad would fall under the jurisdiction of foreign law. In some U.S. states, without the Convention, courts could refuse to take jurisdiction and send claimants to a foreign court.
- **Lack of world-wide standardization** of documents required by the Convention would deny passengers or claimants the necessary legal proof to take an action. Without standardization of contractual terms of carriage in these documents, passengers could be forced to take action in a foreign court and maybe find that the financial protection in that country is lower than that afforded by the Warsaw Convention.

Convention opponents have argued that the principle of limited liability is "indefensible morally, sociologically and economically." The core of the argument is that plaintiffs in an American court should be entitled to damages equal to the American standard of living, not to an international average.

Possible Compromise

A possible compromise may be derived from a memorandum prepared by Peter H. Sand, a graduate student at the University of California. The memorandum, submitted by Professor Richard M. Buxbaum of the university, has attracted wide attention in legal groups here and is being used by the Air Transport Assn. as a part of its case in defense of the Convention.

Sand points out that the Convention omitted a number of points which, according to background drafting documents, would later be resolved by national law. He notes that a number of foreign nations have taken advantage of these omissions by enacting laws that implement the Convention and adds:

"Although American courts have repeatedly emphasized the need for implementing legislation, or have even, wrongly, assumed that it had already been passed, no such steps have been taken in the United States. As a result, American plaintiffs are being denied rights under the Warsaw Convention which plaintiffs in other countries have long since obtained."

Specifically, Sand proposes that reconciliation of the Warsaw Convention and American economic standards could be attained by an implementing law that would require automatic accident insurance for the benefit of all passengers on international flights to and from the U.S. and would give the passenger or his agent a direct statutory right of action against the insuror.

Unsuccessful Attempts

Sand states that there have been several unsuccessful attempts to introduce automatic accident insurance by international agreement. However, he points out that at least four airlines now provide such insurance to their passengers without charge: Swissair, Air France and two privately-owned French airlines, TAI and UAT. He said that IATA would not oppose the free insurance system on an industry-wide basis, but, to prevent price-cutting, the association has issued a resolution opposing the advertising of free insurance by individual airlines.

As a result, the French carriers do not publicize or advertise this feature and Swissair changed its accident insurance plan into an "admitted liability" form.

Sand's research disclosed that several nations require automatic air travel insurance by statute. These include Germany, Austria, Italy and Brazil. Airlines in these countries provide insurance to passengers under law without additional charge. In Spain, travel insurance is automatic and is paid for by train, bus and airline passengers. Iberia Airlines, however, absorbs this cost without an increase in fares.

Insurance Cost

Sand concludes that the cost of automatic insurance would not be exorbitant and could be undertaken without any increases in fares.

He adds that, if the automatic insurance program is adopted, the beneficiary should be granted a direct statutory right of action against the underwriter. This, he says, would eliminate most litigation between passengers and carriers.

This right of action, according to Sand, would also eliminate conflict of law created by the necessity of the court characterizing an aircraft accident as either a tort or as a breach of contract, both of which would involve local foreign laws in accidents abroad.

PanAm Negotiations

Washington—Pan American World Airways and the Air Line Pilots Assn. resumed contract talks last week, despite the possibility that the pilots may walk out on Jan. 9. The airline estimates that meeting the union's wage and working condition demands would increase operating costs by $27 million, and has told all its employes that ALPA refuses to accept the Feinsinger Commission findings on crew complement, which have officially been accepted by both Pan American and the Flight Engineers International Assn. ALPA maintains the recommendations can be discussed only on an individual carrier basis. FEIA favors talks on an industry-wide basis.

CAB Will Grant 3% Fare Increase

Washington—Civil Aeronautics Board late last week rejected all specific airline fare increase proposals but indicated it would grant a general increase of 3% for a six-month period if this was requested. The 3-2 decision carried dissents from Vice Chairman Robert Murphy and Member G. Joseph Minetti, who warned that any fare increase might adversely affect the industry's already weakened traffic growth rate.

The Board's formal order recounted the industry's problem of low load factors and diversion to coach traffic of first class (AW Dec. 4, p. 38), but emphasized that "no fare program alone can restore earnings to reasonable levels. On the contrary, the industry's economic problems must be attacked on a broad front of which load factor improvements is the cornerstone."

The Board asked all carriers to submit to it by Jan. 15, 1962, suggestions for improving load factors.

Citing the carriers' complaints on low-yield coach fares, the Board said it was not convinced that coach services were "inherently" less profitable than first class.

As an interim measure, CAB said, the industry could be permitted a general fare increase of not more than 3% under tariffs of six-month duration. During that period, the Board emphasized, it would undertake a program to resolve the industry's basic economic problems. The Board also urged the carriers to examine closely the variety of special fares and discounts now in effect with an eye to abandoning those which are of doubtful economic value.

In particular, CAB cited the family fare plan, which it said results in a first-class family fare ticket being offered at a price well below corresponding coach fares. As an inducement to encourage more first-class travel, the Board suggested it would approve an increase in free baggage allowance to 66 lb. and a new rule authorizing stopovers at a reasonable charge in first-class service.

As other measures to improve the airlines' earnings, the Board pointed out that it has already authorized carriers to discuss matters such as cabin services, the "no-show" problem and the use of joint facilities. Cabin services in particular tend to be over-emphasized today, the Board said. It noted that there appeared to be opportunities for new economies without eliminating the "real necessities."

Improving the industry's load factor appears to hold the greatest promise for economic health in the industry, the Board said. A CAB program already under way includes increased emphasis on such economy measures as the consolidation of services at regional airports, suspension of service to uneconomic points, substitution of local service for trunkline service and route investigations designed to reduce excessive competition. But none of these measures could be taken without formal proceedings before the Board.

Murphy and Minetti, underscoring the majority's discussion of load factors, noted in their minority opinion that a 1% improvement would bring in an estimated $30 million in additional gross revenues to the industry as a whole. Most of the non-recurring jet integration costs have been absorbed by the industry, they said, and over-all costs give strong indication of levelling off, so that no dramatic changes in fares seem to be required, they said.

"Now is the time to hold the line," they said. "In short, additional trunkline passengers must be attracted to fill the present empty seats and this is unlikely to occur if fares are raised. The inevitable result of the fare increase authorized by the majority is a contribution by the traveling public of an additional $54 million (per year) without any real expectation that this will solve the carriers' complex problems."

The dissenters also objected to the majority's suggestion that special fares and discounts be abandoned. Such programs constitute "constructive merchandising" methods which have developed new markets and may continue to encourage the growth in air travel, they said.

The Board's decision was in the form of a denial of United Air Lines' fare increase proposal and included a review of similar informal requests by other airlines. A hearing will be held on the United request but no date has been set.

First airline reaction was that the amount of increase was insufficient to correct the serious fiscal problems facing the industry. In addition, a number of airline representatives said the revised tariff failed to close the gap between first-class and coach fares, a situation which many carriers feel is causing the expanding diversion of first-class traffic to the lower fare category. On the other hand, a New York financial source viewed the 3% increase with favor, pointing out it would produce a badly needed addition to receipts.

The dissatisfaction with the 3% increase re-emphasized the wide variance of opinion between industry and the CAB as to the measures required to improve profit margins.

Lower Fares Proposed for North Atlantic

By L. L. Doty

Washington—In a last-ditch drive to introduce new promotional fares on the North Atlantic before March, the International Air Transport Assn. traffic conference is circulating a mail vote asking for approval of a new group fare and a revised individual excursion fare.

The group fare would be 38% below normal round-trip economy rates for passengers traveling in groups of 25 persons or more. The individual round-trip excursion fare would be the same as the current 17-day winter excursion rate, which expires Mar. 31, but would be effective throughout the year. In addition, the new fare would be applicable for a minimum of 16 days and a maximum of 21 days travel time.

Chances now appear strong that the new low fares, which have been under consideration since the 1960 Cannes conference, will be approved by airlines operating on North Atlantic routes. Approval must be unanimous before the fares can be made effective.

Target date for the new fares is Feb. 1. Voting closes Jan. 5. Between Jan. 5 and Jan. 12, the fares, if approved by the airlines, will be filed with the governments involved for formal approval.

Earlier Attempt Failed

A previous mail vote on group fares only, circulated in late September (AW Oct. 2, p. 36), following regional traffic conferences in London and New York (AW Aug. 7, p. 36), failed because of widely split opinions on minor issues. Although the vast majority of the airlines favored the group fares principle, wrangling over superficial conditions deadlocked both meetings.

In addition, British Overseas Airways Corp., backed by Air-India International, firmly opposed the group rate principle at that time. SAS led a group of small carriers that wanted either a reduced individual fare or more passenger benefits attached to the excursion fare. This difference helped seal the fate of the September mail vote. El Al, which was originally opposed to any type of excursion fare, has recently reversed its position and now favors a lowering of rates (AW Dec. 18, p. 38).

Despite split opinions, however, it was evident at the traffic conference that most carriers believed lower fares were vital to stimulating increased traffic volumes on North Atlanttic routes. As a result, the conference appointed another special working group to attempt to compromise the differences expressed at previous meetings and in comments included in the September mail vote.

The group consisted of representatives, all at vice presidential level, from Air-India, BOAC, KLM, Lufthansa, PAA, SAS Trans-Canada and TWA. Sessions, which terminated last month, were held in Bermuda. All agreed that the recommendations for the group and excursion fare which were developed in the meeting would win the full support of the carriers they represented. The chief drawback to the resolution incorporated in the mail vote is the provision that failure to approve one of the two fares would nullify both.

The new group fare and the revised excursion fare would be effective throughout the year, except on weekends during May, June and July on eastbound flights and during August, September and October on westbound flights. Passengers traveling as a group must travel together for the entire planned itinerary.

The requirement that a group must travel as a unit was one of the sources of controversy but it is believed that opponents, particularly Pan American, are now ready to accept this condition. Early differences over the minimum size of the group—some wanted as few as 20 while one carrier wanted 40—appear to be settled by the selection of 25 as a compromise.

One aspect of the group fare proposal which may meet resistance from the Civil Aeronautics Board is the determination of the eligibility of a group for the lower fares. For this purpose, the special working group has divided the eligible groups into two categories: affinity groups and spontaneous groups.

By IATA definition, an affinity group is an association, corporation, company or other legal entity which was formed for purposes other than travel and which shall have had "sufficient affinity prior to the application for transportation to distinguish it and set it apart from the general public."

A spontaneous group is any group of persons which has neither been publicly solicited nor gathered, directly or indirectly, by a person engaged in soliciting or selling transportation services. The conference defines public solicitation to include announcements of the group travel plan in "advertisements or any other writing or by means of public communications whether paid or unpaid. . . ." The CAB may question this category as being too loosely defined.

Sales of group fares, under the proposal, will be confined to the U.S., Canada and Mexico. However, group fares will not apply to and from points in Canada, U. S. and Mexico to the U.S. or Canadian gateways. Group fares cannot be used in the construction of around-the-world fares.

The revised excursion fare now has a better chance of winning approval, due primarily to declining load factors this year on North Atlantic routes. For most airlines, the need to generate new traffic has overcome earlier fears that added benefits in the lower rate groups would divert business traffic from higher fare classes, thus reducing gross revenues.

Incentive Need Seen

In addition, capacity will continue to increase during 1962 as some 230 new jet aircraft are introduced into service on international routes. Prospects for a substantial increase in international travel during 1962 are considered good by most airlines, but are not expected to materialize fully without the backing of new incentives.

The majority of airlines opposes any further reduction in individual fares. The revised excursion fare plan is expected to mollify outright proponents of reduced fares, without losing the support of carriers that want the fare level to remain stable for another two years.

The case for lower fares has been so highly publicized during the past year that many airlines feel that failure to produce some form of reduction, such as the new excursion fare, would bring a shower of criticism on the industry.

In the U.S., both fares will require CAB approval. The secretary of the traffic conference will file the fares with the Board if they are approved by the airlines.

Halaby on Art

Washington—Federal Aviation Agency Administrator N. E. Halaby's efforts to improve the decor of airports and air route traffic control centers (AW Sept. 4, p. 41) have been entrusted to an "Art in Aviation Advisers Panel" appointed by the administrator.

First task of the panel, which is headed by Jane Wheeler, a local artist and an active Democrat, will be to make Dulles International Airport reflect the best in "contemporary American artistic design and decoration," Halaby said last week.

Other members of the panel are artist William Walton, architects Gordon Bunshaft and Mrs. James H. Douglas, Henry Dreyfuss, a Los Angeles designer, and Andrew Ritchie, director of the Yale Art Gallery.

Halaby said: "Whenever you try to get beauty into anything governmental, you have a major task, an artistic task of great delicacy and difficulty."

SHORTLINES

► **American Airlines** scheduled 32 extra flights Jan. 1 to accommodate an expected rush of holiday travelers. The airline has scheduled 16 extra flights for Jan. 2 and six for Jan. 3. The airline scheduled a total of 132 extra flights during the Christmas-New Year holidays.

► **Braniff Airways** reports tourist travel on all airlines from the U. S. to Mexico has increased 660% in the last five years. In 1956 about 65,000 tourists flew to Mexico; in 1960 the total was 498,000. Braniff credits the increase to the addition of 1,800 hotel rooms in Mexico City during 1961, more than 52,000 additional seats being flown into Mexico annually with the introduction of jets and travel costs only half those of Europe.

► **Delta Air Lines** reports a net income of $4.59 million, including $509,000 on the sale of used aircraft, for the first 11 months of 1961. Net income for the same period last year was $2.89 million, which included $314,000 in equipment sales. Operating revenues for the first 11 months were $143 million—a 19% increase over the same period 1960.

► **Federal Aviation Agency** will hold a conference in Washington Feb. 27 to discuss airborne equipment which will be required to implement the Project Beacon recommendations. Aircraft operators and avionics equipment manufacturers are invited.

► **Flying Tiger Line** reports it moved 624,000 lb. of airfreight over the Dec. 16-17 weekend—the largest weekend shipment ever moved over its domestic route.

► **Lake Central Airlines** has asked Civil Aeronautics Board to permit it to serve six cities on six route segments currently served by trunklines. Trunklines have filed with CAB for deletion or suspension of service at Ft. Wayne, Ind.; St. Louis, Mo.; Bowling Green, Louisville, and Owensboro, Ky. and Nashville, Tenn.

► **North Central Airlines** reports it boarded its one millionth passenger for 1961 on Nov. 26.

► **Robert F. Six,** president of Continental Airlines, predicts that his airlines' traffic will continue to grow through 1962. Six, in a year end statement, estimated that in 1962, Continental's revenue passenger miles will be up 15 to 20% from 1961, while the industry's growth will be about 4 to 6%.

AIRLINE OBSERVER

► Federal Aviation Agency still is denying interested parties access to important rule-making dockets despite the Project Tightrope report recommendation that FAA follow the lead of other governmental agencies and keep its regulatory proceedings open from start to finish. Comments filed in response to rulemaking proposals of FAA's Flight Standards Service may not be inspected until after dockets are closed. The Tightrope report urged that this practice be abolished immediately.

► **Number of passengers carried by all scheduled airlines of the world in 1961, excluding the Soviet Union and the People's Republic of China, has been estimated by the International Civil Aviation Organization at 112 million, a 6% increase over the 1960 volume. The increase is the second lowest since 1946. Revenue passenger miles in 1961 were 72 billion compared with 67.5 billion in 1960. International Air Transport Assn. admitted that the 6% passenger increase fell short of the anticipated growth, but expressed the belief that the volume would increase by about 8% next year. IATA Director General Sir William Hildred predicted that the world's airlines will carry 121 million passengers in 1962.**

► Watch for the Federal Aviation Agency's Fiscal 1963 budget proposal to include a request for about 800 additional air traffic controllers in order to accomplish radar hand-offs at additional ATC facilities. The request is expected to revive argument on whether the capacity of ATC centers and approach controls can be increased merely by expanding their personnel complements.

► **Market interest in airline common stocks is expected to stay soft until merger talk has subsided. Individual mergers or rumors of mergers may spark some speculation but most investors will wait until the industry is stabilized before starting any active buying.**

► Local service carriers will show record increases in passenger revenue miles for 1961. Load factor for the year is expected to be substantially higher than last year's level despite a heavy increase in available seat miles.

► **If no-show penalties against passengers are adopted (AW Dec. 11, p. 41), chances are strong that the Civil Aeronautics Board will require the airlines to pay penalties to passengers who buy tickets and then discover there is no room for them.**

► Air France has ordered an additional seven medium-range Sud Caravelle transports for delivery in 1963. Completion of the order, coupled with delivery of the Boeing 707 intercontinental transports it has ordered, will bring Air France's turbine-powered fleet up to 64 aircraft: 24 Boeing 707s and 40 Caravelles.

► **Aeroflot will increase its Tu-114 trans-Siberian service from once weekly to five times weekly. The 170-passenger, double-decked, turboprop transports will operate from Moscow to Khabarovsk on Mondays, Tuesdays, Thursdays, Fridays and Saturdays. Nonstop time is 8 hr. 10 min.**

► Yemen will establish a national flag airline and is now formulating the system and laws under which the company will operate.

► **Look for the local service carrier industry to propose to the Civil Aeronautics Board a nation-wide network of low excursion area fares, similar to that adopted by Bonanza. The main purpose will be to provide tourist fares for foreign travelers under the "Visit U. S. A." program.**

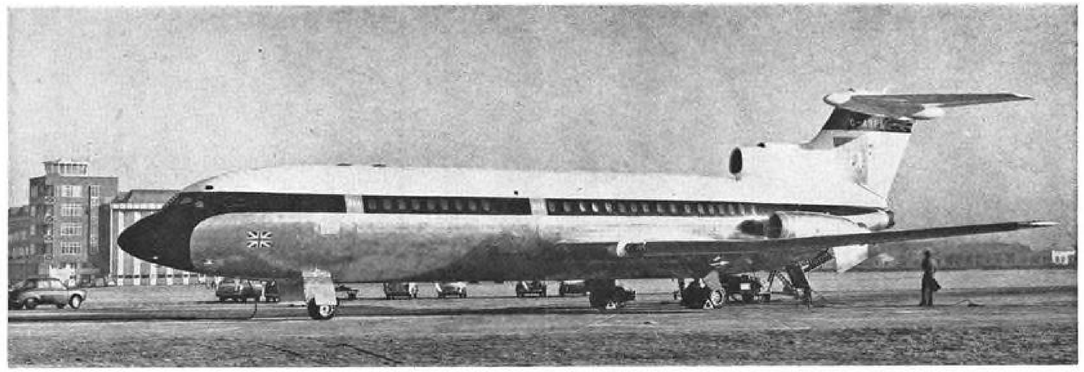
► Several airlines using Washington National Airport are refusing to pay higher landing fees that went into effect last October. Instead, they are continuing to pay the old fees and have asked the Federal Aviation Agency to discuss the entire fee situation. Airlines want leases of up to 20 years to establish their position as permanent residents. Longest time period FAA wants is three years, but it may be willing to compromise. Airlines are also willing to agree to an escalator clause providing for gradual increases in landing fees.

Airline Income and Expenses—October, 1961

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenues	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNKS								
American	$33,276,812	$ 776,107	$ 394,408	$2,662,690	$ ----	$37,537,734	$35,798,706	$1,739,028
Braniff	6,167,206	171,876	80,459	271,877	140,709	6,924,329	6,371,160	435,407
Continental	4,651,000	115,000	52,000	158,000	30,000	5,110,000	4,807,000	77,000
Delta	12,215,000	260,000	146,000	487,000	----	13,378,000	12,116,000	1,034,000
Eastern	19,682,659	537,678	----	1,105,928[1]	----	21,419,006	25,003,074	-3,942,859
National	5,482,229	142,328	43,563	335,044	130,319	6,306,872	6,629,545	- 516,239
Northeast	3,404,247	52,220	33,909	84,643	----	3,642,448	4,682,487	-1,285,087[2]
Northwest	6,136,044	218,564	----	520,375[1]	67,988	6,986,378	7,244,929	- 536,023
Trans World	22,230,888	492,973	1,660,480	203,952[1]	45,486	24,992,657	25,678,357	-1,628,556
United	39,313,503	1,426,846	----	3,026,727[1]	249,516	44,530,338	44,636,954	- 918,071
Western	5,186,370	116,469	----	211,585[1]	101,418	5,630,503	5,493,088	19,744
INTERNATIONAL								
American	427,158	6,213	370	70,348	----	533,363	571,043	- 37,680
Braniff	712,026	31,306	----	70,604	259,814	1,120,048	1,219,622	- 121,890
Caribbean Atlantic	251,653	3,611	----	17,872[1]	9,308	287,472	288,995	- 1,480
Delta	80,000	1,000	----	4,000	----	88,000	200,000	- 156,000
Eastern	2,121,482	51,509	----	140,553[1]	----	2,323,351	2,594,620	- 310,179
Northwest	2,083,223	713,450	----	381,340	179,876	3,515,867	2,699,308	708,557
Pan American Combined	28,660,000	2,896,000	----	3,907,000	3,889,000	40,365,000	40,089,000	- 882,000
Alaska	257,000	17,000	----	48,000	----	310,000	435,000	- 92,000
Atlantic	14,134,000	1,375,000	----	1,498,000	1,909,000	19,617,000	19,068,000	762,000
Latin America	6,427,000	246,000	----	1,243,000	704,000	8,781,000	10,005,000	-1,247,000
Pacific	7,842,000	1,258,000	----	1,118,000	1,276,000	11,657,000	10,579,000	837,000
Panagra	1,556,000	76,000	----	272,000	12,000	2,215,000	2,016,000	172,000
South Pacific	27,625	294	----	272[2]	----	28,549	100,415	- 76,799
Trans World	6,318,356	776,654	----	679,550	63,386	8,096,977	7,839,321	- 97,687
United	1,979,377	105,255	----	99,819	----	2,225,542	1,804,660	360,548
Western	456,059	9,671	----	12,315	9,671	479,172	406,468	64,022
LOCAL SERVICE								
Allegheny	1,176,795	12,540	32,270	49,810	----	1,825,315	1,714,756	49,480
Bonanza	487,479	3,504	720	7,826	2,300	792,263	715,405	52,117
Central	382,587	15,122	4,741	17,810	13,464	827,100	746,980	79,046
Frontier	599,846	12,402	7,608	31,410	7,920	1,267,971	1,223,063	23,650[2]
Lake Central	543,624	12,116	13,875	14,409	14,868	952,040	895,442	36,159[2]
Mohawk	1,434,113	20,508	18,612	21,730	39,432	1,963,793	1,867,174	96,619
North Central	1,288,225	33,945	27,300	46,454	13,561	2,096,659	2,057,762	18,837
Ozark	725,806	17,366	18,047	29,164	6,311	1,148,151	1,089,365	49,022
Pacific	541,391	13,777	8,004	11,248	2,667	915,211	837,392	53,282
Piedmont	795,776	11,956	12,117	17,816	----	1,257,996	1,093,778	142,524
Southern	532,791	20,154	13,517	19,545	17,230	956,933	882,460	61,684
Trans-Texas	489,883	12,414	10,186	22,839	6,857	924,285	881,907	38,314
West Coast	545,537	11,248	2,997	13,422	5,342	1,040,600	929,603	93,133
HAWAIIAN LINES								
Aloha	397,215	2,191	----	4,856	----	436,539	471,633	- 63,637[2]
Hawaiian	491,432	3,959	----	75,798	----	566,874	638,697	- 90,249[2]
CARGO LINES								
Flying Tiger	----	4,484	----	918,044[1]	2,355,136	3,287,590	2,989,913	128,289
Seaboard World	----	321,678	----	634,731	407,677[4]	1,386,466	2,030,414	- 740,946
HELICOPTER LINES								
Chicago Helicopter	119,150	135,898	----	----	----	255,057	268,696	- 13,521
Los Angeles Airways	16,398	11,517	15,908[3]	----	175	137,853	124,401	14,123
New York Airways	109,173	5,421	2,616	3,625	----	322,561	345,360	- 24,710
ALASKA LINES								
Alaska Airlines	340,260	55,908	967	83,198	158,255	861,905	936,947	- 111,484
Alaska Coastal	75,390	10,240	----	10,942	2,642	152,545	161,451	- 10,878
Cordova	21,878	18,097	----	13,715	17,590	97,902	114,365	- 17,472
Ellis	40,400	4,000	----	5,100[1]	800	81,500	107,800	- 27,300[2]
Kodiak	11,368	935	----	2,290	4,031	20,937	36,977	- 16,156[2]
Northern Consolidated	73,097	68,063	----	41,873	----	276,599	300,153	- 15,794[2]
Pacific Northern	531,568	97,994	3,366	124,430	799	878,707	963,878	- 99,687
Reeve Aleutian	154,889	51,098	----	43,856[3]	12,936	263,997	191,345	70,956
Western Alaska	5,270	12,587	----	1,179[3]	5,821	24,763	23,165	- 2,683[2]
Wien Alaska	71,585	99,540	----	39,016	38,695	355,265	433,995	- 32,562[2]

[1] Property: Figures include freight, express and excess baggage revenues. [2] Net profit or loss. [3] Includes excess baggage.
[4] Combined passenger and freight charters. Figures for Mackey, Trans Caribbean, Aerovias, Riddle, Slick and Avalon were not available.

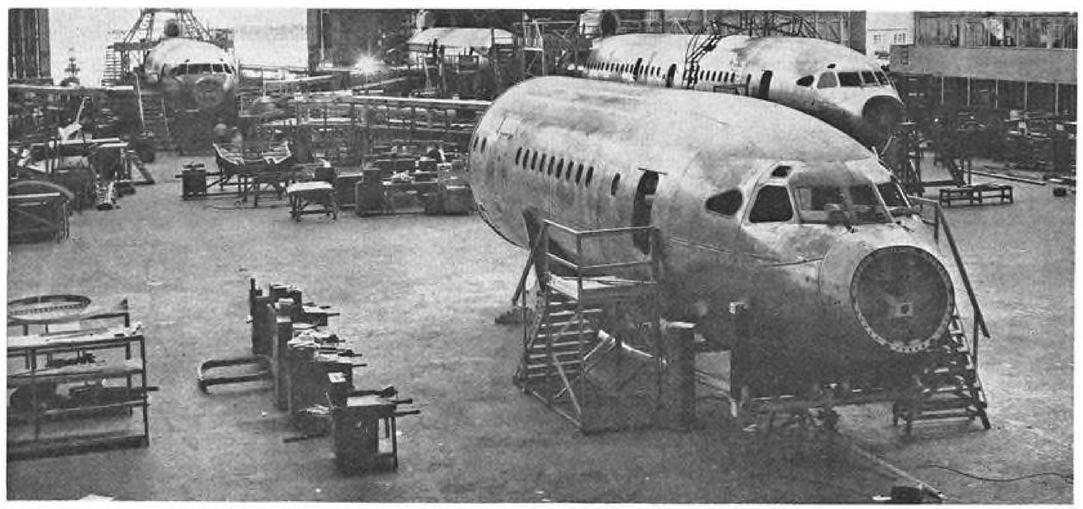
COMPILED by AVIATION WEEK from airline reports to the Civil Aeronautics Board.



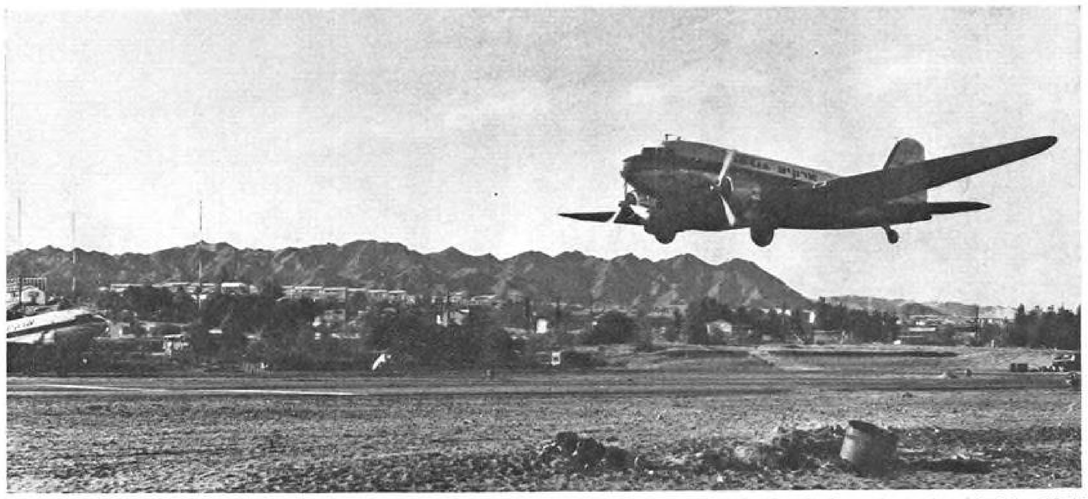
De Havilland DH-121 Trident transport is powered by three Rolls-Royce Spey turbojets. Rolls-Royce expects the engine to accumulate 2,000 hr. time between overhauls within 2½ years. British European Airways has ordered 24 Tridents with 77-passenger capacity.

Trident to Begin Flight-Test Phase

First flight is imminent for the de Havilland DH-121 Trident jet transport, which rolled out of the company's Hatfield, England, factory in August (AW Aug. 14, p. 43). Three aft-mounted Rolls-Royce Spey turbojets (9,850 lb. thrust) power the short- to medium-range transport. British European Airways has ordered 24 Tridents. In BEA configuration the aircraft will carry 77 passengers, 18 of them in first-class accommodations. A follow-on Trident version, the 1C, will carry additional fuel in the center section tank and will have a gross weight of 115,000 lb., compared with BEA Trident gross weight of 107,000 lb. Photo at left shows nose section fabrication. The aircraft makes extensive use of large skin panels. One bonding press handles panels up to 42 ft. long and 5 ft. wide; its operating pressure is 3,000 tons. Design aims at low stress levels with multiple load paths.



Four Tridents, the initial batch of British European Airways' order of 24, are shown in construction at de Havilland's Hatfield, England, plant. The short- to medium-range aircraft's gross weight is 107,000 lb.; maximum speed is 606 mph. (Mach .875).



TOURIST FLIGHTS form the backbone of Arkia's operations. During the summer months, the Israeli domestic carrier schedules 10-12 flights daily between Tel Aviv and Eilat. Photo shows DC-3 takeoff from Eilat.

Israeli Domestic Line Maintains Profits

By Cecil Brownlow

Tel Aviv—Arkia, Israel's small but robust domestic airline with only 330 unduplicated route miles to call its own, is keeping pace with its international counterpart, El Al, in the number of passengers carried, showing a profit and busily seeking new equipment as replacements for its aging fleet of Douglas DC-3s.

With a total of 72 employes, 18 of them pilots, Arkia Inland Airlines, Ltd., this year will fly 120,000 passengers into the Red Sea port of Eilat—a town of approximately 5,000 inhabitants—plus another 12,000 to Haifa and Rosh Pinna in the north. In comparison, El Al Israel Airlines in its Fiscal 1960/61 year boarded 122,155 passengers.

The mainstay, of course, is the tourist trade—an estimated 30-35% of all passenger traffic on a yearly basis. A major and sustaining attraction is Arkia's ability to place the visitor in the center of Biblical history within a short time and at low cost from his Tel Aviv port of entry. To take maximum advantage of this attraction, Arkia works closely with a national bus company in offering package tours.

Excursion Flights

"One Day Package Tour of Galilee," $26.40 all-inclusive beginning with a flight to Rosh Pinna, includes sightseeing trips by bus along the mountain road to Nazareth; to Kfar Kana, where the Bible says Christ turned water into wine; Tiberias, the capital of Galilee; the Sea of Galilee itself, and Magdala, the village of Mary Magdalene.

"Day Tour to the Red Sea," $32, includes tours to King Solomon's Mines and Solomon's Pillars as well as skin diving among the tropical fish of the Red Sea and a visit to Eilat's Philip Murray House, a cultural center.

Longest regularly-scheduled route segment—Tel Aviv-Eilat—is 167 naut. mi., although special flights are sometimes made between Rosh Pinna and Eilat, 235 naut. mi. Frequencies vary with the season.

During the six-month summer period when tourist traffic is at its highest, 10 to 12 flights a day are scheduled into Eilat from Arkia's headquarters at Tel Aviv's Sde-Dov airport, and more can be added if there is sufficient demand. Over the remainder of the year, the round-trip flights during the mid-week are trimmed to a minimum of five and are currently running at six per day.

Three daily round-trip Tel Aviv-Rosh Pinna flights are scheduled on a year-round basis. There also are a morning and afternoon flight to the northern port of Haifa, primarily for delivery of daily newspapers with a national distribution on a contract basis, although passengers are carried on most of the runs.

Utilization Problems

Passenger load factor averages about 80% per flight, but effective utilization of the five DC-3s and single de Havilland Dove over the short stage lengths can be a problem. Present DC-3 utilization rate averages about four hours a day. The Dove is used primarily for charter flights and, during the winter when passenger demand is low, on the newspaper route to Haifa.

"Tourists," explains Lew Bigon, Arkia technical manager and second in command, "want to make a day of it, leaving in the morning and returning at night. So it makes it difficult to schedule flights during some periods of the day." Eilat and Rosh Pinna residents visiting Tel Aviv also prefer the morning and evening flights as a rule.

Arkia's present schedule of six daily flights to Eilat Sunday through Thursday depart at 6:30 a. m., 8:15, 9:45, noon, 12:15 and 3:30 p. m. Eilat takeoffs are scheduled at 9 a. m., 11:30, 2:15, 2:30, 5 p.m. and 6:15.

On Fridays, the schedule is trimmed to three flights a day. Like El Al, Arkia suspends all flight activities over the Jewish sabbath—dusk Friday to sundown Saturday—a factor that cuts sharply into its revenue potential. Straight one-way fare to Eilat is $10.40, to Haifa $3.30 and to Rosh Pinna $10.20. Highest Arkia fare within Israel, except for the package tour costs, is the $28.70 round-trip between Rosh Pinna and Eilat.

In order to boost DC-3 capacity to a maximum of 32 passengers each, a number of modifications have been made to Arkia specifications. Lightweight but comfortable high-density plastic-bodied chairs weighing 21 lb. each with seat belt have been substituted for the 56-lb. seats that were originally aboard the aircraft. A light sandwich-type flooring covered with a glass fiber finish has replaced the previous metal undercover and carpet topping. Some of the original soundproofing also has been removed from the fuselage.

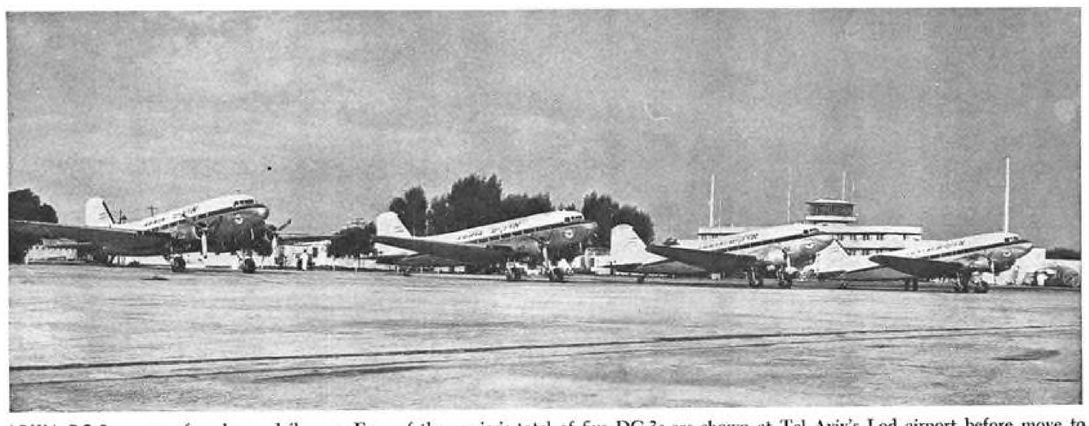
Total weight saving per aircraft is 880 lb., equivalent to four passengers with baggage, five without.

Arkia hopes to replace two or three of the DC-3s, which were originally purchased by the Israeli government during the 1947-48 war of independence, with twin-engine turboprop equipment within the next 18 months. Chief Pilot H. Agmon, a former member of South African and Israeli air forces, has visited a number of European manufacturers within the past few months, and the airline currently seems to favor the Fokker F. 27 Friendship.

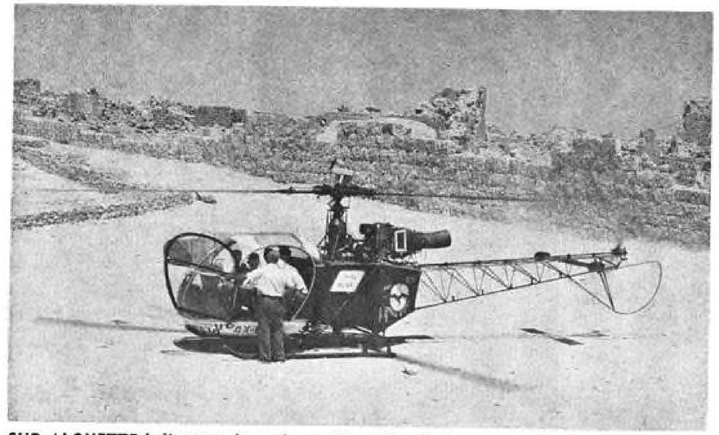
Helicopter Tested

It also has experimented with helicopter transport in the past—operating a Sud Alouette 2 for a year and a half—and Bigon regards Israel, with its isolated historical sites plus a need for cargo and passenger flights into rural areas, as a prime spot for such service when a helicopter with high lift capability and sufficiently low seat mile cost becomes available.

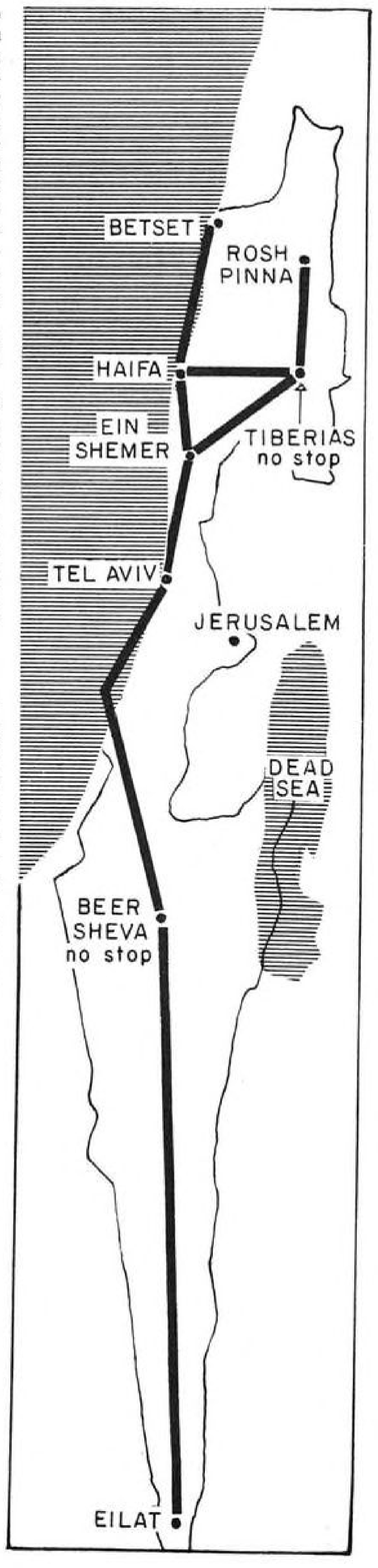
The four-passenger Alouette, however, was taken out of service and sold in 1960 as a money-losing operation. "Its main failure, besides the fact that helicopters generally are very expensive, was that it was too light to give service as a crane" on cargo missions, accord-



ARKIA DC-3s average four hours daily use. Four of the carrier's total of five DC-3s are shown at Tel Aviv's Lod airport before move to Sde-Dov. Arkia also operates one de Havilland Dove, primarily for charter flights.



SUD ALOUETTE helicopter, formerly used by Arkia, is shown at isolated tourist site—ruins south of Beer Sheva. Carrier's route map is at right.



ing to Bigon. "For the general tourist," he adds, "the seat mile cost also was too high."

Cost of an Alouette charter was $120 per flight hour, or $30 a passenger when filled. What Arkia needs, Bigon says, is a 60-to-65 passenger vehicle that can operate economically over short stage lengths.

Internally, Arkia also hopes to eventually begin scheduled service into the divided city of Jerusalem, the capital of Israel and the country's greatest single tourist attraction. The British-built airport lies across the line in Jordanian territory, however, and the Israeli portion of the city is now served on a scheduled basis only by surface transport.

The closeness of hostile Arab borders—the hills of Jordan can be seen from Tel Aviv—is always felt, but they are particularly tight at Eilat where the corridor between Egypt and Jordan is only seven miles wide. In addition, the Eilat field with its 4,500-ft. north-south runway is located only 1¼ miles from the Jordanian airport for the major oil port of Aqaba, and there is no formal communication or traffic coordination between the two towers. Yet, there have been no real problems thus far in the 12 years Arkia has been flying into Eilat.

"We don't talk to one another," Chief Pilot Agmon says, "but we listen."

On the approach flights, Arkia aircraft fly over the Gulf of Eilat, turn over the water away from the Egyptian, and most hostile, border and then come in for an in-line landing. The same procedure is followed on takeoffs to the south.

Arkia began life in 1949 primarily as a cargo carrier, flying C-46 loads of drinking water, fuel, meat, vegetables and other necessities to Eilat which was then isolated from the remainder of Israel. The Eilat cargo flights continued as a major source of income until 1958 when a major road to the port city was opened, and refrigerated trucks took over the task.

Tourism Profitable

With the loss of the cargo route, Arkia dipped into the red in 1958 after a peak year in 1957 but managed to pull out into the black again in 1959 with renewed emphasis upon passenger service. It has remained there since and, with the growing tourism into Israel, expects to regain its 1957 form by next year.

Arkia ownership is divided on a 50-50 basis between the government and Histadrut, the national labor organization, but there is no subsidy coming from either source and, to survive, the little airline must stand on its own.

Cargo flights to all points are playing a declining role in the carrier's over-all fortunes, although there is still some activity in overseas charter business. "We'll fly anywhere," Agmon says. Nicosia, Cyprus, slightly over 200 mi. away, has been a major charter point for both cargo and passenger flights, and the airline last year logged over 1,000 hr. on overseas operations.

While passenger charters have accounted for approximately three quarters of the overseas business in the past, Arkia has taken on such chores as regular twice-a-week flights to Sofia and Rome with the aircraft loaded with Israeli chickens for European consumption.

The passenger charter flights, however, are now being operated on a pool basis with El Al.

Arkia is an operating company in the strictest sense. All maintenance and overhaul is contracted to Israel Aircraft Industries, Ltd., which keeps an average of seven employes, including storekeepers, at Sde-Dov for each of the two shifts a day operated by Arkia. Even the refueling operations are handled by a private firm.

"We're as Spartan here as you can get," one Arkia employe observes. "The way we live, the way we sit. That's how we stay in the black."

Mohawk to Continue Gas Light Flights

By James D. Hendricks

Utica, N. Y.—Popularity of Mohawk Airlines' Gas Light Service among commuting businessmen has forced the northeastern local carrier to continue the flights beyond the cut-off date originally set for the first of the year.

The weekday evening Douglas DC-3 service features Victorian-styled accommodations, beer and cigars. It was created in September, 1960, as a "gimmick" to lend appeal to Mohawk's aging DC-3s until the airline could build up its fleet of Convair 240s and 440s and Martin 404s.

Gas Light has proved so successful, however, that it has posed a unique problem to the carrier's management in trying to abandon it.

PASSENGER CABIN is styled after a Victorian parlor, with red velvet curtains, Currier and Ives prints and electric lamps fashioned like gas lights.

As a result, Mohawk has decided to continue the service on a reduced scheduled basis, seek still more novelties to sustain its popularity, and promote it for charter operations.

New Schedule

Mohawk's new schedule, which went into effect Dec. 11, includes three Gas Light flights—3 p.m. from Buffalo to Albany with stops at Rochester and Syracuse, 5:30 p.m. from Albany to Buffalo with Syracuse and Rochester stops, and 8:20 p.m. non-stop Buffalo to Ithaca.

Previously, all Gas Light flights started after 5 p.m.

The 3 p.m. flight formerly left at 5 p.m., but has been replaced at that time by a Convair because traffic demands were too heavy for the DC-3's 25-passenger capacity.

Mohawk cites these statistics and developments as partial proof of success that has been achieved with Gas Light Service.

- **Consistent** 52% to 60% average load factor on Gas Light flights since their inception 15 months ago.
- **Widespread** local, national and international attention received by the service.
- **Several occasions** when Gas Light aircraft, scheduled as extra sections for scheduled flights with newer Mohawk planes, were filled to capacity while the primary aircraft were left with several empty seats.
- **Recent "customer attitude"** survey, involving Mohawk, in which the cross section of people interviewed tabbed the Gas Light Service as the most familiar aspect of the airline's operations.

"We created a monster—but a good one for us," a Mohawk executive said. "Gas Light has paid for itself commercially and more than paid for itself in publicity."

Peak Period

At its peak period in late 1960 and early 1961, Gas Light served Boston, Hartford, Albany, Utica, Syracuse, Rochester and Buffalo on Monday-through-Friday flights east to west, and Newark to Watertown, N. Y., and the Thousand Islands area on north-south flights. Until a few months ago, the flights were limited to men only, but Mohawk said it has had to remove that restriction under pressure from women passengers.

"We thought the beer and cigar smoke would be too much for them," Russell V. Stephenson, Mohawk vice president-sales and service, said. "But as long as they want to get on board, we'll let them fly."

Stephenson attributes most of Gas Light's popularity to the "relaxed" DC-3s. "Let's face it, the DC-3 is at least obsolescent," he said, "but the beer and cigars seem to make up for that."

At present, Mohawk has three DC-3s in operation, including the two outfitted for Gas Light Service. One standard plane is used as a standby aircraft for charters and scheduled hops between Binghamton and Poughkeepsie, a segment flown mainly by International Business Machines Corp. employes traveling to IBM facilities in the area. Four other Mohawk DC-3s are for sale at the airline's facility in Ithaca.

GAS LIGHT DC-3 features distinctive fuselage markings, use of old-style print for the name and gas lamp insignia on the tail.

Gas Light planes are identified by a special red and black trim with the name in old-style print and a gas lamp insignia on the tail. Inside, they are styled after a Victorian parlor, with pinkish-red upholstery, lace headrests on seats, Currier and Ives prints on the walls, red velvet curtains with gold fringe, electric lamps modeled after gas lights on either side of the door and a pot-bellied stove painted in three-dimensional effect on the rear wall of the cabin entrance.

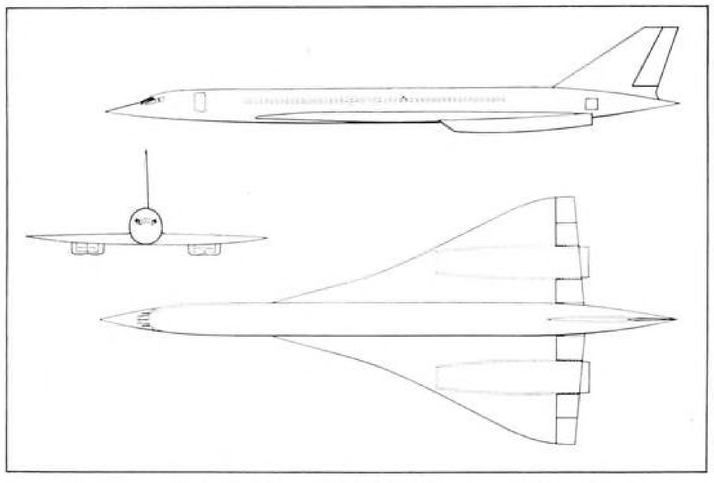
The stewardess wears a replica of an 1890 vintage full-length gown with elbow-length gloves and a plumed hat. During the flight, she serves beer, cheese, pretzels and cigars to the passengers.

Gas Light planes without the special service have been available at no additional charge for charter bookings since last August. Flights with the service carry an extra $50 charge and have not been particularly successful.

"Men's clubs and similar groups going to football games or conventions are about the only ones who request Gas Light Service for charters," Stephenson said. "We're planning to use the service experimentally on ski flights to step up its appeal for charters."

Mohawk also plans to continue using Gas Light planes as extra sections to back up its Convairs and Martins. "We wouldn't send an ordinary DC-3 into an airport like Idlewild, for instance, to sit beside someone else's jets or Electras," Stephenson said. "But we would have no qualms about sending a Gas Light DC-3 because it's an attractive plane."

Stephenson said Mohawk is not planning to convert Martins or Convairs to Gas Light trim or service. "It's just a hunch, but I don't think the decorations or service would do as well on our newer planes as it has on the DC-3s."



Super Caravelle Configuration Detailed

Sud Aviation Super Caravelle Mach 2 transport will have double-S wing form with four wedge-type engine intakes under trailing edge (AW Dec. 4, p. 45). Engines would be four Bristol Olympus turbojets (25,000 lb. thrust) with partial afterburning and thrust reversers.

BRITISH AIRCRAFT CORPORATION

ONE HUNDRED PALL MALL LONDON SW1 ENGLAND
USA: BRITISH AIRCRAFT CORPORATION (USA) INC.,
399 JEFFERSON DAVIS HIGHWAY ARLINGTON VIRGINIA

NUCLEAR ATTACK AND INDUSTRIAL SURVIVAL

The Editors of McGraw-Hill consider this report the most critical assignment ever undertaken by our segment of the business press of this nation. In its development, at one moment or another, each member of the task force has felt the enormous contemplative weight of the subject and the almost overwhelming demands for accuracy. Rarely have we dealt with a matter of such potential import to individuals and to responsible leaders in all segments of the American economy. Never before have we volunteered as much effort, hoping it would not be needed.

However, not only now during the Berlin crisis, but probably for many years to come, the U. S. will live under threat of a nuclear attack. How well we could survive such aggression, and how rapidly we could restore a viable civilization, depends heavily on how we prepare to meet the danger.

And yet, paradoxically, we are aware that the very effort to do this work . . . or even to address this subject . . . is controversial. There are those, in highly respected echelons of our society, who say no civil defense is worthwhile . . . that the more security you feel, the more willing you are to risk the holocaust.

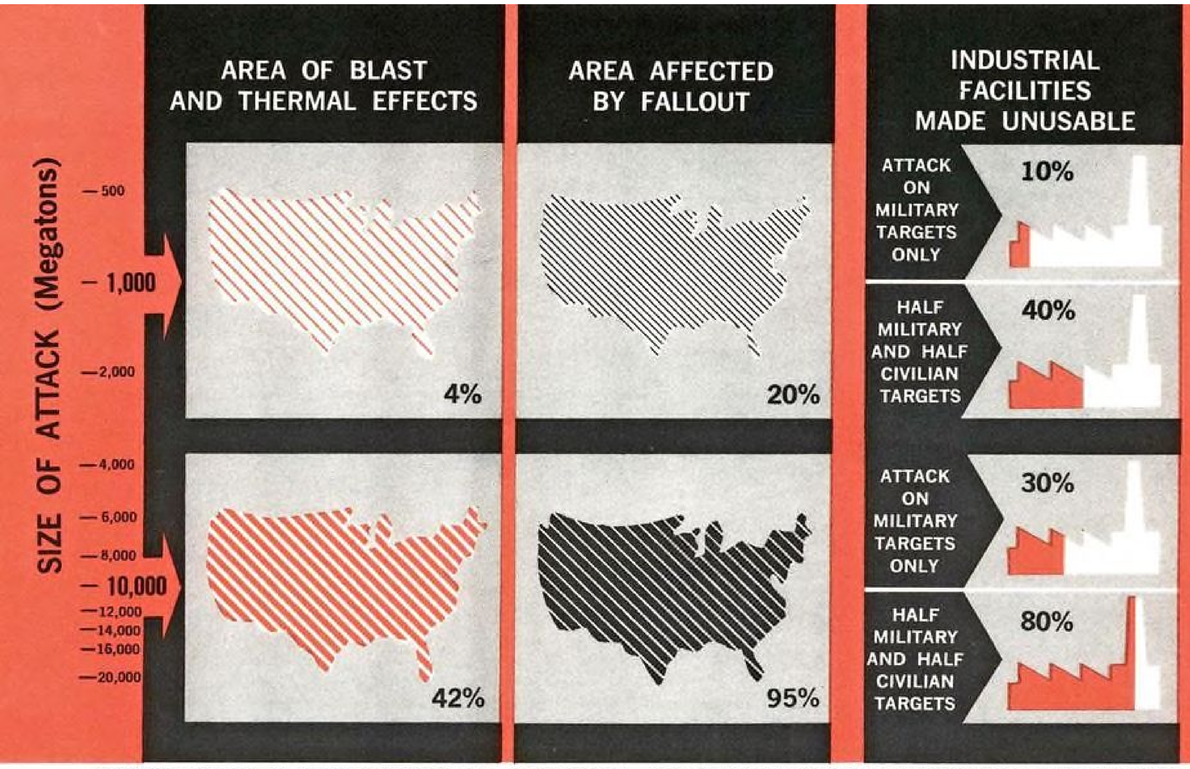
- Our study of nuclear attacks, and consultations with experts both within government and outside, convince us that responsible and prudent management can, and should, act on the basis that protective measures constitute a sound form of insurance.
- We believe the suggestion that a sense of security might provoke aggression libels both the intelligence and the morals of the American people. Nothing in this report, or in any other realistic appraisal of this somber subject, encourages aggression or bravado. On the contrary, the awe-full dimensions of destruction . . . despite all preparations for protection . . . compel the utmost effort for prevention of nuclear war.

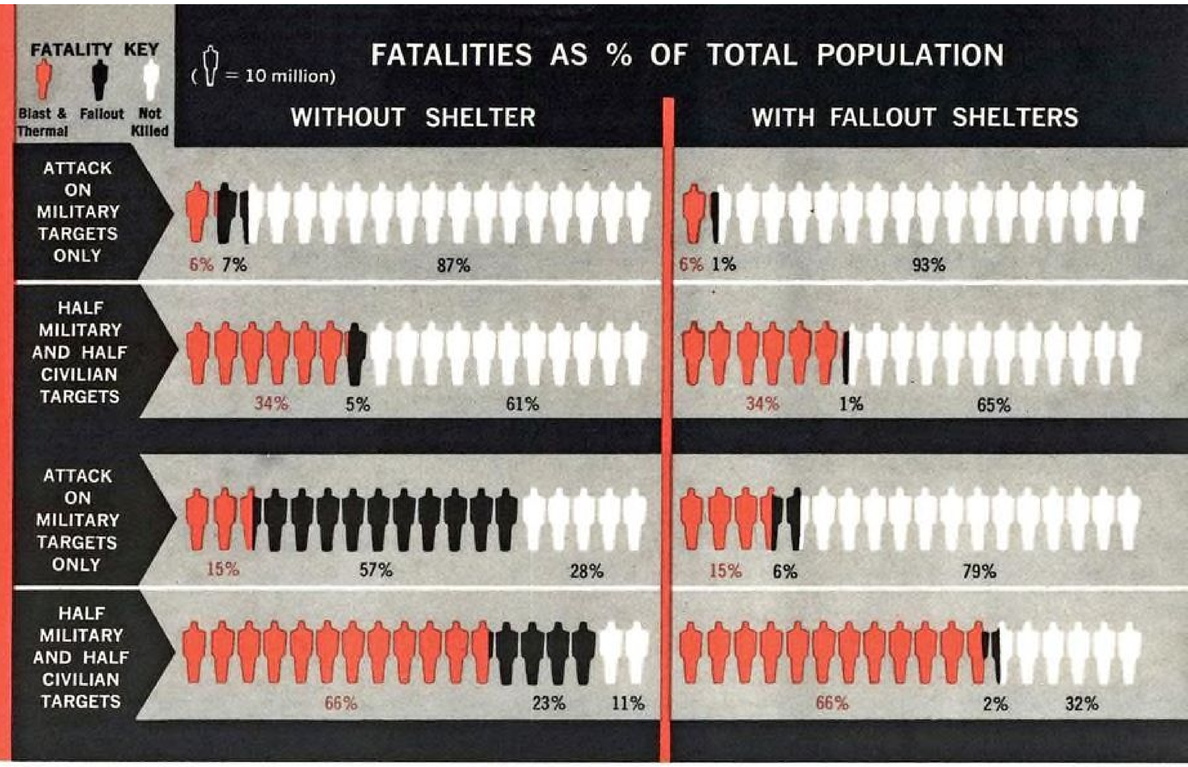
This report concentrates on the problems of U.S. *industrial* survival for two important reasons. First, the excellent organization that industry already has can be a powerful force for the protection of people. Second, in the aftermath of any war, it is vital to society that production be restored as quickly as possible. Therefore, in planning for both survival and recovery, business and industry have special responsibilities . . . to employees, to the community, and to the nation.

Let us make one thing absolutely clear. If any part of the pages that follow can be accused of sensationalism, then we have failed our job. The Editors of McGraw-Hill do not believe that nuclear war is likely. But we do believe that the possibility of it . . . however remote . . . must be examined.

The Editors of McGraw-Hill

PUBLISHED AS A SERVICE TO INDUSTRY BY McGRAW-HILL PUBLISHING COMPANY





ESTIMATED EFFECTS OF NUCLEAR ATTACKS at a clearly credible present level (1000 megatons) and a possible future level (10,000 mt). Individual bombs assumed to be 10 mt with 50% fission yield; half are surface bursts, half air bursts. Area figures assume no overlap between air bursts, 50% overlap of surface bursts. Limit of thermal-effects area taken as 2nd-degree-burn level; this automatically includes all blast-damage area. In fallout-affected area, precautions would be needed to avoid radiation sickness or death (first-day dose is 200 r, or more). In combined military and city attacks, military targets were assumed to receive all surface bursts and city targets all air bursts. For industrial facilities, "made unusable" means destroyed or requiring major restoration after blast or fire. Fatalities "without shelters" assumes poorly instructed population with no shielding beyond ordinary housing. "With fallout shelters" assumes informed, well disciplined population fully equipped with good group shelters. No account is taken of blast and fire protection afforded by fallout shelters. Fatality figures do not include deaths from secondary causes such as lack of medical treatment for injuries. Estimates based on data from Office of Emergency Planning, Atomic Energy Commission, Rand Corporation, and hearings of the Joint Committee on Atomic Energy

THE DIMENSIONS OF DISASTER:

What might nuclear attacks cost us in facilities, people?

Because no nation has ever suffered a full-scale attack employing modern thermonuclear weapons, there is no direct experience to use as a basis for appraising the damage the U.S. would suffer under such an attack — or for gaging what government, industry, and others in the community might do to provide protection.

To assess the damage in advance, you must turn to data drawn from painstaking studies of the relatively small attacks on Hiroshima and Nagasaki, and from the tests conducted in the years since.

These give reasonably precise knowledge of the effects of a single explosion. And they make it possible, with only slightly less precision, to calculate the effects of a known pattern of bursts.

Attack estimates. To estimate the results of large attacks, however, you must assume a range of factors: total size of attack, size of individual weapons, type of burst, and — most controversial of all — the nature of the targets. In other words, you must try to divine the enemy's strategy. Any estimates you produce reflect the assumptions with which you begin.

In the chart above, you see an attempt to picture the range of possible attack — from a level that is credible now to one that might be credible in the future. It also shows the effects of some of the variables. For example, in this case the assumption is made that 10-megaton weapons would be used. Of course, it is possible that an enemy might employ bombs both larger and smaller than 10 mt, with somewhat different results.

Another important variable is the burst pattern. Surface bursts do the most blast damage to missile sites and airfields, hence might be chosen for military targets. They also yield radioactive fallout that can kill people and disrupt life many miles from the target. On the other hand, air bursts inflict blast and fire damage on two to three times more area. These might well be used against "soft" military targets and centers of population.

Target selection. Biggest variable of all is the enemy's selection of targets. The chart shows two patterns for each level of attack: one concentrated on military targets, the other divided equally between military targets and cities. In both cases, half the bursts are in the air, and half are on the surface.

The smaller attack, directed partly at cities, could actually cause more deaths and damage to industrial facilities than would the larger attack aimed solely at military targets, because industrial facilities tend to be concentrated in or near centers of population. These figures point up the crucial role targeting would play.

The chart at right above shows what might be accomplished by a really good protective program — a goal that could be reached only by a major change in the nation's present unprepared posture. It should be noted that the chart assumes a one-day war; losses would be different — and probably greater — if a big attack were followed by several smaller ones.

Imperfect as such estimates must be, what can they teach us? How should we interpret them?

Clearly, these figures — and those of other authorities — reveal the sheer size of the problems posed by nuclear attack. Right now, a single blow could cost us 40% of our industrial facilities and, without protective measures, 39% of our population.

Destruction varies. In assessing this grim picture, it is important to realize that destruction would not be universal. Nor would it be uniformly distributed. Some areas would be essentially unaffected. Others, nearer targets, would be physically untouched but contaminated by fallout. Closer in, there would be areas with even greater fallout concentrations, plus fire damage. Moving in still closer, blast damage would be heavy, and fire and fallout would make conditions still worse. Finally, there would be centers of virtually complete destruction.

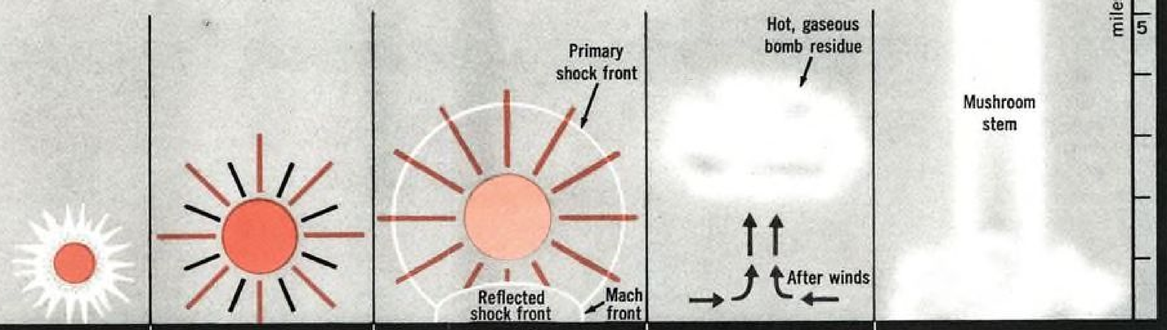
It should be clear that no company management can predict which of these varying degrees of destruction might hit its facilities. It is equally clear, however, that there would be many areas in which protective measures, such as shelters, would be effective, as the casualty figures demonstrate. And the "graded" nature of the damage offers some clues to the approaches management might take in planning for survival — approaches that will be examined in more detail later in this report.

Finally, this effort to gage the dimensions of the disaster resulting from a large-scale nuclear attack gives some idea of the environment in which individuals and companies must try to rebuild. There would be no "business as usual", even in the relatively unscathed areas of an economy that has suffered major disruptions to the services on which industry depends — communications, transportation, utilities, raw materials, fuel, food, money and credit, to name some. This glimpse of the post-attack period gives urgency to efforts to plan now for the problems of the recovery.

In the following pages, this report tells business and industrial management what it needs to know about:

FIVE STAGES OF A NUCLEAR AIR BURST

Times and distances shown are for 1-mt bomb; both would increase with larger weapons.

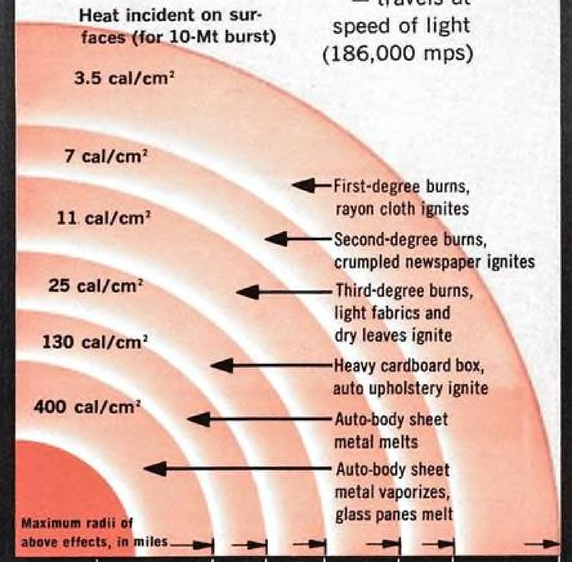


First few millionths of a second	0 + 2 seconds	0 + 5 seconds	0 + 37 seconds	0 + 2 minutes
FIREBALL APPEARS	NUCLEAR AND HEAT RADIATION	PROGRESS OF BLAST WAVES	FORMATION OF MUSHROOM CLOUD	FULL DEVELOPMENT OF MUSHROOM CLOUD

1. Instant release of bomb's vast energy raises temperature of its materials several millions of degrees, gasifies them to form a roughly spherical luminous mass. Emitting nuclear and thermal radiations, this "fireball" grows and rises. For a 1-mt weapon, maximum diameter of 1.4 mi is reached in about 2 seconds. Very shortly after explosion, shock wave develops and moves rapidly away from fireball. When shock wave reflected from earth surface meets primary wave, the reinforced "Mach front" forms and moves outward. Rising ball of fire, no longer luminous, creates strong updraft and "after winds" that raise dust and debris. With condensed bomb residue, these form radioactive cloud

THERMAL RADIATION

— travels at speed of light (186,000 mps)

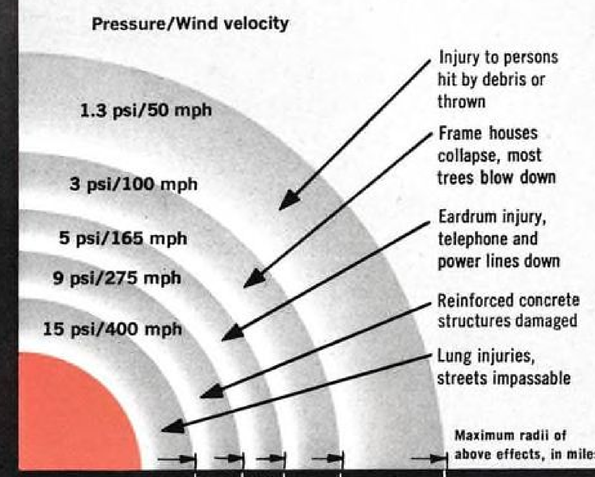


1 Mt	Air	1.5	2.7	5.5	8	9	13
	Surface	0.9	1.6	3.3	5	5.5	8
10 Mt	Air	4	7	15	22	25	35
	Surface	2.4	4	9	13	15	21
100 Mt	Air	11	19	45	60	70	100
	Surface	6.5	11.5	27	36	42	60

2. About 35% of total bomb energy goes out in a burst of heat, uniformly radiated. Heat level falls rapidly with distance, as shown in calories per square centimeter at successive circles, above. Figures below give clear-day radii of circles for three weapon sizes, two types of burst. Also shown are possible effects on materials, people

BLAST

— travels faster than sound (over 770 mph)



Air	1.4	2.6	3.9	5.3	8.8	
Surface	1.5	2.0	2.9	4.0	7.2	
Air	3	5.6	8.5	11.3	18.5	
Surface	3.2	4.4	6.1	8.5	15.5	
Air	6.5	12	18	24.5	40	
Surface	6.9	9.5	13	18	33	

3. About 50% of bomb's total energy goes into blast; the front of the blast, called the "shock front", travels rapidly away from the fireball, behaving like a moving wall of compressed air. Chart above shows various levels of blast pressure, equivalent wind velocities, and possible effects in the annular zones between successive circles

NUCLEAR EXPLOSIONS: What are the immediate effects?

The split-second blast of a modern nuclear weapon lets loose awesome amounts of energy — so awesome, in fact, that it is usually measured by comparison with the force of thousands or millions of tons of TNT (*kilotons* or *megatons*). It would take a block of TNT the size of New York's Empire State Building to duplicate the energy release, or *yield*, of a 2-megaton nuclear bomb.

How can you pack that much wallop into the warhead of an ICBM? The answer lies in the way a nuclear explosion unlocks the vast forces inside the nucleus of the atom. There are two techniques for doing this:

- In *fission*, you split the nucleus of a heavy element — such as uranium-235 or plutonium — into two lighter nuclei, called *fission products*. If fission were 100% complete — it isn't — 1 lb of U-235 would produce the energy of 9000 tons of TNT.
- In *fusion*, you cause two light nuclei to unite into a single heavier one. Fusion will create, from the same mass of material, nearly three times as much energy as does fission. But to trigger the fusion process, you need temperatures akin to the heat of the sun. To produce this heat, you use a fission explosion. Fission triggers fusion. Then, as an extra dividend, more fission results because fusion liberates high-energy neutrons that split some of the atoms left intact by the first fission. This combination — fission, fusion, then more fission — adds up to the terrible energies of today's thermonuclear weapons.

Sequence of events in a nuclear explosion appears in Fig. 1, above. First there's a flash of light that can be literally blinding — eyes turned directly toward it suffer retinal burns, even at distances of hundreds of miles with megaton blasts. How much damage is done to the eye depends on such factors as weapon size, height of burst, time of day, weather, and speed of blink reflex.

Millionths of a second after the bomb is detonated, the *fireball* forms and grows by engulfing surrounding air. In about two seconds it reaches a maximum diameter of 1.4 mi for a 1-megaton (1-mt) bomb. Maximum diameter is 3.4 mi for 10 mt, 4.6 mi for 20 mt. When the burst is low, and the fireball touches earth, all above-ground installations within it are vaporized or otherwise destroyed, except for heavy concrete structures.

Simultaneously, the explosion releases an initial burst of radiation — about 5% of the bomb's total energy — that is itself lethal over an area about the size of the fireball. This radiation includes high-energy neutrons and gamma rays. Additional gamma rays come from radioactive bomb materials and fission products.

Heat and fire. The fireball sends out *thermal radiation* in two pulses, making up 35% of the bomb's total energy. The first pulse, a split-second ultraviolet flash, isn't a major hazard. But the second is: mostly infrared, it carries nearly all the heat of the burst, lasts several seconds. As the heat radiates from the fireball, it spreads over ever greater areas, so heat levels diminish sharply with distance (Fig. 2). Low clouds or fog tend to cut heat, but high clouds can act as reflectors, raising heat levels on the ground.

Because heat is applied only for a matter of seconds, light, easily kindled materials are most likely to ignite. But surveys show typical American cities contain 5 to 25 points per acre where fires might begin from thermal radiation. Although it's hard to predict precisely, there's a danger that many small fires might merge into single, great "firestorms", with strong updrafts at center creating violent cyclonic winds.

Thermal radiation travels like light. So ducking quickly into a shadow or covering exposed skin with clothing offers some personal protection.

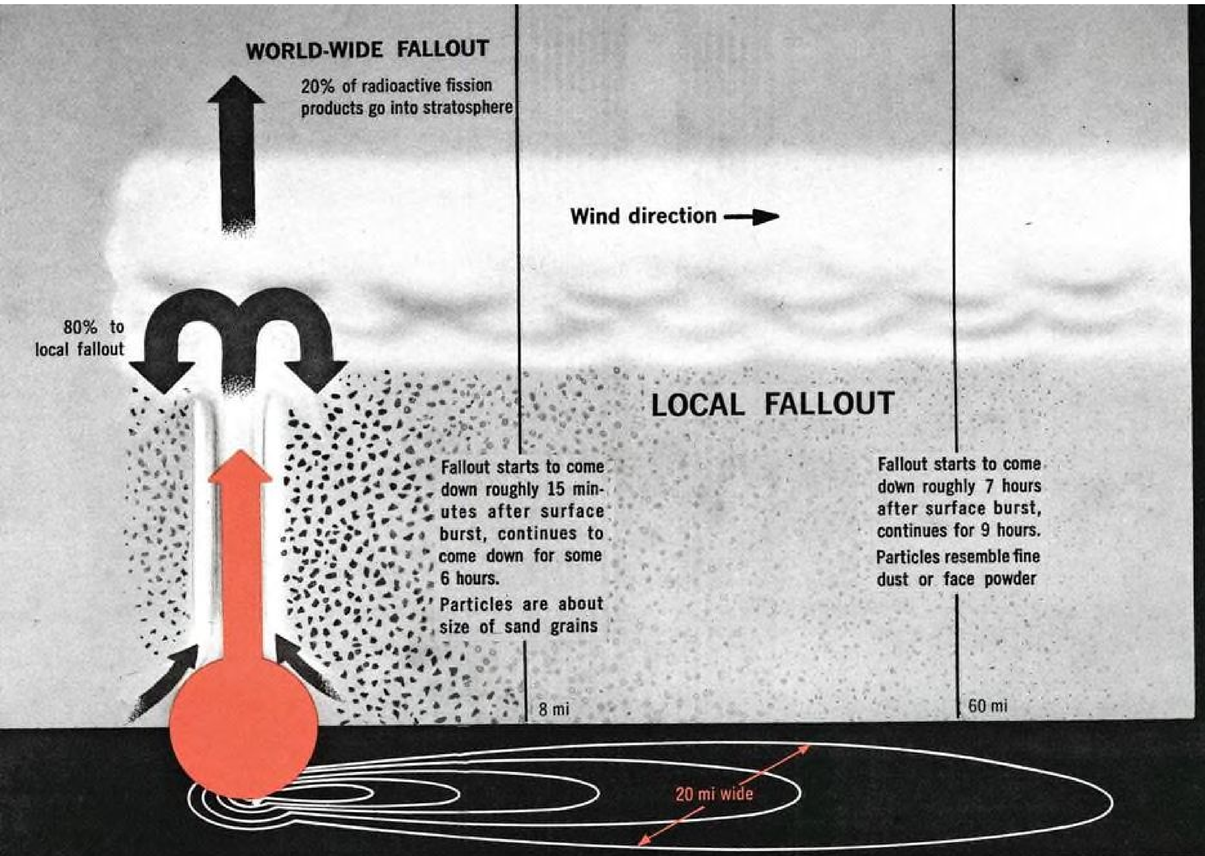
Shock pressures. In about the time it takes for a thunderclap to follow a lightning bolt, the blast wave follows the thermal flash; about 50% of weapon energy is in this form. The blast wave starts as a high-pressure shock front, traveling somewhat faster than the speed of sound. After a few seconds, a negative-pressure phase follows. The effect is to first squeeze and then expand or explode structures and human tissues.

Along with these great swings in pressure, there would be short wind gusts of enormous velocities — up to 1000 mph near ground zero. Drag forces of these winds would inflict much of the damage to buildings and the bulk of blast injuries to humans. As Fig. 3 shows, shock pressures in themselves would be fatal over only a small area by comparison with the area in which pressures and winds would hurl people and objects through the air to cause injury and death.

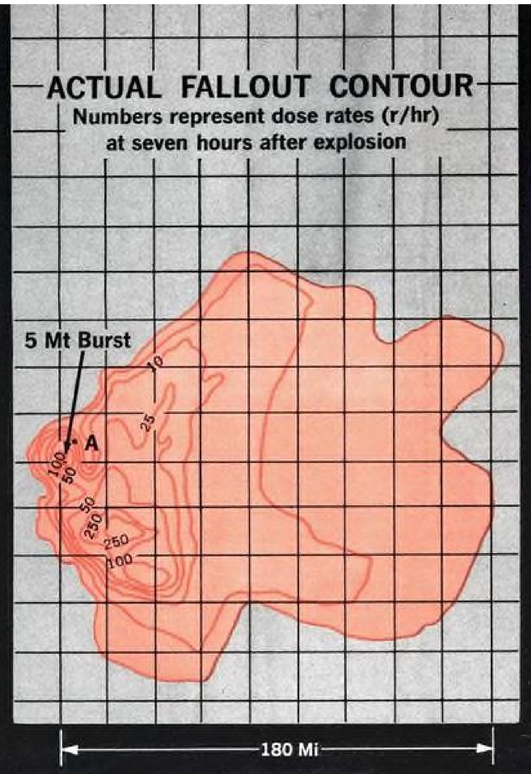
Near ground zero, pressures and winds are higher in a surface burst than an air burst. Farther out, an air burst creates stronger pressures and winds because the blast wave bounces off the earth and reinforces the primary wave to create the so-called "Mach front" (Fig. 1).

In areas of heavy blast damage, fires will be started by broken gas mains and electrical short circuits. They will feed on the kindling produced by the blast.

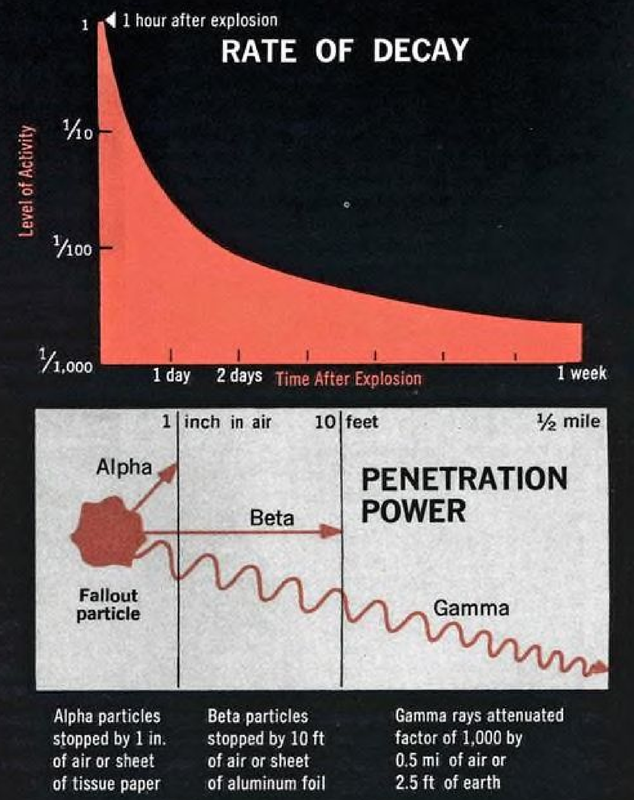
Thanks to the relatively slow speed of the blast wave, there is often time to take evasive action, such as dropping flat, or seeking shelter below ground.



4. In contrast to air bursts (Fig. 1, page 4), where fallout goes mainly to the stratosphere and may travel far, surface bursts are characterized by heavy local fallout. This results from great amount of debris swept up into the fireball. Like the materials of the bomb, such debris is initially vaporized. Material swept up later may be only melted. When the vaporized materials, including fission products and materials made radioactive by neutron bombardment, condense into fine particles, many of these adhere to larger debris particles. Resulting size keeps particles from rising high, causes them to settle out over large areas as the radioactive cloud moves with the wind



5. Theoretical pattern of fallout distribution at ground level appears at base of diagram on facing page. In contrast to this cigar-shaped pattern, actual distribution may be highly irregular, as illustrated above. Note particularly the several local "hot spots" and the fact that radiation intensities do not always fall off downwind



6. Radiation from fallout particles decays rapidly at the beginning, as shown in upper curve. This radiation takes three forms: Alpha and beta radiations consist of atomic particles that do not travel far, can be stopped easily. Gamma radiations are true rays, like X-rays. They can travel relatively far and they have great penetrating power

NUCLEAR EXPLOSIONS: How fallout hazards develop

A nuclear explosion vents about 90% of its total energy immediately — in initial radiation, heat, and blast. The other 10% shows up afterward, mainly as radiation from fission products that rise with the mushroom cloud. Sooner or later, they descend to earth as *fallout*.

Fallout has its origin in the fission chain reaction that triggers the nuclear blast. This forms more than 200 different radioactive isotopes, which begin at once to *decay*, each at its own rate. Some decay almost completely in a matter of minutes, others so slowly that years later they are only slightly less radioactive. The differences in decay rate are a crucial factor in determining the hazards of fallout, and also in distinguishing between the two types of fallout — global and local.

Global fallout is the type that has resulted from weapons tests already conducted, most of them air bursts (Fig. 1, p. 4). Fission products formed by such a burst first vaporize, then condense as extremely fine particles that rise into the stratosphere and travel with upper-level winds for long periods of time. Meanwhile, decay eliminates all but the long-lived isotopes, such as the much-discussed strontium-90. When the particles do drift down to earth, they are widely distributed. So they raise the radiation level at any given point only minutely.

Such increases in radiation levels are considered to produce genetic effects. And strontium-90, moving from the earth's surface to plants and to food, can be selectively absorbed by the human body to cause bone cancer. Because these are all long-range effects, the impact of global fallout from nuclear tests is widely debated and will be truly known only in the future, when sufficient statistical data have been accumulated and analyzed.

Local fallout is much quicker to take effect — and much more dangerous. This type of fallout results from surface bursts, which would probably be part of a nuclear attack. Fission products from the explosion agglomerate with larger particles of debris (Fig. 4, above) and roughly 80% of them settle to earth in a matter of hours. Heavier particles descend in the first hour or so; lighter ones take several hours or more and winds carry them over hundreds of square miles. The major and immediate danger of this local fallout is radiation from these particles as they sift down over land and buildings.

The other 20% of the fission products from a surface burst go into the stratosphere and become global, or worldwide, fallout. Because fission products are created in direct proportion to the amount of material exploded, a nuclear attack involving thousands of megatons would produce much more global fallout than has resulted from all the weapons tests so far.

Theoretical calculations to determine the distribution of local fallout usually assume that the wind blows in just one direction at 15 mph. Under such conditions, radioactive fallout will tend to settle in a cigar-shaped pattern (Fig. 4, bottom), with radiation intensity diminishing in the downwind direction and toward the outside edges.

In practice, however, winds at different altitudes move in different directions at different speeds. So actual patterns of fallout tend to be highly irregular (Fig. 5). This means that it isn't safe to use reports of general radiation levels as an estimate of hazards in your area. The only sure answer is to measure radiation locally.

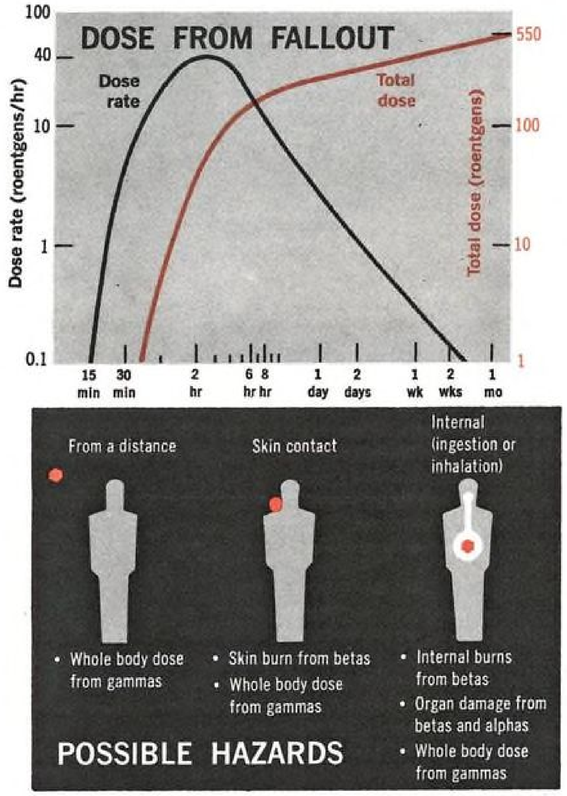
How to measure. Fallout particles emit three kinds of radiation (Fig. 6), but only one — *gamma* radiation — is of major importance. Gamma radiation is like X-rays and you gage exposure, or the *dose*, in the same units — *roentgens*. To measure the dose *rate* or radiation intensity, you use roentgens per hour (r/hr).

An instrument called a *dosimeter* will show the radiation dose to which you have been exposed. One common type, designed to be worn, is shaped like a fountain pen. Dosimeters of this sort usually record accumulated radiation up to about 600 r. In addition to keeping track of the total dose you have accumulated, you should also know the rate at which radiation is being received (r/hr). This can be crudely done with a dosimeter, by noting the increase in total dose over a period of time. For greater convenience and accuracy, a similar pen-shaped device is calibrated to read the rate up to 100 r/hr.

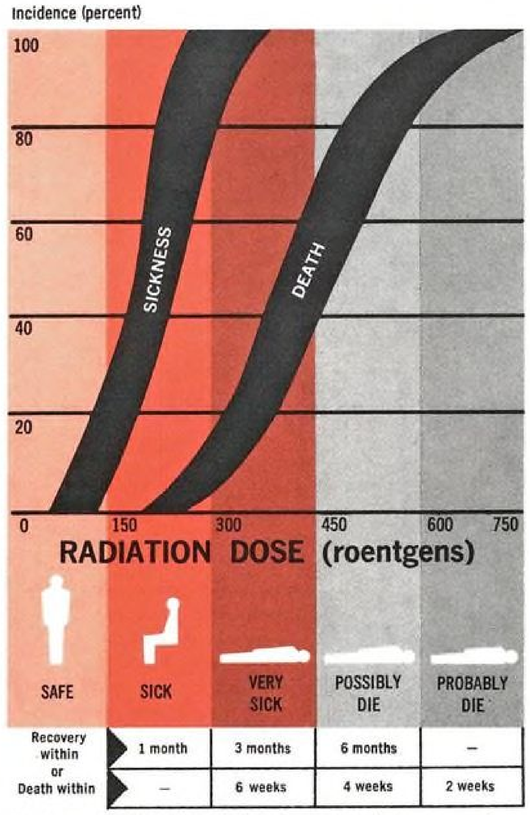
More elaborate portable *ratemeters* are on the market to indicate radiation intensities up to 500 r/hr — although at such high levels hand monitoring is dangerous. For more safety, you can install a stationary ratemeter — capable of registering levels of 1000 r/hr or more — and hook it up for reading in a protected location, such as a group shelter. To use the more elaborate instruments properly, operators would need a few hours of special training.

Speeds of decay. In appearance, fallout particles have a glassy surface. They range in color from white to black, and in size from clearly visible "sand" to barely visible powder (several thousand *microns* down to about 20).

In any group of fallout particles, there will be a wide variety of isotopes, each with a different decay rate. For mixed fission products, the radiation level starts high but drops quickly (Fig. 7), as the isotopes with rapid decay rates spend themselves. An easy rule of thumb is that for



7. Radioactive fallout particles (lower diagram) can injure from a distance, on skin contact, or internally. Upper diagram shows whole-body gamma dose received by an unsheltered person at point A, Fig. 5. Dose rate reaches a peak when fallout is complete, then decreases as radioactivity decays. In contrast, cumulative dose continues to rise



8. Effects of whole-body radiation doses can only be expressed statistically. Curves show percentage incidence of sickness and death in a group of exposed persons, for doses accumulated in a few days. Effects prove less severe if accumulated over weeks or months. As indicated at bottom, radiation sickness is usually a drawn-out process

each increase in time by a factor of seven, the radiation level decreases by a factor of ten: Seven hours after a burst, radiation level will be 10% of the level in the first hour.

In practice, however, it's not quite so simple. The first fallout might not arrive for 15 minutes or more after the explosion. But then fallout might keep coming for a time, and more than offset the decay that was occurring. As fallout slacked off, however, decay would begin to push radiation levels down, and after all fallout had arrived, the "rule of seven" would apply with reasonable accuracy for several months. So the rate of change in radiation would look like the humped curve in Fig. 7. But the dose accumulated by an exposed person would continue to increase, although more slowly after fallout has stopped coming down and the peak of the rate curve has been passed.

Radiation hazards stem from the fallout particles themselves. The air through which fallout passes, and the surfaces on which it settles, do not themselves become radioactive. Remove the particles and there is no danger.

Alpha and beta radiations from fallout particles penetrate such a short range that they are dangerous only if you cannot avoid inhaling, ingesting, or coming into skin contact with them. Gamma radiation is more perilous, however. It can be effective a considerable distance from the particle and has great penetrating power, hence ranks as a major hazard. An hour after a burst, the accumulated fallout on a 30x40-ft lawn — measuring at most 1/10 inch deep — might subject a person standing in the center to a dose rate as high as 1000 r/hr.

Effects of radiation on humans depend on such factors as age and general health. But statistical projections (Fig. 8) show that some people would not survive a dose of 300 r received over, say, 24 hours, while a few others would recover from twice this dose. Recent studies suggest that it is possible to survive even greater total doses accumulated in small units over long periods of time.

Radiation causes sickness primarily by damaging the blood-manufacturing centers in the bone marrow and lymph glands. In early stages it is usually accompanied by nausea, diarrhea, general malaise. These symptoms usually appear during the first day. Loss of hair, and skin ulcers, may follow in more severe cases. There is no specific treatment, but antibiotics and blood transfusions may help. Recovery is slow, involving weeks or months (Fig. 8). The sickness is not communicable.

For more details, consult "Effects of Nuclear Weapons" ($2) and "Comparative Nuclear Effects of Biomedical Interest" (CEX58.8) ($1), both published by the Atomic Energy Commission and for sale by Superintendent of Documents, Washington 25, D. C.

There is also a wealth of information in the record of hearings conducted by the Joint Committee on Atomic Energy (June 1959) and the Committee on Government Operations (August 1961).

SURVIVAL AND RECOVERY:

Why industry needs to plan now; how to go about it

What can business and industry do to prepare for the possibility of nuclear attack?

If your office or plant suffers a direct hit, obviously the answer is nothing. But the likelihood is that, even in a massive assault, the degrees of destruction would vary (pages 2 and 3). So you would have some chance to survive and to recover.

What plans should you make? As an executive, you are responsible for seeing that your company continues to exist and to function. In the narrowest sense, this responsibility is directly to the stockholders—the owners. More broadly, you have a responsibility to your employees, their families, the community, and the nation. Your company's organization and resources could be vital in coping with the crisis an attack would bring; the services it performs could be equally essential.

In the ordinary course of business, you plan some form of insurance to protect your company against a variety of risks — fire, windstorm, and so on. A large-scale nuclear attack is a risk that has never become reality. But it differs only in magnitude from the risks you routinely take into account. It is oversimplifying only slightly to say that you can apply the principles you use in preparing for other risks.

Seeking a balance. In building a conventional insurance program, you would try to assess the risk as realistically as possible — the degrees of damage that might be inflicted, how likely you are to suffer each degree of damage, how much it would cost to buy different amounts of protection. From these calculations, you would then strike some sort of balance, to give you the most protection possible for the money you can spend.

How would this approach apply, for example, to protecting your company's personnel from the effects of a nuclear attack?

You can't do much to protect against a direct hit, of course. But with nuclear attack, as with other risks, you don't assume that total loss is certain. The best estimates suggest that the most widespread danger will be from fallout. Second in order of probability comes fire; last is the combination of fire and heavy blast damage.

You must consider costs as well as probabilities. In general, the closer you might be to the target, the more it would cost to provide physical protection.

Balancing these two factors, it seems relatively easy to justify steps for protection against fallout. For a minimum investment, you can achieve some measure of protection against the most likely hazard.

But don't stop there: For comparatively little more money, you may be able to buy some degree of protection against fire and blast. It depends on your situation, of course; to find the most practical answer, you must weigh the increasing costs of greater protection against the decreasing scale of damage probabilities.

Plans such as this for protecting personnel are only part of the over-all thinking that should go into the effort to survive a nuclear attack—and recover. Ideally, you should consider every element of your company's operations—such matters as preserving its framework of organization, its assets of all kinds and the records that prove ownership, its productive knowhow. And, when new facilities are planned, you should consider the problems of survival under nuclear attack in their location and design.

Guidelines. To draw up an effective plan, you might think broadly along these lines:

- The plan should start with top management—and top management should give it continuing support. This means launching the preparations with a meeting of directors or key officers, assigning the planning job to responsible people, informing employees of the policy over the chief executive's signature.
- The plan should be firm. In other words, it should not ebb and flow with the tides of international tensions, as some past planning has done.
- At the same time, the plan should be frequently reviewed to keep it in tune with changing conditions. New weapons, for example, might make your previous preparations obsolete.
- The plan should suit the community. You should coordinate it with plans of local government and neighboring industries. You should also consider what to do about employees' families and nearby residents. But, in most cases, you probably shouldn't count on civil defense authorities to solve all your problems for you.
- The plan should be suited to your company — its own resources, problems, type of operations. Some companies have found that streamlined procedures devised for the emergency plan can be applied to make everyday operations more efficient.

These, in broad outline, are some of the goals to aim for in preparing a plan for your company. More details on how to plan follow.

SURVIVAL COORDINATOR

In a typical company's organization for survival, this would be the key man, directing, with top-management support, a Plant Survival Advisory Committee composed of the heads of the functions outlined (right). He would probably be chosen from upper management, since he must be well able to plan, organize, and delegate authority. He must believe in the importance of the job.

His first task would be to master the fundamentals of the assignment, by reading and special training. Then he would select top aides—who may now be heading up departments related to survival functions.

Broadly, the coordinator must plan the complete program for survival, help organize each of the functions, spell out responsibilities, designate shelter areas in existing buildings or provide for them in new ones, set up an emergency headquarters.

Other jobs would include linking the company's program with other community plans, arranging mutual aid, spotting vulnerable points in the utilities and process areas, preparing a survival manual for employees.

Periodically, the coordinator must report to top management on the company's readiness to survive an attack and on progress and shortcomings of the program to date.

The coordinator must always be alert to keep training and drills from slipping into routine. He should groom an assistant to step into his shoes. Finally, his compensation should reflect his importance.

ENGINEERING

Members of the company's engineering staff would form the nucleus of the survival engineering group. Its job: to design shelter areas, perhaps with consultants; to equip shelters with utilities — emergency generator, water, light, heat or cooling, ventilation and air filtration, sanitation; and to operate and maintain equipment in shelters.

Sanitation in shelters would be a major problem that engineers must carefully think through in all aspects—toilet facilities, garbage, housecleaning, burial of the dead.

Engineers would help the communications group decide what equipment is needed, then help install and maintain it.

They would also work with the radiological team on such matters as monitoring equipment, building and plant design features to make decontamination easier, radiological control of decontamination and plant repair procedures.

When an alert sounds, engineers must be ready to shut down the plant—and to reduce the risk that the halt in production might cause fire, explosion, or escape of dangerous fumes. Fuel lines should be closed, most circuit breakers tripped in main substation. However, it would be wise to use regular sources for electricity and fuel in shelters as long as they were available, to lessen the load-time on emergency sources.

Engineers must be prepared to make some repairs to shelters—from blast or fire damage, say—and to the plant after attack.

SHELTER MANAGEMENT

The team charged with shelter management would cope with all the problems of sustaining life in close quarters cut off from outside. Key men would probably come from the personnel department, with help from specialists in other areas. They would face problems such as:

- Mass feeding. The team would decide whether to use austerity rations, canned or dried, or a more nearly normal diet prepared in a shelter kitchen. It would also decide how much food to stock.
- Water. Questions would include how much would be needed, how to dispense.
- Sleeping accommodations. The program should set up a scheme for rotation; some people sleeping, others eating, etc.
- Assigning chores. This would keep people busy, shelter operating smoothly.
- Installing lockers. In these, employees could store personal needs in advance.
- Stocking supplies. The list would include reading and recreational materials, clothing, blankets, and so on.

To help bolster morale, personnel staffers should be able to draw on employees with special talents—excellent military records, entertainment ability, religious leadership.

The shelter management team would carry out the plan—if any—for accommodating employees' families in the shelter. It would work with the transportation team to evacuate shelters if necesary. And it would handle the many human problems.

HEALTH

Looking after health problems would be the job of the plant physician, aided by his nursing staff and a special team trained in first aid and emergency medical care. Don't expect outside help until well after the attack.

Each shelter should contain at least one health station, stocked with drugs, oxygen, and supplies for treating the effects of possible chemical and biological warfare. There should be plans for meeting psychological problems.

With the shelter management team, the health director would plan for moving casualties to treatment stations and identifying them. This could be simplified by use of "dog tags."

FIRE AND RESCUE

A trained firefighter should guide this team. During attack, it would have two jobs—to control fire and to clear damage for health teams.

In the planning phase, this team would pinpoint plant areas where fire danger is greatest, such as stockpiles of flammable materials. If hazard can't be eliminated, engineering group may install sprinklers or other measures.

For effective rescue work, the team should have detailed knowledge of the plant's structure and production processes. This group would probably be last to enter shelters—and should be prepared to leave them for short, controlled periods to cope with emergencies.

RADIOLOGICAL

This vital team—most likely selected from the company's engineering staff—would focus on radiation problems. Among other things, it would:

- Estimate the protection from fallout that is available in various shelter areas.
- Buy radiation measuring instruments.
- Monitor radiation levels and be on alert for agents of chemical and biological warfare.
- Plot fallout patterns in surrounding areas.
- Record individual dosages of radiation.
- Analyze food and water to assess contamination—and supervise its removal.
- Working with the engineers, this group should plan, and supervise, decontamination.

COMMUNICATIONS

The goals of this group would be to link the company with the nationwide alert program, set up a plant warning system; provide for emergency telephone, telegraph, radio equipment; staff a communications center connecting all plant shelters; keep in touch with local civil-defense authorities and the community if possible, help employees contact families.

The team might also publish some version of the company newspaper in shelters, perhaps in mimeographed form. The shelter communications center should include a public-address system; it might sometimes be advisable to hook Conelrad broadcasts into this system.

SECURITY

Built around the company's present security force, this group would be an in-plant police team. The chief could recruit as aides employees with military or similar qualifications.

The men would need training in maintaining order, handling crowds, and coping with panic, and they should be prepared to prevent looting. They would map emergency routes to shelters, both inside and outside plant grounds.

At all times, this group should be on the alert for possible espionage and sabotage. It would establish liaison with state and local police and assist them in carrying out any emergency plans for community security.

TRANSPORTATION

Trucks and manpower would be needed before and after an attack. The core of this program would be a fleet of trucks well equipped for radiological monitoring, first aid, carrying casualties and supplies, emergency repair of utilities. These vehicles would link the company with others participating in a mutual-aid plan.

In developing emergency transportation plans, this group should tie in closely with local civil-defense authorities and should coordinate its efforts with those of other plants in area.

During the early period of recovery, bulldozers — possibly shielded — would push contaminated earth and debris away from the plant.

THE SURVIVAL PLAN: How to set up the organization

Once your company decides to plan a survival program, the first step would be to appoint a coordinator, or director. Then management must work with him to form the organization he would head.

The key areas in such an organization are outlined above. To fit your own operation, it may be possible to eliminate or combine some of the areas; on the other hand, you might have others to add.

At the outset of planning, it would be wise to consider enrolling key personnel in the Office of Civil Defense Staff College at Battle Creek, Mich., for training in the problems they will face.

In developing your program, you can profit from a mutual-aid plan. Besides arranging to assist neighboring companies and the community in an actual emergency, you can exchange study results and balance one company's assets against another's liabilities — one may have abundant shelter space, another portable self-powered generating equipment, a third skilled disaster teams, a fourth large food supplies.

One of the first problems in your plant would be the attack warning system. Your internal system should be hooked up to receive the national alert instantly. Several techniques are under study for a nationwide alert; closest to reality is NEAR — for National Emergency Alarm Repeater — which uses existing electric power lines. Using a high-frequency signal, NEAR would reach about 95% of U.S. buildings within one minute. After hearing signal, you would turn on a radio for more information. NEAR units — expected to be available at low prices — could be plugged into any 120-v outlet.

The alarm in your plant should trigger production shutdown, and the moving of people to shelters.

Another immediate concern would be surveying how vulnerable the plant is to damage from attack. You should look, for example, for combustible materials that might easily be ignited, for large glassed areas that could be hit by blast, for narrow entrances or passages that could hinder the movement to shelters. You should also take note of points in the production process where damage or loss might cause major, long-time shutdowns.

Participation. Over-all, the urgent need in your planning would be to train personnel as quickly as possible, prepare them to be self-sufficient for some time after attack.

To be most effective, the company's plan should call for training all employees to take part in some way. Acceptance by employees could be encouraged by consistent management support, by constant efforts to keep the program vital and interesting, by regular checks of the coordinator's staff, by quick dissemination of the latest information on civil defense and community programs, by enlisting support from unions and community groups.

The problem of keeping a disaster team efficient — perhaps for years—challenges the resources of the most imaginative company officer.

To complicate the problem, the planning should include decisions on what to do about protecting off-duty employees, families, and such people as visitors and contractors who happen to be at the plant when attack strikes. If your community is one where families live fairly close to the plant, you might think seriously about accommodating them in the plant shelter, as part of your broad responsibility to employees and the community.

Sustaining morale. In setting up a shelter, you must consider more than engineering (pages 12-13): One concern — largely unpredictable — is morale and discipline. Sweden has tried to ease the problem by using color and design extensively to make shelters brighter. Morale can also be influenced by such factors as the amount of space available to the individual; providing routines and chores, entertainment, spiritual guidance; keeping families together; and taking action in cases of hysteria and panic.

It would probably be best to leave discipline to supervisors and others accustomed to exercise authority. With training, the plant security force could help the shelter-management group to direct routines, and the medical team to handle shock and panic victims.

You should make generous provision for food, clothing, and blankets in the shelter. For the food planner, a great deal of information is already available. Perhaps the basic study is "Food Stockpiling for Emergency Shelters," published by the Food & Materials Div. of the U.S. Dept. of Agriculture's Commodity Stabilization Service. OCD and USDA offer many other pamphlets on the subject.

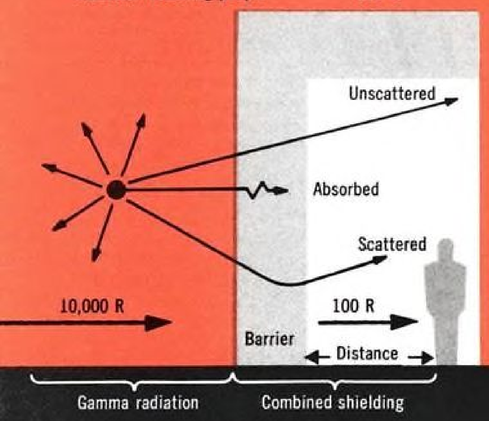
Another question would be how to distribute food in the shelter. If the company cafeteria can be moved into the shelter area, mass feeding is probably the answer — although cooking in the shelter would require some source of heat. Or you might decide on stocking individual rations that supply minimum requirements in concentrated form. A variety of such subsistence foods is already available and on the market.

Study of your plant and employees would probably reveal other special needs.

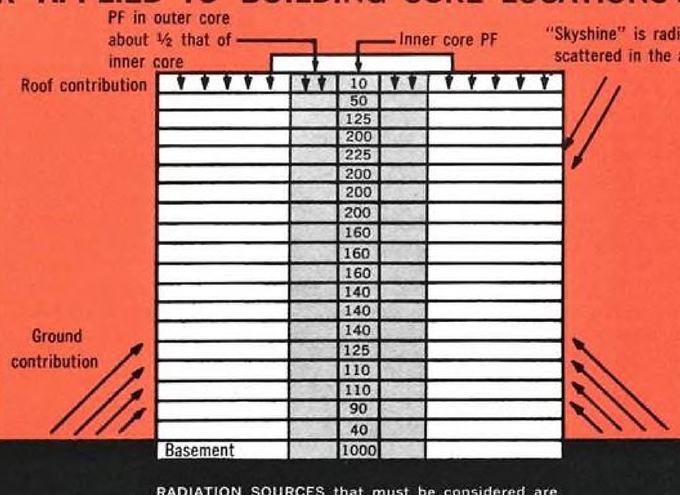
Engineering points to consider in planning a shelter are discussed on the following two pages.

FALLOUT PROTECTION FACTOR APPLIED TO BUILDING CORE LOCATIONS . . .

$$PF = \frac{\text{Radiation level outdoors}}{\text{Radiation reaching people}} \qquad PF = \frac{10{,}000\ R}{100\ R} = 100$$



PENETRATING POWER of gamma radiation through a barrier depends on energy level of fallout components, density and thickness of barrier. No material, regardless of density and thickness, completely blocks radiation

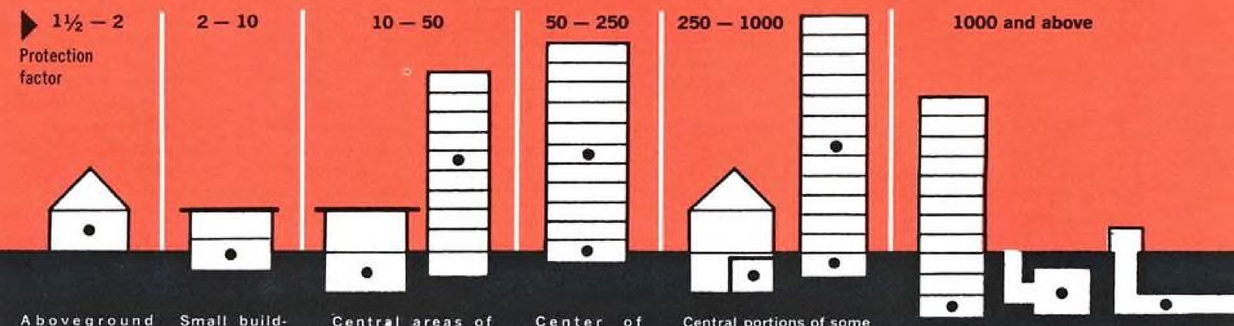


RADIATION SOURCES that must be considered are roof, ground and "skyshine". Don't overlook contribution from adjacent roofs and building setbacks. Note high PF areas in office building shown are within core on upper floors and basement. Structure studied has a steel-frame, concrete floor arches, masonry exterior walls, having 50% openings

TYPICAL PLANTS, COMMERCIAL BUILDINGS AND UNDERGROUND SHELTERS

LIKELY SHELTER LOCATIONS in any building are those offering highest protection factors. Illustration below gives a general idea of the relative protection found in common structures. Use it as a guide only, to estimate protection against fallout. The PF values listed may be conservative, being based on isolated structures.

Your shelter survey starts with knowing construction detail of all your buildings, number of people normally on the property, placement of utilities. Roughly estimate total group the shelter can handle by allowing 15 sq ft of gross floor area per occupant. Gross area includes columns, some fixed equipment, storage for shelter supplies. Net area per person should be 10 sq ft. Shelter occupancy time may be limited by room volume rather than area, particularly in absence of mechanical ventilation. Natural ventilation from interior stairways, shafts, extends stay. Fresh air minimum: 3 cfm per person



Aboveground areas of low buildings including residences, stores, light industrial type of structure

Small building having partly exposed basement: (or 1st fl of heavy wall structure)

Central areas of some upper floors in a multistory building with light floors, walls. Basement in a 1- or 2-story bldg

Center of some upper floors, basement, in heavy multistory type building

Central portions of some upper floors in high-rise building (more than 10 stories) and basement in a multistory structure: heavy floors and walls

Subbasements of multistory buildings. OCD underground shelters and under-earth installations. Typical: mines, caves

THE SURVIVAL PLAN: What about physical protection?

As you set up a company organization for survival, a prime ingredient in the plan would be finding the best way to protect your people against the effects of nuclear explosion — primarily against radioactive fallout, but also as much as possible against blast and fire.

After an attack, fallout would threaten you from three directions (drawing, right, above). Some would accumulate on the ground around your plant, and some on rooftops. In addition, building walls would feel the radiation scattered by the air, sometimes called "skyshine".

Key to protection from fallout is to place a physical barrier between it and you—steel, concrete, earth, water, or wood. How well a material screens you depends on its density and thickness. To do an equal job of absorbing radiation, you would need thicknesses of 0.3-in. of lead, 0.7-in. of steel, 2.2-in. of concrete, 3.3-in. of earth, 4.8-in. of water, and 8.8-in. of wood. These figures represent a quantity called the *half-value layer thickness* or HVL.

The HVL figure shows in inches how much thickness of each material is necessary to stop half the gamma radiation outside from penetrating the barrier. Each HVL thickness you add to the first reduces what comes through another 50%. Two HVL thicknesses side by side let in only 25% of the total gamma radiation outside; adding a third HVL thickness lets in but 12½%, and so on. This is true as a general concept, results vary with specific conditions.

Use a material's HVL figure to approximate how effectively a barrier will soak up radiation energy. But the practical value of the barrier — its *protection factor*, or PF — depends on the location of the fallout in respect to the barrier and on the area of fallout.

A building's geometry plays an important role in protection against fallout, too. For example, protection factors would differ in two tall buildings of the same height and construction if one covers a larger area than the other, neglecting roof contribution. At the center of the first floor, the PF would be higher in the structure with the larger base simply because at that point you would be farther from the outside ground radiation. Likewise, the PF would differ at first floor center of two buildings with similar base areas and construction but varying heights. Neglecting ground contribution, the taller building would offer more protection because radiation would have farther to go from roof to first floor. Of course, in such calculations you must also consider the contribution from fallout on roofs of adjacent buildings.

What is a minimum acceptable protection factor? There is no standard figure, since it is impossible to predict the radiation level to which you might be exposed. One commonly suggested minimum is 100.

For many structures it may be practical to adopt the "core" shelter plan—in which you would set aside one area of a shelter offering highest possible protection, perhaps at the well-protected center. People would be crowded into this core, however uncomfortably, during the hours of peak fallout, then rotated between the core and shelter areas with lower protection factors. Or the rotating schedule might be used from the beginning of the shelter stay.

Spotting safe areas. A survey of your building should reveal areas that would offer some fallout protection without radical change. The choice would quickly narrow to areas with walls and ceilings of thick, high-density material and few windows and doors. Some degree of safety would be available, for example, in sub-basements, basements, centers of masonry buildings. You could thicken existing walls if necessary, and concrete baffles could be placed a few feet or so in front of windows and doors to screen out radiation while leaving them in service. To further guard, primarily against roof fallout, you could erect false ceilings using supported concrete planks.

For detailed help on how to survey structures for fallout protection, consult Office of Civil Defense publication NP-10-2, *Guide for Architects and Engineers*.

Shelters from scratch. If adequate shelter areas cannot be created in present buildings, you would probably construct new ones designed primarily as shelters. Such a structure could be engineered to withstand some blast and fire as well as fallout. It could take one of several forms; there are many designs for combination blast and fallout shelters. Some are all concrete; others use a multiplate corrugated-steel arch set on a concrete slab. Latter shelter could be built above ground, with an earth mound completely covering it; partly underground with an earth cover, or entirely underground. An underground shelter could be designed as the sub-basement for a building to rise on this foundation later. Whatever the choice, you should try to give the shelter some peacetime use—perhaps as a plant cafeteria or recreation center.

Typical group shelter suggested by the Atomic Energy Commission (in its booklet CEX-58.7) would accommodate 100 persons with a protection factor of 10,000 against fallout. This shelter would withstand blast pressure of 35 psi—which should make it safe against blast effects of a 10-mt weapon to within a few miles of ground zero. Tests have shown it could withstand a firestorm.

For any shelter, you must plan utility supplies. Water would be the first need; the best bet would be to store it in a closed system, unless you have a dependable well. Figure on a minimum of 2 quarts of water a day per person, another 2 quarts for washing. If you draw on public water supplies that might become contaminated or polluted, you should install filters for insoluble isotopes, ion-exchange for soluble ones, plus chemical treatment. You would also have to take account of buildup of radiation levels in ion exchanger and filters.

To provide ventilation, you could choose a variety of systems. For most fallout shelters, a simple mechanical ventilation system with filters to remove fallout particles should suffice.

A more elaborate system offers fully automatic, thermostatically controlled air conditioning for underground blast shelters. It draws 100% fresh air from outside, filters and conditions it to proper temperature and humidity, and removes used air. With an air conditioning system that removes carbon dioxide and adds oxygen, it would be possible to shut the shelter off from outside for 24 hours.

At the other extreme, in some situations you could use simple natural-draft ventilation.

Electric supply. You must also supply electric power to the shelter for lighting, ventilating equipment, some cooking, and possibly for sewage pumping. The answer would be an engine-driven generator and a stockpile of fuel. You should also install a separate electrical feeder from your main substation to shelter areas, so that you could use the normal power as long as it is available.

For sewage, you should include in the plans a collector tank with an ejector pump leading to a cesspool.

Decontamination facilities, for people who must come into the shelter after being exposed to fallout, should be installed near entrances. Recommended procedure includes removal and safe disposal of contaminated clothing, followed by a shower before donning fresh clothes.

The post-attack environment: What problems will it present?

In its day-by-day operations, your company depends on all sorts of links with the rest of the economy. It uses the services of the transportation, communications, utility, and banking systems. It relies—directly or indirectly—on outside sources for materials, fuel, food, and other supplies. It looks to the community to provide such essentials as water, sewage disposal, highways and other public works, health services, and the like.

Nuclear attack would tear that fabric and leave behind a patchwork of areas with varying degrees of damage (pages 2 and 3). For your planning, you need to visualize how this would hit your company—and what steps are under way to soften the blow and to restore services after an attack. It is impossible to predict post-attack conditions precisely, of course, and many present plans are tentative and subject to change. But here's a current summary of the probable situation in vital areas:

TRANSPORTATION — for moving food, fuel, medical supplies, material, and personnel — would be the service perhaps most essential to recovery. Railroads, with their fixed routes, are likely to be hardest hit. With adequate fuel supplies, trucks and other flexible forms of transport—such as aircraft—could operate by bypassing damaged areas.

Unfortunately, planning in trucking is confused by divided authority. One federal agency would have emergency control over carriers, another over the streets and highways on which they move. And this control seems to apply only to interstate carriers; there is no authority to coordinate intrastate truckers and private company fleets.

Present plans call for carriers to take these steps in emergency: (1) Warehouse all goods, sell perishables if possible. (2) Obtain permits —from at least one, perhaps three agencies— to start hauling priority traffic.

The industry has begun to form trucking mobilization groups that may become the core of a broad emergency transport system.

COMMUNICATIONS has several vulnerable points — among them the network of exposed lines and the lack of protection for radio and TV personnel and equipment. In addition, high-altitude explosion of large nuclear weapons could cause temporary radio blackouts.

Major common carriers are working to "harden" lines and equipment and to bypass likely target areas with self-contained underground communications channels. They also have repair crews, fully equipped and trained for disaster, spotted at widely dispersed points. Some radio and TV stations have launched protective measures. And there are plans for coordinating commercial and amateur radio operations to close gaps in coverage after an attack.

During the early period of recovery, communications facilities would probably be available only for highest priority messages.

UTILITIES are in danger because many power generating plants are concentrated geographically and because transmission lines are exposed. Suggested remedies include building multiple and interconnected lines, and dispersing switchyards. Many companies are studying ways to protect personnel and equipment, constructing alternate emergency control centers. Utilities have a major asset in personnel trained and experienced in dealing with disaster.

MONEY AND CREDIT is one area where plans are ready now. The Federal Reserve System has led other government agencies in preparing for the problems of recovery. It has made lines of succession and authority clear. Member banks have been encouraged to store duplicate records in safe locations from which they could operate if necessary. More than two years' supply of Federal Reserve notes has been placed at strategic points around the U.S. The Fed itself has an emergency headquarters.

A check with the Fed and its member banks may greatly simplify your own plans for meeting emergency needs for money and credit.

What are plans for restoring key segments of the U.S. economy?

AGRICULTURE: Food is not likely to be a critical problem early in the recovery, except for local shortages caused by transportation snarls. The grim probability: more food would survive than people.

Fallout does not harm food in cans or in non-porous bags and packages that remain closed. So most stored food would be usable, except in heavily damaged areas. Some of the standing crops that survive could be harvested and used after decontamination. Livestock killed by radiation would be edible if promptly dressed and refrigerated.

Food from current inventories and stockpiles would probably be sufficient to support the survivors while they slowly returned some fallout-contaminated farmland to cultivation.

PUBLIC WORKS would present a variety of problems. According to most experts, water supply would not be a serious worry. Surface waters and open reservoirs would be contaminated by fallout, but most of this could be filtered out. Some fallout would be soluble, however, and this might require either waiting for radioactivity to decay enough for safe use, or installation of ion-exchange treatment in addition to usual treatment for potability.

Water distribution systems, sewers, and streets would suffer various degrees of damage. Removing debris would be a huge chore in areas damaged by fire and blast. OCD has briefed state and city public works agencies on their responsibilities in these jobs. Emergency equipment—including generators, pumps, water purifiers, and pipe—are already on hand at 24 spots around the country. To encourage states and cities to buy similar supplies, the federal government will put up matching funds to equip and train local personnel.

Any company registering equipment, personnel, and engineering talent with a central disaster-relief organization can obtain "Plan Bulldozer" from Associated General Contractors. The plan includes instructions for a cooperative program to clear debris quickly.

HEALTH SERVICES will present one of the gravest post-attack problems. Even with effective shelters, an attack would leave many people injured and sick. Physicians, nurses, hospitals would be lost—most heavily in the areas with most casualties. And in the aftermath of attack would come infections and disease.

The U.S. Dept. of Health, Education & Welfare has designed a basic package unit for an austere but effective 200-bed general hospital. Some 1900 of these units have been bought and placed in critical areas away from likely targets. Plans are under way to distribute another 750 units and to equip all of them with 30-day supplies of medical equipment and supplies. HEW is also responsible for stockpiling plasma, serums, essential drugs, supplies.

To offset a shortage of doctors and nurses at least partly, HEW is readying a program called "Medical Self-Help." This provides basic training in first aid and general medical treatment. The course will be given to civil defense groups and industrial disaster organizations.

THE RECOVERY PLAN: What needs to be included in it?

Planning for recovery from a nuclear attack takes an almost staggering effort of imagination. You must try to visualize the shattering of our complex civilization, the breaking of the many links that tie our economy together (above). If you are to plan at all, somehow you must picture the problems attack would create for your company and its people — and prepare now to cope with them.

Problems of the early post-attack period would be basically similar to the problems of survival. So they could be tackled best by the same organization—which would be in control not only during an attack but in the weeks after.

After the assault, trained workers should be able to foray briefly into plant areas that have been damaged, or contaminated by fallout. They should work in relays, to expose each team member to minimum radiation. The purposes of such trips should be ranked by priority spelled out in your company's plan; at first, the goal should be only to take steps that would make shelter life safer.

Decontamination would be a major problem, particularly on roofs and on land surfaces around the plant. An automatic flushing system, draining to a safe distance, might help clean roofs; as mentioned earlier, a shielded bulldozer could scrape contaminated soil away from facilities. These chores must be under radiological controls.

A related job — subject to the same careful controls — would be removing debris from possible fire and blast damage and making repairs. Here again, priority should go to steps that would yield the most immediate benefit.

You must assume that you would perforce be self-sufficient for some time after an attack. But you would try to link up as soon as possible with any interrupted utilities. You should be equipped to test your water supply for radioactivity and potability until notified that it is safe.

Information needed. You should plan early efforts to contact others in the community—the civil-defense organization, disaster-relief groups, neighboring plants that might offer—or need—mutual aid. In this immediate post-attack stage, there would be a desperate need for information. Employees would want to know what happened to their families, their homes, the community; you would need to know about local supplies of food, fuel, and other supplies, about casualties, about regulations to keep law and order.

In some nations with extensive civil-defense plans — Sweden, for one — martial law takes effect as soon as an attack warning sounds. U.S. plans thus far made public do not call for martial law—although it would seem possible. Instead, the approach has been to try to insure that local and state governments would continue to function. Federal agencies have already done a great deal toward specifying automatic lines of succession for officials, setting up alternate headquarters or hardening present sites, preserving essential records. All but five states have taken some legislative steps along similar lines, although only a few have scored much progress.

Despite these steps, law and order could break down in some areas. So your company's plan should provide for handling such problems both inside and outside your plant. On the outside, your organization could help restore order in the community. This requires close integration of your group and local civil government.

Long-term plan. For the long-range recovery of your company, you face planning problems different from those of survival during and immediately after the attack. Logically, then, you should assign such planning to a separate group, usually drawn from top management. This committee's primary worry would be outlining steps to take, in advance, to preserve the company's organizational framework and the assets — tangible and intangible — on which it depends.

The bylaws of most companies tightly limit the board of directors—where it may meet, what constitutes a quorum, how new directors are elected, and so on. Such restrictions might make it legally impossible for the company to carry on if a massive disaster should incapacitate many directors, or resulting transportation snarls should prevent a quorum.

To correct this, your plan should include bylaw changes to permit surviving directors—or even a single director—to fill vacancies without delay, pending a regular or special stockholders' meeting. You might also create an emergency management committee, empowered to act for the board of directors under specified conditions. Any such steps should be based on careful legal study. Some states have modified their laws to give you more flexibility — or plan to do so — but others have not. A good starting point for your program: the literature on corporate continuity published by the Office of Civil Defense, industry and trade associations, and other such groups.

As a next step, you should review all company functions in the light of probable conditions during the recovery. From this review, you would be able to pick the most essential jobs and allot them among the company's staff — with successors named for each post. This succession, too, may require bylaw changes.

For recovery, a company would need essential records to continue operating. Storing them safely would be the smallest problem; much more difficult is deciding which records are truly vital. Some executives recommend dividing them ruthlessly into three categories:

- *Vital records*—irreplaceable; of less value in reproduced form; necessary to recover monies promptly or to restore production, sales, and service.
- *Important records* — very expensive to reproduce, in dollars or time.
- *Useful records*—whose loss would be inconvenient, but could be replaced readily.

Records such as the following would probably qualify for safekeeping: property deeds and other proofs of ownership of assets; stockholder data; insurance certificates;

Reprints of this report are available at publisher's cost: Less than 100, 20¢ each; 100 or more, 15¢ each; 1000 or more, 10¢ each. Address all requests to "Operation Survival," P.O. Box 573, Times Square Station, New York 36, N. Y.

FEDERAL AGENCIES AND CIVIL DEFENSE

By executive order (August 1, 1961), the President transferred basic responsibility for civil defense from the former Office of Civil Defense and Mobilization to the Department of Defense. With its remaining functions, OCDM was renamed Office of Emergency Planning.

Specifically, the Secretary of Defense is in charge of development and execution of a program to minimize the effects of attack, including informing and educating industry and the public in methods of survival. This includes a fallout shelter program, a warning and communications system, and a program to assist state and local governments in such post-attack community services as health and sanitation, maintenance of law and order, firefighting and control, debris clearance, traffic control, provision of water supplies.

The Director of the Office of Emergency Planning is responsible for planning continuity of state and local goverments, the natural-disaster relief program, the defense mobilization program, the strategic and critical materials stockpiling program.

Previously established policy calls for making maximum use of existing Federal departments. Typical civil-defense responsibilities that are assigned to other agencies include:

Dept of Agriculture: Food stockpiling, rural fire control, protection of vegetation and animals against radiological, chemical and biological hazards.

Dept. of Commerce: Restoring streets and highways; use of emergency shipping.

Federal Aviation Agency: Emergency use of civil air transport, civil airports and airways.

Dept of Health, Education, and Welfare: Medical stockpiling; care of refugees from attack, including location services.

Dept. of Interior: Emergency plans for power and petroleum.

Dept of Labor: Planning use of emergency manpower, except medical, in immediate post-attack period.

Post Office Dept: Registration of individuals and families.

Housing and Home Finance Agency: Emergency housing and community services in the post-attack period.

Interstate Commerce Commission: Plans for use of domestic service transportation in emergency.

patents, important engineering drawings and process data; records of employee pension funds and other such financial plans; important contracts, including union contracts. These would also have to be kept up to date, of course.

If you carry on business at several widely separated points, you should store duplicates of vital records at each location. You should also arrange for management personnel at each point to take control of company operations at other locations, if necessary. Plans should also be made for mutual aid between the several plants and offices.

In some cases, you should consider establishing alternate headquarters, with duplicate records and living quarters. This could give a one-plant company the advantages of a larger company with dispersed operations.

If an attack struck when employees were not at work, they would need to know where to report when conditions permitted. One answer would be to designate emergency centers, possibly in suburban homes of supervisors.

Fiscal plans. Your plan should set up emergency financial procedures. For example, you would probably need a simplified accounting system for use after attack. You would want funds quickly available for wage payments, advances to employees, and buying food and supplies. One solution might be to preprint checks of fixed denominations and distinctive design. They would be stored in a safe place and used only in emergency, with the signature of anyone of a list of management personnel.

Finally, you must try to prepare for restoring production in an emergency economy — probably with wage and price controls, government allocation of materials and manpower, and so on. Production would quite likely be geared to goods most useful for recovery.

You would want to analyze how your company would be suited to alternate lines of production, perhaps develop alternate sources of supply, and production techniques to make your operations as flexible as possible.

THE TASK AHEAD

If our nation should suffer a large-scale nuclear attack, the measure of our ability to survive and recover will be the courage with which we appraise the dangers, and the vigor with which we act to prepare for them.

In such planning, business and industrial executives have a special stake and exceptional responsibilities. The organizations they direct not only provide the sinews of the economy on which recovery would depend, but can — and should — provide focal points of direction and leadership.

Some companies have already displayed commendable foresight and enterprise in preparing for the possibility — however unlikely — of nuclear war. But a big job remains to be done. I urge every responsible American executive to give these problems his immediate and earnest attention.

Robert S. McNamara
Secretary of Defense

S-6 Satellite to Probe Earth's Atmosphere

By Edward H. Kolcum

Washington—Component testing and prototype assembly are under way at the Goddard Space Flight Center near here for a geophysical satellite that will permit direct measurement of eight characteristics of the structure of the earth's atmosphere. The satellite is scheduled for launch next summer.

Instrumentation for the satellite, designated S-6 by the National Aeronautics and Space Administration, was developed during the International Geophysical Year and some components have been flown a number of times as rocket payloads. Unlike a great number of NASA missions, which are oriented to support the manned lunar landing mission, the S-6 project is a flying laboratory designed solely for basic research in the physics of the atmosphere.

With four sets of sensors, the 375-lb. satellite will directly measure atmospheric pressures, densities and temperatures, composition of neutral particles, electron temperatures and densities, and ion temperatures and densities.

Indirect determination of atmospheric density has been made by measurement of the drag on satellites, notably by Echo 1. For the first time, the S-6 satellite will measure density directly by means of two types of ionization gages, and the sensors will be capable of isolating data on both charged and neutral particles.

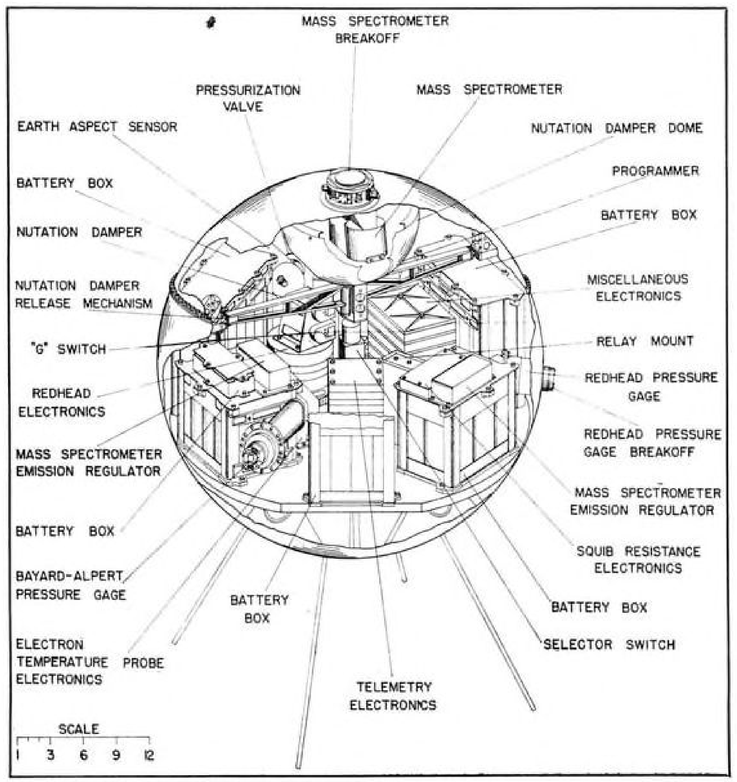
The basic instrumentation in S-6 consists of:

• **Two Bayard-Alpert** ionization gages. These sensors are thermionic or hot cathode total pressure gages, using an anode to collect positive ions which provide an information signal.

• **Two Redhead** ionization gages. These are cold cathode tubes without a filament. These sensors are configured like a spool, with the magnetic field generated axially. Resulting electrons are emitted from the cathode to produce a current signal.

• **Two mass spectrometers.** These are designed to analyze the gas ionized just off the outer surface of the spacecraft. Beam constituents of the gas are focused on an electrode, and the current of each gas is measured to determine the relative concentrations of molecular nitrogen, molecular oxygen, atomic nitrogen, atomic oxygen, water vapor and helium.

• **Two electrostatic probes.** These are derivatives of Langmuir negative probes. The 13-in. probes are $\frac{1}{16}$-in. in diameter at the base and 0.002-in. in diameter at the extremity. A voltage is applied to both sections to determine the energy distribution of the charged particles. The smaller section is the measuring electrode. It will be outside the plasma sheath that surrounds the spacecraft.



CUTAWAY of Goddard S-6 atmospheric structure satellite shows location of components.

Electrostatic Probe

The electrostatic probe experiment was developed by the University of Michigan Space Physics Research Laboratory.

Co-experimenters in the electrostatic probe project are L. H. Brace and G. R. Carrigan of the University of Michigan, and Nelson Spencer, of Goddard, who also is the S-6 project manager.

The remaining experiments were designed and developed at Goddard. George Neuton is head of the development team on the ionization gage experiments, and Carl Reber heads the group developing the mass spectrometer experiment.

An unusual feature of the satellite is the program for sending data. Minitrack ground stations can command the package to relay data from any one, or any combination, of the four sets of experiments. This ability to "turn on the experiments we want to use," Spencer told AVIATION WEEK, "makes it possible to ascertain any mutual interference from other experiments."

The S-6 satellite also will mark the first use in a Goddard satellite of the more precise pulse coded modulation (PCM) telemetry system. Earlier satellites use the FM/FM telemetry system.

Seasonal Variation

The satellite will provide a diurnal, or day-night, variation but because of its relatively short active lifetime, only modest seasonal variation in readings are expected.

The satellite will be powered by silver zinc chemical batteries and an active life of 90-100 days is anticipated. The payload will be launched into a 50 deg. orbit with a NASA-Douglas Thor Delta vehicle. Programed orbit is 150 mi. to 375 mi.

All experiments in the 35-in. diameter shell are mounted on the inner surface of the spacecraft. At the end of the first orbit, the Blossom Point, Md., Minitrack station will give the command which will energize the satellite's electronics. At the same time, bellows devices will break glass seals covering the orifices to each sensor. The satellite will operate 5.5 min. on each command and then turn itself off automatically. The program device is cam operated.

Solar Influence

Because the solar cycle is approaching its quiet period, it is not expected that there will be a great deal of unusual influence on the satellite from the sun. The package will be able to detect the effects of any solar flares, however, and to determine any usual effects on atmospheric parameters, such as concentration of ions or changes in electron temperatures.

Spencer expects that the satellite sensors will return pressure readings within the range of 10^{-6} to 10^{-10} mm. of Hg.

S-6 may also provide the answer to a scientific controversy—whether electrons and neutral particles have different temperatures. One school holds that the temperatures of electrons are higher, and another school contends they are the same.

Neutral particle sensors will measure from 1,000-1,500K, and electron sensors from 1,500-2,500K.

The Budd Co. is fabricating seven stainless steel satellite shells for the S-6 project—one for flight, one a backup, one as the prototype and the remainder for test. After instrumentation, electronics and batteries are installed, the structure is sealed with a copper shear bolted flange.

In addition to the University of Michigan and Budd, other top tier participants in the S-6 project with Goddard are Consolidated Systems Corp., which built the mass spectrometers; Westinghouse Electric, Bayard-Alpert Gages; National Research Corp., Redhead gages, and Yardney Electric Co., batteries.

Transit System Slated to Serve As Routine Navigation Aid by October

By Russell Hawkes

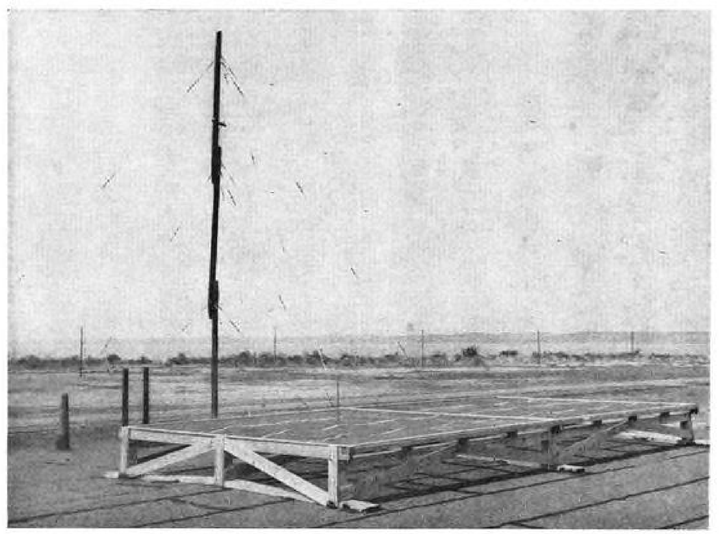
Pt. Mugu, Calif.—Navy is about to establish the command which will operate the Transit satellite system as a routine navigation aid and the system will be available for use by ships and aircraft probably by October of this year.

Command is known as the Naval Astronautic Service Group and will be formed mainly from Pacific Missile Range personnel who are now planning and implementing the operational system and are currently working in the Transit research and development program.

PMR based its proposal to run the operational net on its experience as part of the research and development network. The group will be based at the Pt. Mugu headquarters of PMR. It will supervise USAF launch of Transits from Naval Missile Facility, Pt. Arguello, Calif., and will operate four tracking stations, one data injection transmitter, and one computing center in the operational tracking and control net.

October target date for operational status is not being announced formally for fear of unforeseen delays, though the program currently is living up to its schedules.

The October date probably will make Transit the first operational space system to be utilized routinely for nonresearch, earthbound activities.



PAIR OF SIMPLE STUB ANTENNAS in the middle of a reflecting ground plane of wire screen is all that is needed to receive Transit navigation aid satellite signals.

Potential Accuracy

Transit's superiority to existing navigation aids is due partly to its better potential accuracy and partly to the fact that it will be available everywhere in the world for less cost than it would take to extend the coverage of Loran and other earthbound aids to areas not now covered. Transit will be able to function in a High Accuracy Mode or a Moderate Accuracy Mode depending upon how much the user is willing to invest in shipboard receiving and computing components. With a moderate accuracy installation, it will be possible to acquire navigational fixes with accuracies of about one quarter-mile. The high accuracy installations which will be used on U.S. naval vessels are expected to give fixes with errors of 600 ft. or less. One program officer estimates unofficially that later refinement of equipment and orbital calculations will make it possible to fix position within 60 ft.

Transit R & D

Overlapping until at least 1965, Transit research and development will continue separate from the routine functioning of the operational navaid satellite system. It will remain under the leadership of Johns Hopkins University Applied Physics Laboratory, prime development contractor. The concept of the Transit system is such that it can be improved by refining ionospheric refraction corrections and geodetic measurements and by using better methods of calculating orbit parameters without modifying the equipment aboard the ships and aircraft of users. This point is an important consideration to commercial users because it assures them that expensive equipment bought for use next winter will not be made obsolete by the continuing development program.

Four operational Transit satellites weighing about 50 lb. each are to be launched by USAF Blue Scout booster rocket systems from Pt. Arguello, presumably in September or October, 1962.

With the four satellites in precisely

separated polar orbits, Navy believes it will be possible to get Transit position fixes anywhere on earth at intervals of not more than an hour and a half. In Arctic and Antarctic latitudes it may be possible to acquire fixes two to four times more frequently because the orbits will intersect over the poles.

Satellite equipment aging and the precision or perturbation of the orbits may cause gaps to open up in Transit coverage of the earth. To correct this, other Transits will be launched as necessary.

Navy anticipates that the set of satellites will have to be reinforced about once a year.

Tracking stations in the navaid satellite ground net will be precisely located and will have equipment similar to the high accuracy installations aboard Navy ships. The stations have not been located yet but they will be in the vicinity of Winter Harbor, Me., Minneapolis, Minn., Pt. Mugu, and Pearl Harbor, Hawaii. The Transit Operational Center, Computing Center, and data injection command transmitter will be located at Pt. Mugu.

Coded Transmission

Each navaid satellite will function by transmitting a precise coded description of its own orbit along with an accurate time reference signal on two extremely stable UHF carrier frequencies. The same frequencies will be generated in the shipboard and aircraft-borne navigation receivers and the wavelengths of the received and internally generated frequencies will be compared to measure the Doppler shift of the former. The coded orbit description will give the navigator an orbit path whose position is known and the times at which the satellite will be at every point on that path.

Transit's Approach

The exact time of the satellite's closest approach to the receiver will be indicated when the Doppler shift passes zero. The ship will be located on a perpendicular to the orbit path drawn through the position of the satellite at that exact time. This slope of the Doppler shift curve with respect to time is steeper if the satellite passes close to the ship, therefore the angle of the slope can be interpreted as a measure of the distance between the receiver and the satellite's point of closest approach. This enables the navigator to plot the point on the perpendicular which represents the ship's position.

Except for the rotation of the earth, there would be two points on the map, one on each side of the orbit path, which would receive identical signals. However, the west-to-east movement of the earth's surface introduces a latitude dependent cross-velocity moving one point toward the orbit path and one point away from it. This gives the two positions differently shaped Doppler vs. time curves and eliminates the ambiguity from the fix. The more complete high accuracy installations will receive the Transit transmissions and read out longitude and latitude immediately.

The four tracking stations of the Naval Astronautic Service Group will reverse the process and from their accurately known positions will measure any deviation of a satellite from the orbit that its coded messages describe to navigators. The tracking stations will relay their data to the Pt. Mugu Computing Center where an IBM 7090 general purpose computer will update the orbit parameters and the data injection transmitter will erase the existing orbit description from the satellite's memory storage unit and replace it with the new one. As knowledge of Transit orbit parameters increases, program officials believe it will be possible to use a smaller, more limited computer. There will be two opportunities a day to inject new data in each satellite as it passes over Pt. Mugu once on a north-south track and once on a south-north track. If more opportunities or greater reliability are needed, a second data injection transmitter may be established later at another location.

Refraction Problem

The biggest errors in the Doppler signals received by tracking stations and navigators are caused by the refraction of radio frequencies by the ionosphere. Applied Physics Laboratory has developed a technique of correcting first order refraction errors. It is this that makes it necessary for the satellites to transmit on pairs of harmonic frequencies. The technique is based on the fact that the degree of radio refraction by the ionosphere varies with frequency. Because of this, simultaneous transmissions on different frequencies will arrive at the receiver at slightly different times. The APL-designed refraction correction unit measures the refraction-caused difference and algebraically calculates a correction which is incorporated in the readout.

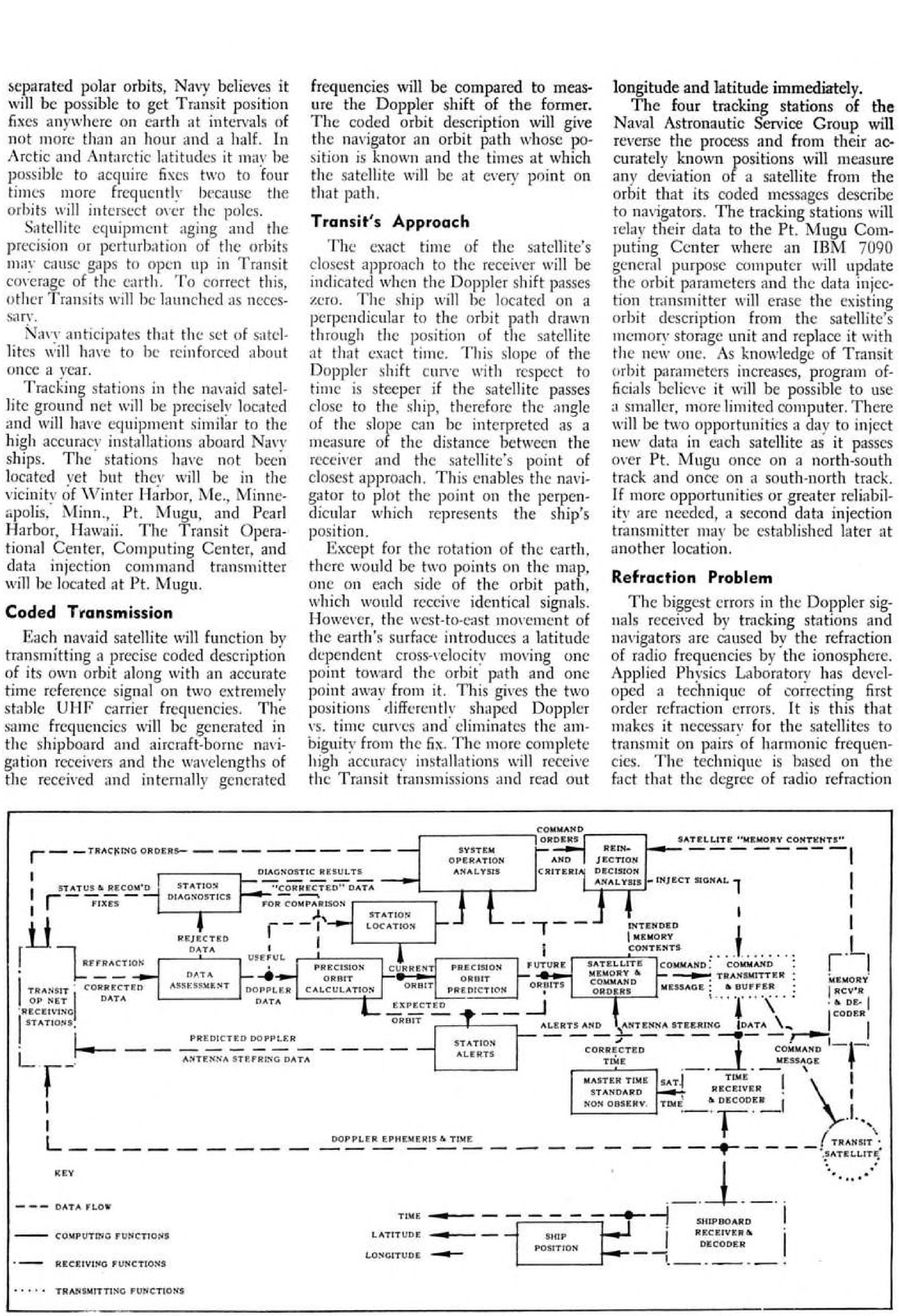
The main difference in performance between high and moderate accuracy installations is due to the absence of a refraction correction unit in the latter. Moderate accuracy installations are also slower because computation and readout are not automatic as in the high accuracy installation. Navigators must rely on slide-rule or desk calculator methods.

Stable Time References

The stable time references in the Transit satellites will give navigators a more accurate indication of time than the signals transmitted by the Naval Observatory over its radio station WWV because ionospheric effects upon the time of transmission will be less for the shorter propagation paths. Goal is an accuracy of 100 microseconds or less. The Transit time signals will be compared with the master time reference of the observatory twice a day when each satellite passes overhead and any error discovered will be incorporated in the next data injection from Pt. Mugu.

A byproduct of the Transit program will be the availability of this worldwide accurate time reference for scientific research and other activities not connected with navigation. When Pacific Missile Range submitted a proposal to implement and staff the operational Transit net, it was motivated partly by such secondary benefits. For instance, the Transit time references will make possible more precise coordination with the Atlantic Missile Range and among PMR stations. A very important byproduct is the improved knowledge of the shape of the gravitational field about the earth that can be expected from the continuous refinement of satellite orbits with the accuracy offered by the Transit system.

Geodesy is one of the most important studies in the continuing phase of Transit development. Since gravitational distortions are often due to local influences, there are 12 portable stations in the R&D tracking net to ensure thorough coverage of most of the earth. Three more are planned. Part of the stations are called Experimental Stations, each of which is specially designed by the agencies which are participating in its operation. The rest are called Field Stations and are relatively standardized. They were designed by the Naval Ordnance Test Station, China Lake, Calif. for PMR which supervises their operation for APL. One Field Station is operated by the Australian Weapons Research Establishment and an Experimental Station is operated by the British Royal Aeronautical Establishment. Specialized components for these stations are supplied by the U.S.



OPERATIONAL TRANSIT SYSTEM provides continuous information loop which uses Doppler tracking data to compute updated ephemerides for the satellites. A new description of the ephemeris of each satellite is then injected in its memory storage unit.

Astronaut Wings

Defense Department has presented astronaut's wings to Navy Cdr. Alan B. Shepard, Jr., and Air Force Capt. Virgil I. Grissom, both of whom made ballistic flights in Mercury capsules this year. Design of the wings for both the Navy (bottom) and Air Force (top) includes a shooting star superimposed on aviator's wings of the service. Qualification for the wings is a flight of more than 50 mi. altitude.

½-oz. Rocket Designed For Orbit Correction

Liquid propellant rocket producing only a hundredth to a tenth of a pound of thrust is being developed by Aerojet-General Corp. for attitude control and orbit correction of space vehicles and is intended to meet performance and weight requirements midway between those met by plasma jets and cold gas jets.

Named Microrocket, the device burns hydrazine and nitrogen textroxide, which is a storable, hypergolic combination.

It is cooled only by thermal radiation and is designed for a chamber pressure of 30 psia. to 50 psia. The Microrocket has a high nozzle expansion ratio of 100 to 1 since it is to be operated only in space.

All of the test firings are done in a vacuum facility at the Aerojet Azusa, Calif. plant.

Combined weight of the thrust chamber and the injector totals a half ounce.

Injector consists of a pair of small hypodermic needles with the ends closed and a .010 in. hole drilled into the side of each at a right angle. Test runs lasting a half hour have been made and the engine is planned for missions requiring as much as two days. The Microrocket has the capability of running for a day on approximately a gallon of propellant.

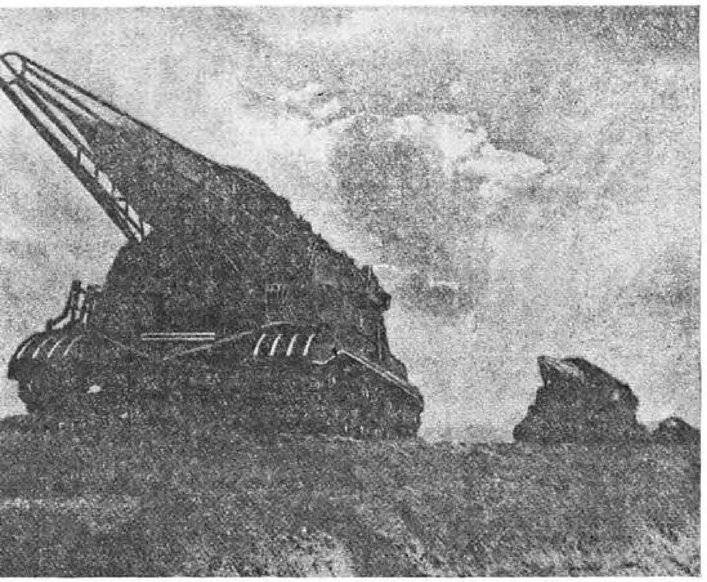
There is no thrust mount for the prototype Microrocket.

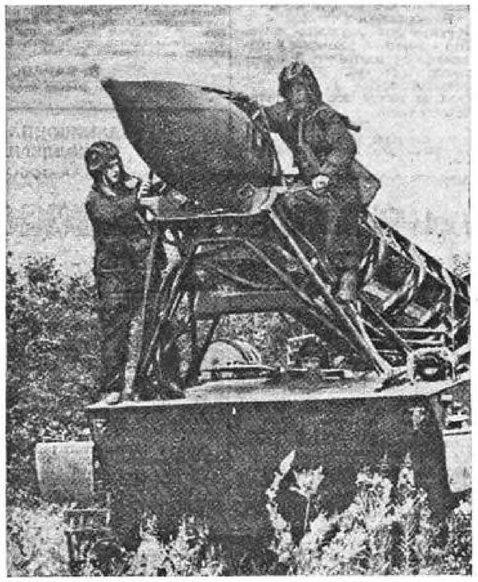
Prototype Comsat Tested in Anechoic Chamber

Bell System communication satellite, prototype of model planned for launching next spring, is shown undergoing tests in a radio anechoic chamber at Bell Telephone Laboratories. The 34-in.-diameter satellite has 72 gem-like facets, some of which mount solar cells protected from space radiation by man-made sapphire cover plates.

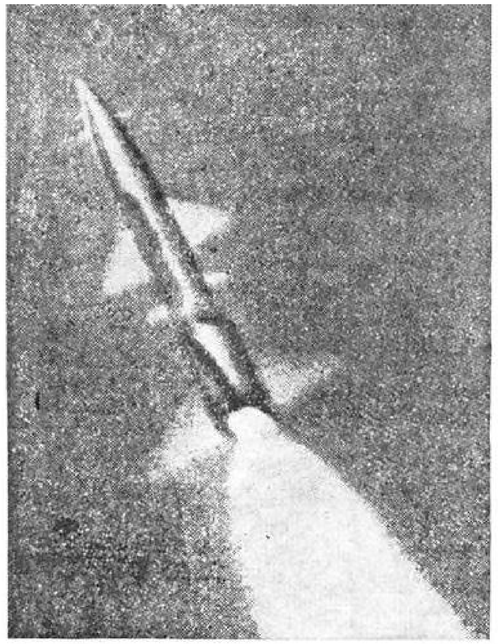
Russian unguided tactical missile, shown in firing position aboard armored carrier, has 35-mi. range. Background of picture has been heavily retouched to the immediate right of the tracked vehicle and in vicinity of tree. Missile has seven solid propellant rocket motors, fixed fins, conventional warhead. It is transported and launched from cylindrical container on vehicle with an independent power supply.

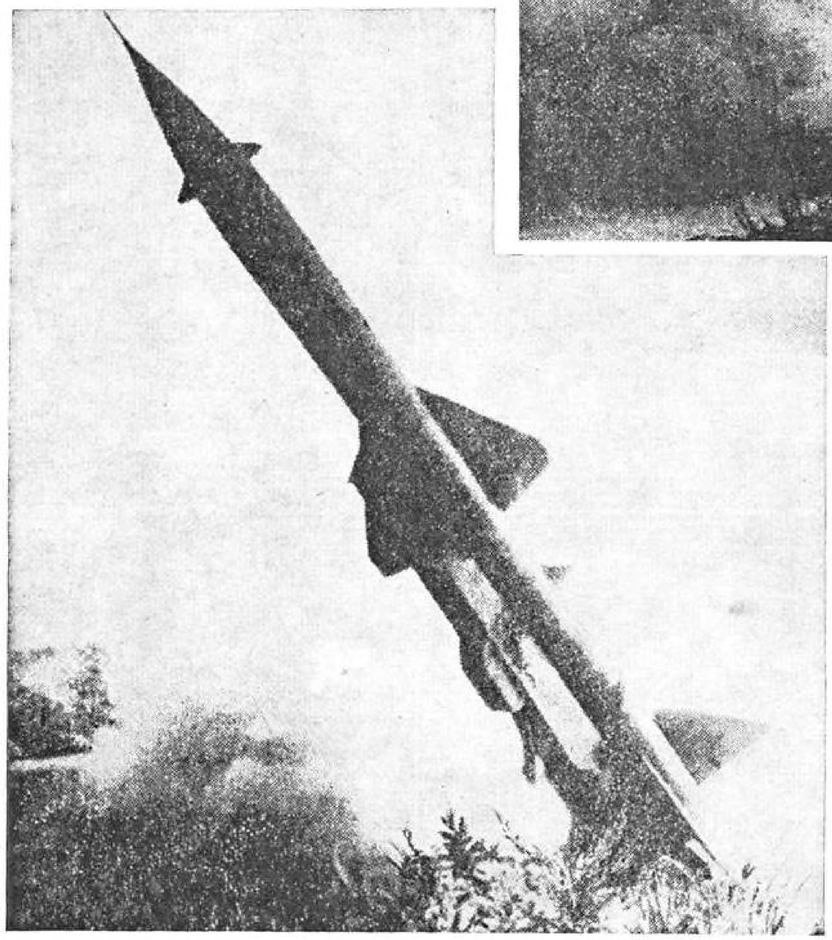
Soviets Display Tactical and Anti-Aircraft Missiles





Three tactical missiles (same type as above) rumble along a ridge on their tracked carriers during maneuvers with the Red Army. At right, two Russian soldiers in tank corps uniforms unlimber a 15-mi. range tactical missile preparatory to firing. Transporter-launcher vehicle is a tracked, amphibious medium-armored type apparently standardized for artillery-type rockets.





First pictures of Russian anti-aircraft rockets during field tests show few details of this early weapon, now being supplanted by a larger and longer-ranged unit. Missile has been shown on parade since 1957.

COLLINS CONVAIR 240 is being used to evaluate new flight director instruments and improvements in autopilot, such as glide slope extension and control wheel steering, as part of company program to enhance low-approach capability of flight control equipment. New flight director system will be announced soon.

Lower Minimums Goal of Collins System

By Philip J. Klass

Cedar Rapids, Iowa—Improved flight director system incorporating a number of advances aimed at lowering safe jet transport minimums will be announced soon by Collins Radio Co.

With similar objectives, Collins also is flight testing a number of improvements for its AP-101 and AP-103 autopilots. (For reports on all-weather improvement programs of other major equipment manufacturers, see AW Nov. 27, pp. 89, 94 and 99; Dec. 11, p. 35.)

The earlier Collins FD-105 flight director system is in use on about 40% of the turboprop and turbojet transports flying this side of the Iron Curtain, according to company figures. Major airline users include Braniff, Continental, Eastern, Northeast, Trans-Canada, United and Western, as well as Military Air Transport Service. Airline users of the Collins autopilot include Trans-Canada and Aer Lingus TTA.

Improvements which Collins has introduced into its new flight director system include the following:

• **Large warning flags:** A frequent pilot criticism of all manufacturers' flight director instruments has been that the warning flags, indicating failure of ILS receivers, ground stations, gyros or other sensors, are too small and can be overlooked by a pilot concentrating on the instrument pointers during an adverse weather approach. Collins not only has greatly increased the size of the warning flags on both flight director instruments, but wherever possible has placed them so that when the flag drops down it covers the appropriate pointer to prevent the pilot from using it for flight guidance. For example, when the glide slope warning flag is exposed, it covers the glide slope needle on both the approach horizon and the course indicator. (See photo, p. 66.)

• **Distance information:** The distance measuring equipment (DME) indicating counter showing distance to the Vortac station, which previously required a separate panel instrument, has now been incorporated into the Collins course indicator. The DME distance display appears in the upper left corner of the instrument.

• **Digital course selector:** A digital counter has been added to the upper right corner of the course indicator to show clearly and unequivocally what VOR radial has been selected.

• **Computer packaging:** The new flight director computer is housed in an Arinc type package, with built-in provisions for self-test and malfunction isolation. Computer also has built-in elapsed time indicator to show accumulated use time.

Collins, like other autopilot and flight director manufacturers, is working closely with its major airline customers to improve the performance of existing equipment to permit lower jet transport minimums. Principally this consists of optimizing the computer and instrument time constants to better match them to the dynamic characteristics of the airplanes on which they are used, according to Edward Fritze, director of Development Division "C" here.

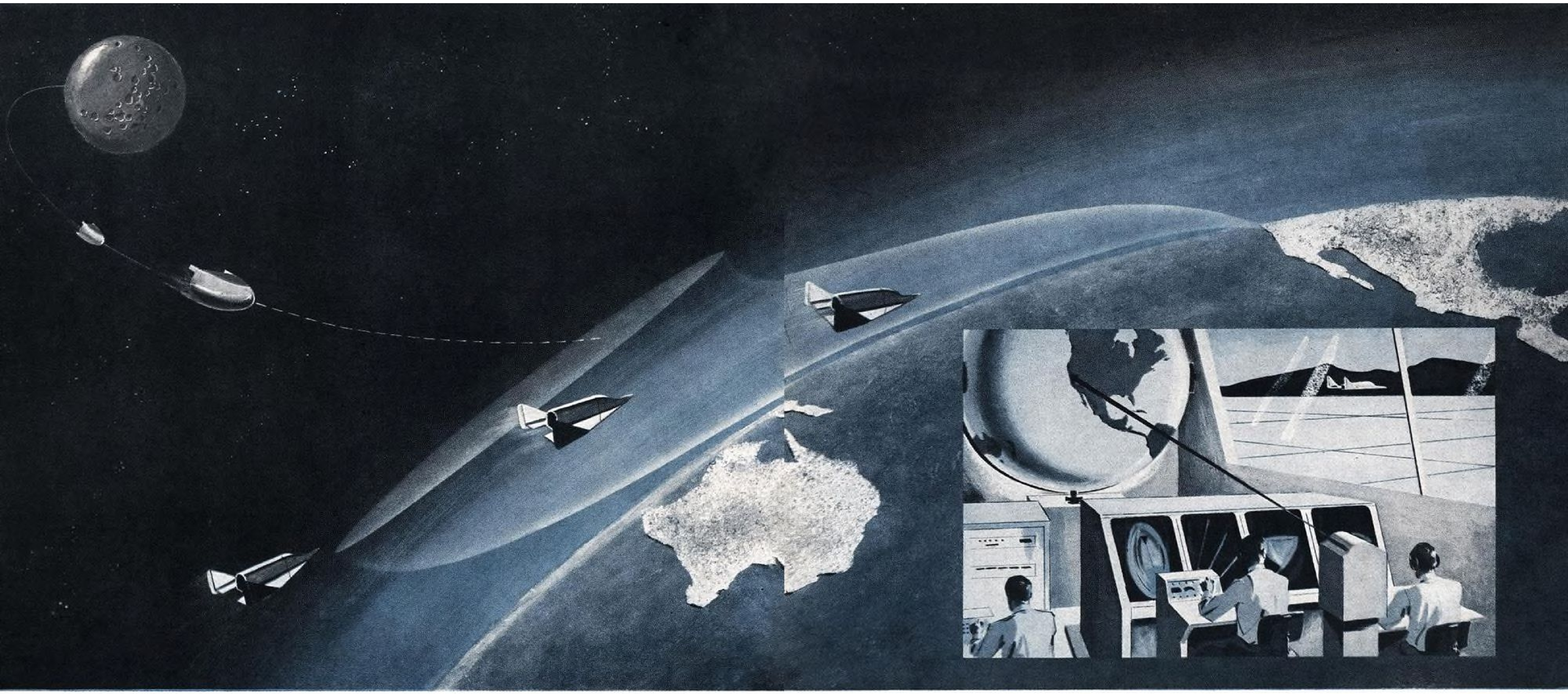
One general complaint voiced by many pilots against all flight directors is that they are "too sensitive," forcing the pilot to "work too hard" to keep the needles centered, according to Ben McLeod of Pan American World Airways.

During the early phase of an ILS approach it should be possible to desensitize the flight directors somewhat because it is not essential that the aircraft be precisely on the center of the glide slope and localizer beams. But as the aircraft nears the airport, sensitivity must be increased if it is to break out in a position where a successful landing can be made without excessive maneuvering.

The reliability of the fully transistorized FD-105 flight director now in widespread airline use has surpassed the fondest hopes of its designers, considering that it was designed in 1956-57 when the reliability of transistors and other components was not up to present levels.

Operational amplifiers in the FD-105 flight directors have demonstrated mean time between failures of 400,000 hr., and servo amplifiers have had a mean time between failures of 160,000 hr. in more than three million flight hours of flight director operation accumulated by Eastern, Trans-Canada, Continental, Western and Braniff, according to Fritze.

The reliability of these solid-state amplifiers has been so remarkable that where the original flight director design contained dual amplifiers throughout for reliability, the redundant amplifiers



Raytheon solution for space vehicle recovery: LONG RANGE GCA

Recovery of space vehicles is a long range problem, commencing at atmosphere entry. Techniques for control from re-entry through touchdown, developed by Raytheon, are comparable to GCA concepts. Over the past two years, Raytheon has conducted a major and continuous investigation of the means by which a manned maneuverable space vehicle can be returned safely from flights in space to normal routine landing on earth. These investigations have included operational control concepts, instrumentation, information flow analysis, basic system requirements and subsystem specifications.

Part of this effort was a space vehicle recovery study for the Air Force Flight Test Center encompassing vehicle energy management, glider characteristics, trajectory analysis, flight parameter accuracies, range instrumentation, navigation, communications, data processing display, and human factors.

Other portions of the effort included earth return navigation and recovery studies for SLOMAR (as a subcontractor to the Martin Company), and joint efforts with Bell Aerosystems Company on DYNA-SOAR Terminal Navigation Systems.

Currently, major emphasis is being placed on the APOLLO Ground Operational Support System (GOSS). This system will include global range instrumentation for tracking; telemetry and communications; and control, display and computation centers.

One of the world's largest scientific-industrial organizations, Raytheon has proven capability to create the required technology and manage every phase of a space vehicle recovery system — from early study and design through development, production and field support of operational systems and equipment.

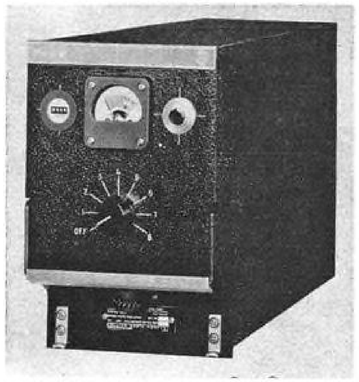
Executive Offices, Lexington 73, Massachusetts.

RAYTHEON COMPANY

EQUIPMENT DIVISION

RAYTHEON

Communications, Radar, Sonar, Guidance, Data Processing and Display, Countermeasures, Systems Design and Management, Basic Research



NEW FLIGHT CONTROL computer has built-in facilities for checking operation and isolating malfunctions. Elapsed-time indicator (top left) shows total use time.

have been dropped from recent production and most airlines no longer carry them, even in older equipment.

The Collins AP-101E autopilot and dual flight instrument system, installed on a fleet of 49 Trans-Canada Viscounts, has demonstrated a mean time between failures of 240 hr. for the complete system over a 21-month period with a total of 223,000 flight hours, company analysis shows. The 240 hr. mean time between failures figure includes all failures in any one of the three related subsystems, each of considerable complexity. Fritze says Collins is not resting on its reliability laurels, but the figures indicate that present reliability of the autopilot and flight director systems is comparable to that obtained with other airline avionic equipment.

The Collins approach to automatic flight control system monitoring differs somewhat from other autopilot manufacturers, principally because of the difference in basic system design concepts.

Where most other manufacturers have maintained isolation between the autopilot and flight director system, Collins has chosen to integrate them so that the same computer which generates steering signals for the autopilot actuators also provides the steering signals displayed on the flight director. In larger transports, a second flight director usually is installed, but it obtains its steering signals from an independent computer and sensors.

Thus almost any malfunction which would cause erratic action by the autopilot will simultaneously cause erratic operation of one of the two flight director systems, but not the other. For many types of malfunctions this should be instantly apparent to the pilot providing he is watching his flight director. But for certain types of malfunctions, it might not be readily apparent.

The Collins approach to automatic malfunction detection is an automatic monitor which continuously compares the basic sources of signals fed to the pilot and copilot's flight directors, one of which also is being supplied to the autopilot. This automatic monitor, currently under development, will compare signals from the two localizer receivers, the two glide slope receivers, the two directional gyros and the two vertical gyros. If any pair differs by more than a prescribed amount, the monitor will energize an alarm warning. It will not attempt to assess which source is in error, leaving this judgment to the crew.

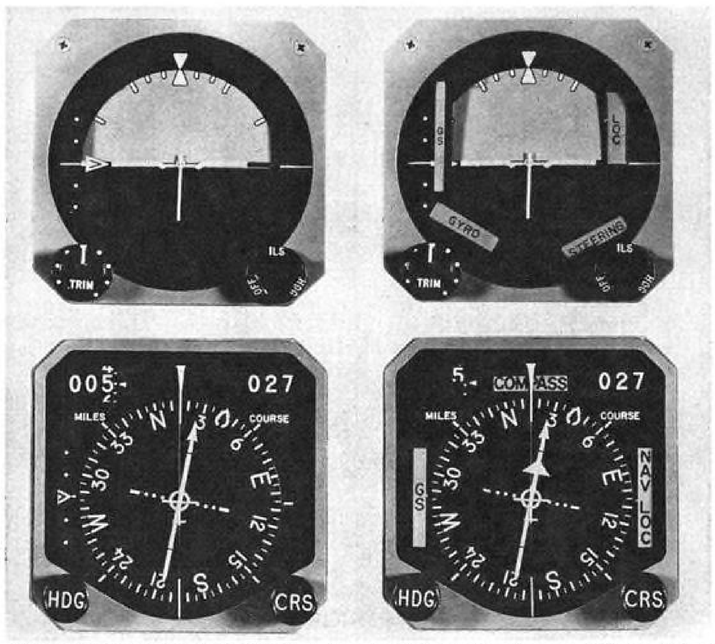
Collins, like other flight control manufacturers, is investigating several different "heads-up" type indicators intended to provide steering displays near the windshield during low approaches. Several of these currently are being evaluated on a flight simulator.

The company also is flight testing, on its Convair 240 and Beechcraft Model 18, techniques intended to improve the performance of the vertical descent portion of an instrument approach at lower altitudes. These techniques, often referred to as "glide slope extension," include the use of rate-of-descent signals which are derived from sources other than the glide slope beam. Other data sources under investigation include the central air data computer, which can provide barometric altitude and rate-of-change of altitude signals, and a radio altimeter.

Fritze points out that Collins has long employed complementary filter techniques in the lateral guidance portion of its approach coupler to enable the system to automatically select the best of several available guidance signals while reducing the use of less desirable inputs. Similar techniques now will be employed in the pitch axis to enable the system to use the glide slope signal so long as it is stable, increasing the use of other rate-of-descent signals as the glide slope signal deteriorates.

The company currently is flight testing control wheel steering in its Beechcraft. The technique under evaluation is one in which the pilot maneuvers by using the regular control column. This disconnects the autopilot from control of the aircraft, but places it in a synchronization mode in which the autopilot follows aircraft maneuvers, being ready to resume control and stabilize aircraft attitude and heading as soon as the pilot releases the control wheel. This technique enables the pilot to feel the same control forces he experiences when flying the aircraft manually.

Collins also is experimenting with a pedestal controller which would permit the pilot to use a single (one-hand) control to introduce both pitch and roll maneuvers through the autopilot.



NEW COLLINS FLIGHT DIRECTORS, horizon indicator (top) and course indicator (below) incorporate number of new features. New large warning flags (right) to alert pilot to failure of radio receiver, gyros or computer, are positioned to cover the corresponding pointer, or appear alongside pilot's point of vision, to assure he knows of failure. Course indicator now contains new DME distance indicator (upper left corner) and new digital VOR radial selector (upper right corner).

Prototype 433L Weather Station in Use

By James D. Hendricks

Westover AFB, Mass. – Prototype station for Air Force's 433L Weather Observing and Forecasting System is integrating elements of its advanced equipment and techniques on a test basis with routine daily weather operations at this Strategic Air Command base.

The 433L system, a network of weather sensors, computers and transmission equipment, is planned ultimately to tighten and accelerate USAF's procedures for accumulating and interpreting weather data from varying altitudes throughout the world, building of precise forecasts from this data and then transmitting the forecasts rapidly to units operating anywhere in the world.

Since the system is still in its early development and test stages, the base weather office and other Westover agencies concerned with control of flying operations do not rely exclusively on those parts of the system which are now available to them. Standard observation, analysis, forecasting and transmission procedures remain the backbone of the base's present weather operations.

However, base personnel join with others in the 433L program to note the system's promise for meeting weather information demands which will continue to grow as USAF moves still farther into supersonic and hypersonic aircraft and missile operations.

Originally, 433L was planned as a joint military-civil weather system involving Air Force, Federal Aviation Agency and U. S. Weather Bureau (AW Mar. 2, 1959, p. 56; July 20, 1959, p. 70).

The program was divided last spring, however (AW May 8, p. 32), and FAA currently is working on its own system while maintaining close technical coordination with USAF's 433L program.

Program division was necessary because FAA's primary concern rests in improving and expanding weather observation and forecasting techniques associated with air traffic control in this country. Air Force, on the other hand, needs a global system tailored to provide detailed forecasts in support of world-wide military operations.

Also, USAF has special weather information requirements in this country beyond those of FAA. For example, civil aircraft presently have no need for precise weather data for altitudes above approximately 35,000 ft. However, much of the Air Force's operations are conducted in altitudes of 50,000 ft. and higher and so it relies heavily on data concerning weather in that realm.

Also, civil aircraft are not concerned with possible formation of contrails, whereas the ability to forecast contrail formation is valuable in planning many USAF missions with high-altitude aircraft.

At present, the Air Force does not intend to increase its use of FAA weather data and forecasts for operations within the U. S., according to a 433L official. However, officers in the 433L System Program Office at Waltham, Mass., headed by Col. George A. Guy, feel that much of FAA's work, particularly in data processing and forecasting techniques, can prove at least partially adaptable to USAF's needs.

They also believe that coordination between the two programs will help avoid duplication and resultant waste of funds in development of equipment and techniques.

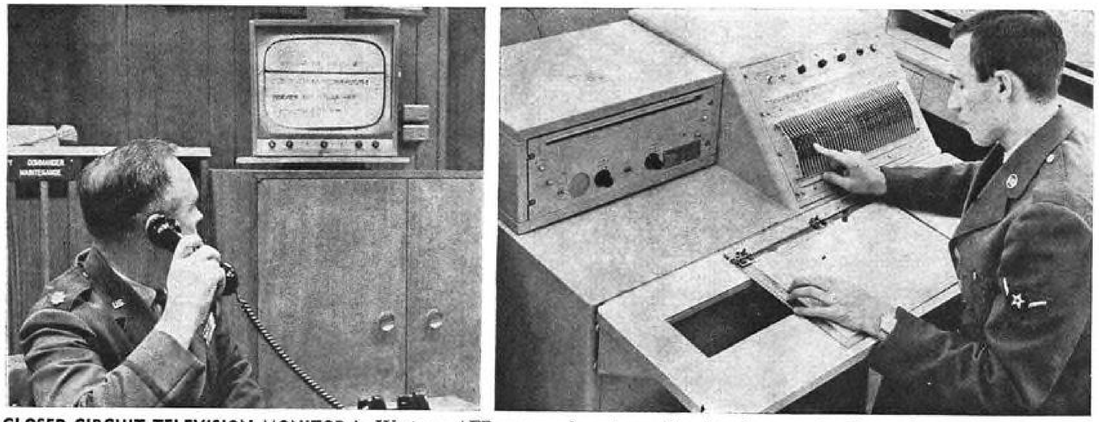
The 433L program will be a continuing one, encompassing development and testing of new gear and techniques as new demands are foreseen. It also must assure that advanced weather observation, forecast and transmission procedures can be readily integrated with other support and control systems, such as 465L Strategic Air Command Control System, 480L Air Force Communications System, SAGE (Semi-Automatic Ground Environment) system for air defense intercept control, and 425L, North American Air Defense Command's control system.

"This is not a 'turn-key' operation like some of the other L (for support) systems," explains Maj. James F. Moir of the 433L SPO. "This is an evolving system for modernization of existing Air Weather Service programs. Each new technique or piece of equipment must be tested and judged on its ability to mesh with techniques and equipment which will be in operation when the new one is incorporated into the over-all system."

This is one of the main purposes of the Westover station. A similar station is in operation at Hanscom Field, Bedford, Mass., home of USAF System Command's Electronic Systems Division, Air Force controlling agency for the 433L program.

Construction has been completed on a third station at McGuire AFB, N. J., and testing is expected to begin there on both 433L and the FAA system when FAA is ready to enter that phase of its program.

Originally, six other test stations were planned at civil and military airfields along the East Coast, but these were dropped, at least temporarily, when program was split last year.



CLOSED CIRCUIT TELEVISION MONITOR in Westover AFB command post provides data for control officers. Seven monitors are located about the installation. Operator's console, right, allows AN/FMQ-5 Automatic Weather Station operators to manually inject data into processing sequence. Other information is received from automatic sensors.

It is anticipated that some of these other stations will be activated by FAA for its test program.

United Aircraft Corp.'s Weather System Center at Manchester, Conn., serves as prime contractor for integration and coordination of 433L technological efforts.

Subcontractors include Travelers Research Center, Inc., of Hartford, Conn., forecasting techniques; Tele-Dynamics Division of American Bosch Arma Corp., Philadelphia, assistance in equipment development and field operations; Philco Corp. of Philadelphia, weather data display techniques; Allied Research, Inc., of Boston, technical writing, and Burns and Roe, Inc., of New York, architectural engineers for the Westover test facility.

U. S. Weather Bureau research in advanced meteorological observation, analysis and forecasting techniques also is contributing to the program.

General goal of the 433L program is to automate present weather operations as much as possible, thereby affording faster handling of data from the Air Force's world-wide network of weather centers and detachments.

Other objectives within the framework of the 433L program include:

• **Analysis of detailed requirements** for all users of Air Weather Service and development of system designs to accommodate them.

• **Preparation of specifications** for equipment, communications facilities, techniques and procedures in 433L.

• **Development of techniques** and programs for meteorological data processing compatible with system objectives.

• **Installation, testing** and evaluation of components and subsystems.

• **Development of new equipment** as needed.

Air Weather Service's Global Weather Central, located in the underground command post at SAC headquarters, Offutt AFB, Neb., will be the main receiving station for all weather data transmitted through 433L. In this central facility, an IBM 7090 computer will process the data and create forecast maps and charts for dissemination to using commands throughout the world.

At Westover, a major subsystem undergoing tests is the AN/FMQ-5 Automatic Weather Station, a computer-keyed device for weather data-gathering, processing and distribution. Information is received from automatic sensors and human observations of atmospheric conditions. The data is stored, processed and transmitted for readout on standard teleprinters or display on seven closed circuit television monitors located in the base weather office, pilot briefing rooms, the base RAPCON (Radar Approach Control) facility and command posts of tactical units on the base.

Equipment used in the AN/FMQ-5 is manufactured by Siegler Corp.'s Olympic Division in Long Island City, N. Y. It includes a master terminal, a visual distance computer and observer's console. All circuits are solid-state, and the only moving parts are the on-off switch, switches used for manual data injection and adjustment controls.

Data received from automatic sensors can include barometric pressure, wind speed and direction, cloud height, rainfall, humidity, atmosphere transmissibility, temperature and dewpoint. Manually fed information includes sky conditions, cloud type, obstructions to vision, cumulative rainfall and pressure changes every three hours.

The AN/FMQ-5 computes and issues almost instantaneous summaries of rainfall, peak wind gusts, mean wind speed, magnetic wind direction, sea level barometric pressure, altimeter setting, free air temperature, dewpoint temperature, runway visual range and approach light contact height.

Once each minute this data is transmitted to all receiving stations through a Semi-Automatic Telecode Transmitter, manufactured by Wang Laboratories, Inc., of Natick, Mass. Manual changes can be inserted into the transmitter by positioning of sliding bars containing a variety of digits and weather symbols.

The status message is dispatched in a line of 72 characters to specially modified teleprinters at the receiving sites. A Meteorological Data Display set, built by Burroughs Corp. of Detroit, is used to feed the data to the closed circuit television system. The television system automatically breaks the message into as many as six lines which are printed out on a small card. The camera is focused on this card.

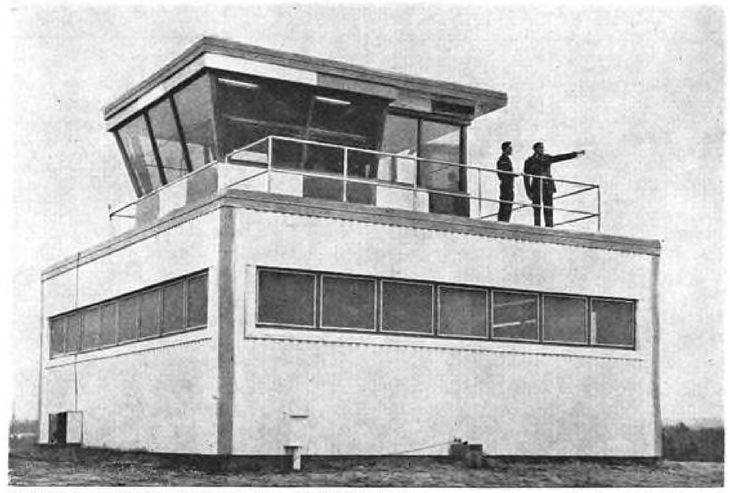
Siegler AN TPQ-11 Radar Cloud Height Detector is being tested at the Hanscom 433L station. The device, consisting of a radar transmitter and receiver, operator's console and antenna group, is designed to measure cloud density profile directly overhead between 500 and 60,000 ft. and record this information on a wet-facsimile machine.

Although the 433L equipment and techniques being tested at Westover are not relied on for primary support to current weather operations, personnel here appear to use them as often as possible to speed data-handling and transmission. Westover is headquarters for SAC's Eighth Air Force, a network of bases ranging from the Arctic Circle southward along the eastern United States to Puerto Rico.

A duty officer in the RAPCON facility said the closed circuit television monitor installed there has proved extremely valuable to controllers, in that they can read information off the screen without leaving their positions unmanned even for a few moments.

Weather Satellites

USAF's 433L program is funding establishment of several meteorological stations around the globe to receive and analyze data from proposed U. S. weather satellites. Satellites will photograph weather conditions over areas measuring up to several hundred square miles and transmit photos back to ground stations.



PROTOTYPE STATION for testing of 433L techniques and equipment is located adjacent to the center of the main runway at Westover AFB, Mass. Structure contains gear for accumulation, processing and transmission of weather data. Similar facility is located at Hanscom Field, Mass.

FILTER CENTER

► **New Perceptron to Learn Speech**—Audio Perceptron, designed to learn to recognize spoken words and to build a vocabulary of up to several hundred words, is being built by Cornell University under direction of Dr. Frank Rosenblatt who developed the first Perceptron at Cornell Aeronautical Laboratory. The earlier Mark 1 Perceptron was designed to operate from visual inputs and to learn to recognize characters and other shapes (AW July 4, 1960, p. 72; Apr. 24, 1961, p. 69). The new machine, being built under Office of Naval Research sponsorship, is expected to be in operation within a year. Rosenblatt reported at recent ONR-sponsored Perceptron conference. The new machine is called Tobermory, taking its name from a fictional cat in a short story of the same name, which learned to understand human speech and to talk. Rosenblatt says new Perceptron will be better behaved than its namesake which became a gossip and a nuisance.

► **High-Power Optical Maser**—Watch for USAF's Aeronautical Systems Division to issue proposal requests for development of a 10-megawatt optical maser.

► **Signed on the Dotted Line**—Among recent contracts announced by avionics manufacturers are the following:

• **Packard Bell Electronics** will design and construct a computer-controlled digital system under a $195,000 contract from the Navy Ordnance Research Laboratory at Pennsylvania State University.

• **Canoga Electronics Corp.**, Van Nuys, Calif., will develop the digital range measuring system for the Mobile Atlantic Range Station (MARS) under a $635,000 contract from Sperry Rand Corp., prime contractor to Air Force.

• **American Electronics, Inc.**, Instrument Division, Culver City, Calif., will make two unspecified types of components for the Navy's Terrier and Tartar surface-to-air guided missiles under a $534,000 add-on contract from General Dynamics/Pomona.

• **Eitel-McCullough, Inc.**, San Carlos, Calif., will develop a ceramic-metal sealed barrier for a vapor turbine generator system in NASA's Snap 8 vehicle.

Aviation Week Pilot Report:

Automatic Landings Performed in TF-102

By William S. Reed

Palmdale, Calif.—Automatic approach and landing system developed by North American Aviation's Autonetics Division has completed contractor flight testing in a Convair TF-102A. After further Air Force evaluation the APN-114 system will undergo Federal Aviation Agency flight tests.

During final phases of testing, this AVIATION WEEK pilot along with Autonetics experimental test pilot R. L. Gorham rode through six fully automatic landings in TF-102A No. 55-4032. The APN-114 controlled the aircraft from the ILS outer marker through touchdown, performing landings which, while not as smooth as those which can be made by a pilot, were in all cases acceptable.

Developed under Air Force contract for the Flight Control Laboratory of USAF Aeronautical Systems Division, the APN-114 system is an outgrowth of the X-10 Navajo program. System was flown by Autonetics in a Convair TF-102A on bailment from the Air Force. During the flight test program conducted by Autonetics, more than 100 landings were made with the APN-114 system. Of these, about 10% were hooded, blind landings flown manually using information the system feeds to the flight director instruments.

Success has been achieved in landing the aircraft automatically or manually about 60% of the time, Autonetics engineers say, including the early flights during which bugs were worked out of the system. Success rate improved steadily as more data and experience were gathered with the system.

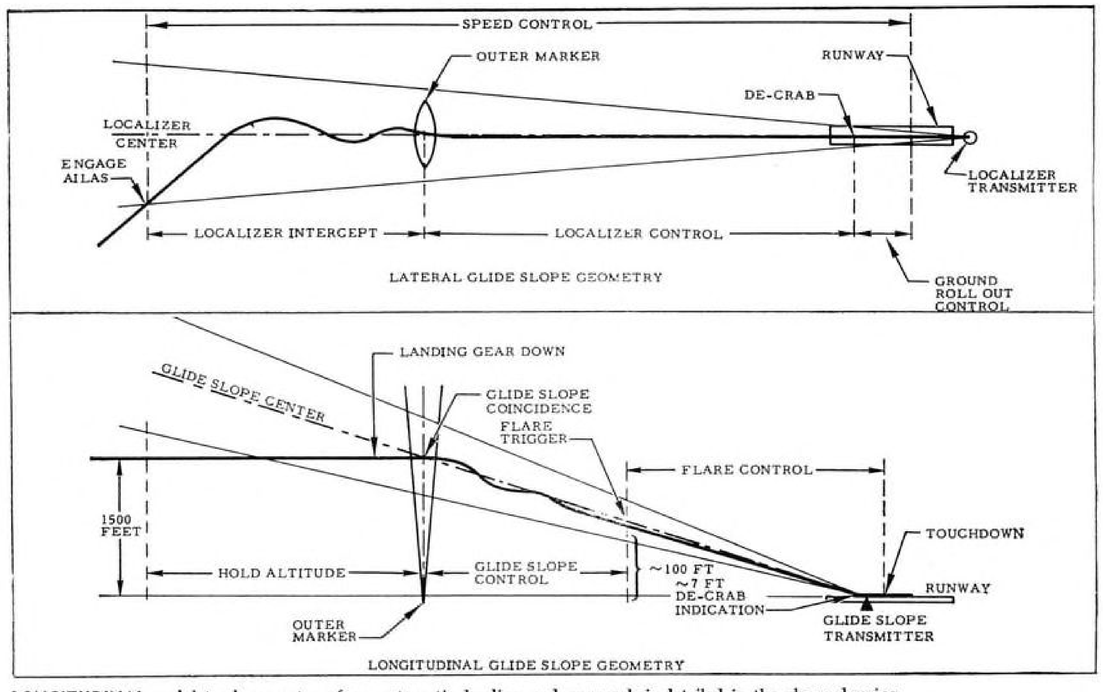
Immediately prior to the formal end of Autonetics' test program in mid-November, a Boeing test pilot made eight successful automatic landings out of eight attempts while gathering data on the system. A commercial version, designated Autoflare, will be flight tested in the Boeing 707-80 prototype next month.

Air Force has established that the system has been brought to the point where it is suitable for transfer, meaning that it soon will be flown to Wright-Patterson AFB, Ohio, where further testing will be done. At a later date, the TF-102 equipped with the Autonetics APN-114 will be flown to the FAA's National Aviation Facilities Experimental Center at Atlantic City, N. J., for further evaluation.

Though operating under conditions considerably less than ideal, acceptable landings were made in all cases during this reporter's flights. Two landings were made at Edwards AFB, Calif.; the remaining four automatic landings were shot at Oxnard AFB, Calif.

Gusty winds blowing out of the northeast at 25 kt. produced the uncommon situation at Edwards wherein approaches on ILS-equipped Runway 22 had to be made downwind. Despite this handicap, the two landings made at Edwards can be described as acceptable. Conflicting traffic, which would have necessitated some loitering at low altitude, dictated a change of landing site and the aircraft was flown to Oxnard AFB where a landing on the ILS runway would be made into the wind.

Conditions at Oxnard permitted landings with traffic on Runway 8 against a 22 kt. wind out of the northeast. Here, although conditions were not as severe as at Edwards, the air near the surface was moderately turbulent due to strong gusty surface winds.



LONGITUDINAL and lateral geometry of an automatic landing and approach is detailed in the above drawing.

A wind shear apparently existed about half way between the outer marker and touchdown at about 500 ft. because strong updrafts caused a speed increase of about 20 kt. on approach as the APN-114 system fought "ballooning" tendencies at this point.

The four landings at Oxnard were satisfactory despite the strong, gusty quartering crosswind but were by no means equal in finesse to those which could have been made by an experienced pilot. In each case, the aircraft landed on the runway, but not always close to the centerline or lined up with the runway heading. Although it could be said that the landings were satisfactory, apprehension was experienced as to whether or not the aircraft would straighten out in time, whether it would drift off the runway, whether it would decrab in time, etc.

One thing becomes readily apparent. The system cannot anticipate problems as an experienced pilot can. Landing a Century-series aircraft in gusty wind requires that possible disturbances be anticipated by the pilot. This anticipation which comes only from experience requires that a pilot adjust his response rate as conditions dictate. Response to disturbances while the aircraft is in landing attitude must be much more rapid than when the aircraft is at cruise or even farther out on the approach. The automatic system's response rate is increased as proximity to the ground increases, but the system is not capable of the infinitely variable gain possessed by a good pilot. However, the fact that the system can consistently land the TF-102A under less than ideal conditions is a certain positive stride in the direction of automatic landing. Autonetics engineers readily agree that the system is not ready for all-weather applications but say it does offer a handy tool that could be used to investigate the problem.

Autonetics started with a basic TF-102A equipped with a Hughes MG-10 flight control system with ILS coupler. To this was added an Emerson radar altimeter, inertial rate of descent system, terminal control computer, automatic speed control, control stick steering, failure monitors and other instrumentation. The Hughes autopilot, as well as the approach coupler, were modified to accept the signals of the flare computer.

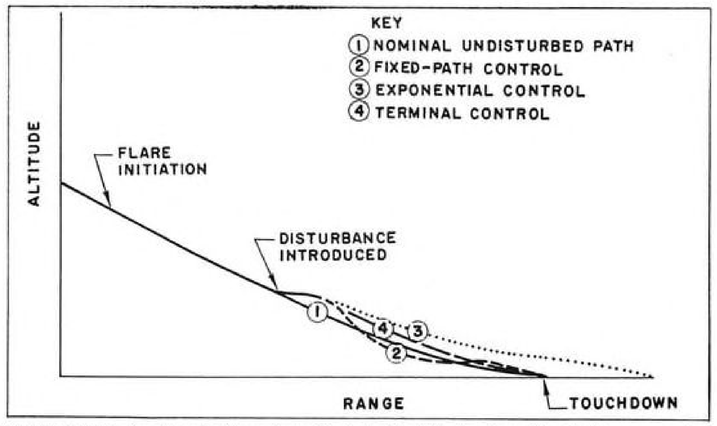
Signals from the localizer and glide slope, radar altimeter, rate of descent system and aircraft instrumentation are fed into the landing computer. The signal to flare is triggered by the radar altimeter at an altitude variable but in the vicinity of 100 ft. Information from the landing computer is fed to a coupler which tailors commands of the flare computer to the dynamics of the airframe. This latter is of great importance inasmuch as it is quite possible for the computer to command unrealistic responses from the airframe. Also, dynamics of all airframes differ and what will work on the TF-102A may not work for other aircraft.

The Autoflare system is capable of making both automatic and manual landings because the information fed to the autopilot in pitch and roll is repeated on the pitch bar of the attitude director indicator and steering needle on the horizontal situation indicator. Making manual, completely-blind landings is a tricky problem, according to Gorham, who has made several with a safety pilot aboard.

The Autoflare system works on a time basis wherein it provides signals to the autopilot or cockpit indicators to effect a landing within a specified time period as differentiated from directing the aircraft along a predetermined path.

Length of time from flare triggger at 100 ft. altitude to touchdown varies from 12 to 18 sec. depending on the dynamics of the particular aircraft. The flare-to-touchdown time for the

TF-102A No. 55-4032 taxis out for a series of automatic landings at Palmdale Airport.



THREE TYPES of automatic flareout are illustrated in this drawing. No. 1 shows a nominal undisturbed flare path. No. 2 line represents the flare path obtained with a fixed-path control method. A low-altitude disturbance with this system could cause severe ground impact. No. 3 exemplifies the exponential control system which commands a descent rate proportional to the existing aircraft altitude. Touchdown point is greatly affected by disturbances with this systeni. Line No. 4 shows the terminal control system used by the Autonetics APN-114. Touchdown point is not greatly affected by disturbances.

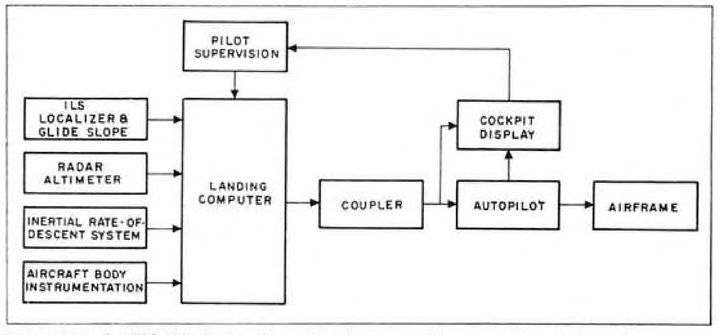
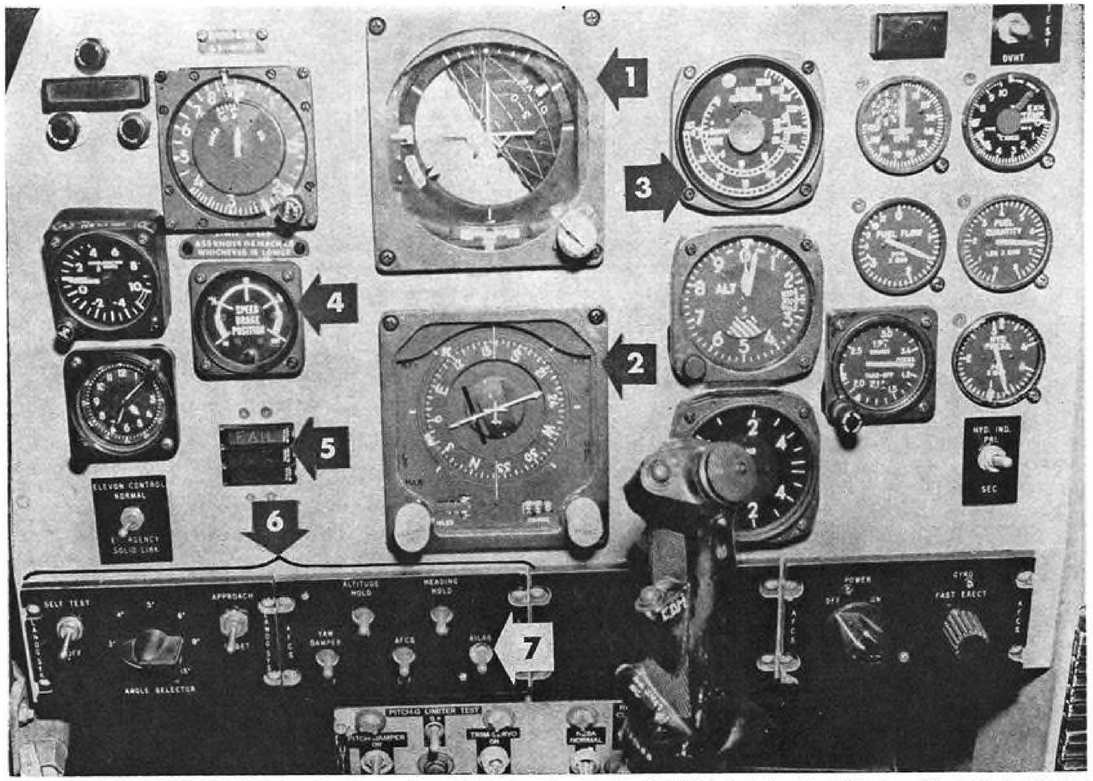


DIAGRAM of APN-114 depicts how pilot has supervision over functioning of computer.



COCKPIT INSTRUMENTATION for the Autonetics APN-114 system in the TF-102A includes the following: (1) Attitude director indicator (ADI); (2) Horizontal situation indicator (HSI); (3) Radar altimeter and sinking rate meter; (4) Speed brake position indicator; (5) Function lights (top to bottom), Fail, Flare, Decrab; (6) Control panel. Once the localizer beam is captured the pilot turns on the Automatic Instrument Landing Approach System (AILAS) switch (7) and the system does the rest.

TF-102 is about 12 sec.—the longer time for slower aircraft. Therefore, point of touchdown will vary slightly according to wind velocity. A tail wind of 30 kt., the maximum the system will tolerate, will result in touchdown 600 ft. farther down the runway than a no-wind condition. Similarly, touchdown will be 600 ft. short of the no-wind point if the aircraft is bucking a 30 kt. headwind.

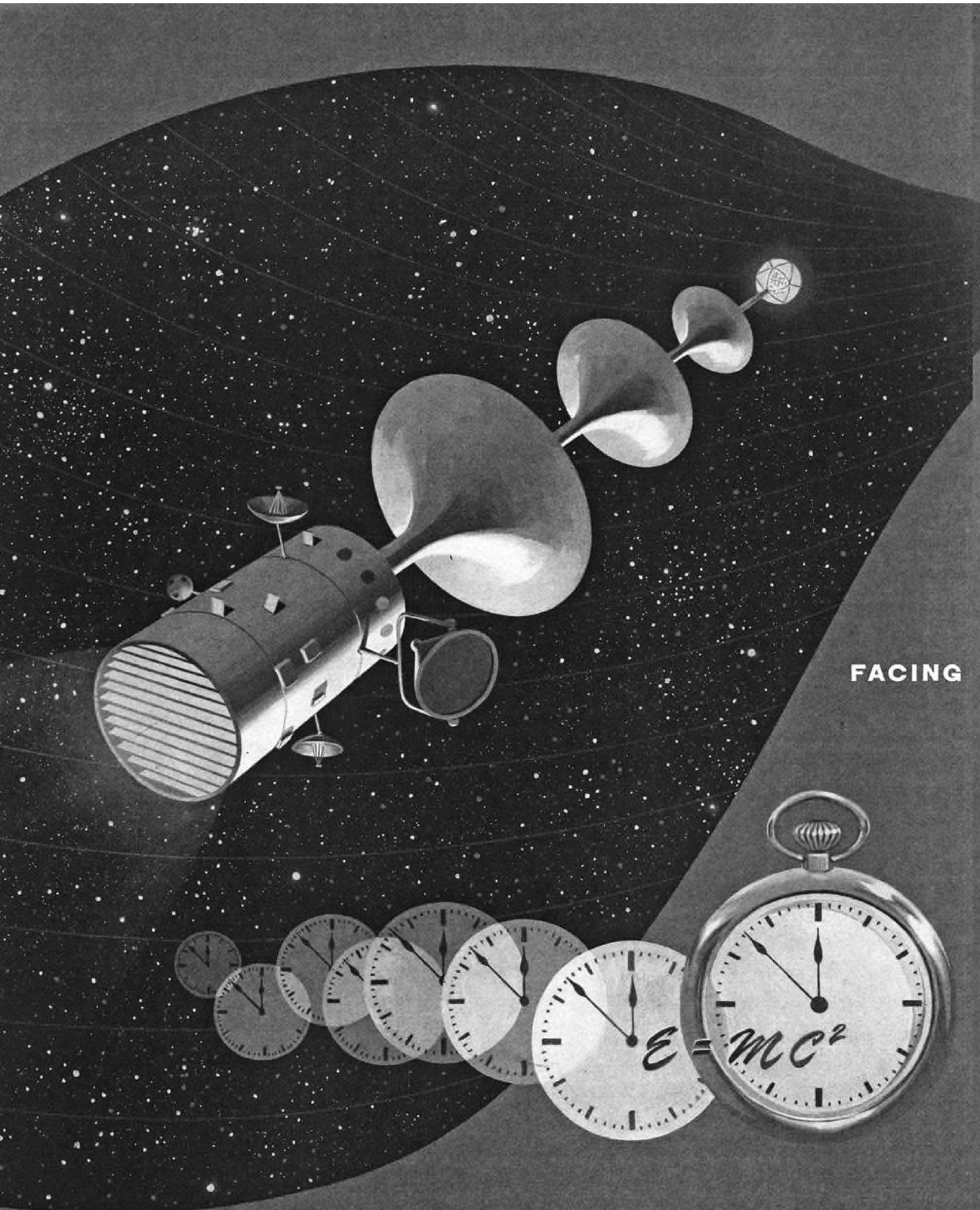
Displacement of the aircraft from an ideal glide path by an outside influence such as gusty wind or from pilot inputs does not measurably affect the touchdown point nor will it result in unacceptable pitchup or pitchdown attitude changes. Rather, the computer immediately calculates a new path to the original touchdown point without forcing the aircraft to return to the "ideal" path. From whatever position in which it happens to find itself, a new path is programed to the original touchdown point.

Early in the program, North American engineers eliminated any tendency in the terminal control system to pitch the aircraft down, no matter how slightly. This is despite the tendency of many pilots to "duck under" the ILS glide path once visual contact with the runway is established. This tendency is due in large part to a desire not to "waste" any runway and, since the GCA or ILS touchdown point generally is about 1,500 to 1,600 ft. from the runway threshold, some pilots do not elect to continue with the steady glide path. They cut power and land as near to the end as possible. This generally results in a glide path profile resembling the bottom contour of a spoon with the handle at the flareout point.

Despite their preference for diving under the glide path at the visual contact point, pilots understandably are against this maneuver being performed by an automatic device. Similarly, pilots prefer that automatic systems start the flareout maneuver sooner than they themselves would start it. One test pilot said the computer was commencing to break the glide much later than he did. Comparison between traces of the test pilot's landings and the automatic landings proved that the flareout was being initiated at precisely the same altitude, approximately 100 ft. by the radar altimeter. However, to satisfy the average pilot's anxiety, the system is programed to commence the flareout maneuver at approximately the same time that a pilot would be thinking about starting to break the glide.

Procedure used during the six automatic landings AVIATION WEEK rode through went like this:

- **Localizer beam** is intercepted at a point beyond the outer marker 1,500 ft. above the runway elevation. Capture of the localizer beam is facilitated if the intercept angle is kept less than 45 deg. because less "bracketing" is required. Airspeed was reduced to 210 kt. with landing gear up and speed brake in.
- **When localizer needle** indicates that beam is being captured, the Automatic Instrument Landing Approach System switch (AILAS) is closed. At this time, the aircraft is still under the glide path as indicated by full up displacement of the needle. Bank is limited to 33 deg. prior to glide slope intercept and to 15 deg. thereafter.
- **Landing gear** is lowered when the glide slope needle is half way between the upper peg and center. Reference speed at this time is reduced to 175 kt. and power is set at about 88% rpm. Speed control is maintained by automatically modulating speed brake position. Throttle control can be employed in the system but proved to be troublesome because too little data is



FACING THE FOURTH DIMENSION IN PROPULSION DEVELOPMENT

Whether the universe has a "saddle shape," or any shape at all, is a matter of interesting conjecture. The matter of space travel, however, is the subject of intense experimentation. A nuclear/thermionic/ionic propulsion system, currently being studied at Lockheed Missiles & Space Company, might well become the power source for space vehicles.

Its design incorporates a nuclear reactor only one foot in diameter, generating heat at a temperature of 1850°K. This is transmitted to banks of thermionic generators, converting the heat directly into electrical energy for the ion beam motor which uses cesium vapor as a fuel. The entire system is designed without any moving parts, minimizing the possibility of failure.

Lockheed's investigation of propulsion covers a number of potential systems. They include: plasma, ionic, nuclear, unique concepts in chemical systems involving high-energy solid and liquid propellents, combined solid-liquid chemical systems. The fundamentals of magnetohydrodynamics, as they might eventually apply to propulsion systems, are also being examined. Just as thoroughly, Lockheed probes all missile and space disciplines in depth. The extensive facilities of the research and development laboratories—together with the opportunity of working with men who are acknowledged leaders in their fields—make association with Lockheed truly rewarding and satisfying.

Lockheed Missiles and Space Company in Sunnyvale and Palo Alto, on the beautiful San Francisco Peninsula, is an exciting and challenging place to work. For further information, write Research and Development Staff, Department M-24A, 599 North Mathilda Avenue, Sunnyvale, California. An Equal Opportunity Employer.

LOCKHEED *MISSILES & SPACE COMPANY*

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

Systems Manager for the Navy POLARIS FBM and the Air Force AGENA Satellite in the DISCOVERER and MIDAS programs. Other current programs include SAINT, ADVENT and such NASA projects as OGO, OAO, ECHO, and NIMBUS.

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA • CAPE CANAVERAL, FLORIDA • HAWAII

available on rpm. time lags for throttle changes, dynamic changes of thrust at various rpm. levels and the effect of airspeed on the two parameters above. Using a nominal throttle setting and then varying drag to control speed works satisfactorily and is less disconcerting to pilots than constant power changes, especially on the landing approach.

• **Flare control** is triggered at an altitude of about 100 ft. above the runway. Obstructions or buildings generally cannot trigger the flare prematurely mainly due to the influence of the rate of descent system which damps out radar altimeter noise. Also, the aircraft usually is over a clear overrun when down to 100 ft.

• **Azimuth control** is obtained from the localizer beam even after the glide slope signal is being disregarded by the pitch axis. During flare, power is reduced on a preset schedule automatically.

• **Touchdown occurs** in a nose-high attitude at about 140 kt. or less and the system will set the aircraft down with a rate of descent of less than 2 fps. Directional control is maintained by the rudder through localizer signals down to minimum rudder effectiveness speed, usually about 70 kt. If cross winds prevail, correction can be put in by the pilot as the de-crab light comes on at an altitude of 7 ft.

Failure Warning

Failure in the system at any time is designed to cause illumination of the "Fail" light on the instrument panel. Additionally, every effort has been made to eliminate hardover signals, especially pitchdown tendencies. Failure generally results in the aircraft tending to maintain altitude. A weak link is designed into the throttle allowing the pilot to disengage throttle control. In addition, the system can be manually disengaged from the control system by the pilot at any time.

In addition to the normal static ground checks on the system prior to flight, a self-test feature is incorporated which can be actuated any time the aircraft is above 1,500 ft. When self-test is initiated, prime inputs to the flare computer are removed and replaced by calibrated voltages. A check of voltage levels is then made at various key points in the flare computer. If any one of the voltages is out of tolerance, the failure light illuminates.

One obvious problem emerges from discussion of widespread use of the Autoflare system: How reliable is it? The answer is that it is fail-safe in design concept. The press-to-test system which can be exercised any time before the aircraft reaches flareout gives a positive indication that the system is functioning properly. Additionally, the system is designed to fail progressively rather than catastrophically. The worst than can happen is that it will give an indication of a zero rate of descent resulting in a maneuver preliminary to a go-around.

A very real problem, however, is how confidence in any automatic landing system can be built up so that in the first instance of landing in zero-zero conditions the pilot will trust the system. The obvious answer to this is to have the automatic system used on each and every landing made. Should the system prove to be reliable in the extreme and perform satisfactorily on every landing over an extended period or at least fail in such a manner when it does fail that the pilot can take over without endangering his aircraft or passengers, then he will have confidence in the equipment. But, all pilots are concerned with their proficiency which must be maintained to the degree necessary to pass semi-annual checks by the FAA and company chief pilots. If each approach and landing is performed by automatic equipment, the pilots will suffer in loss of proficiency. Such a condition exists now in the use of automatic approach couplers with which most airline transport aircraft are equipped. The pilots, hard pressed especially on transcontinental and transoceanic runs to maintain proficiency, are reluctant to allow the automatic equipment to usurp their opportunity to keep their hand in. The alternative to this is exhaustive in-flight tests of the equipment to satisfy pilots and management, and this becomes economically unfeasible. Just what the answer is must await the development of a practical super-reliable system.

PRODUCTION BRIEFING

New flight duration record of 97 min. for a Q-2C Ryan Firebee jet target drone was set recently at Tyndall AFB, Fla., during a target mission at 45,000 ft. altitude. Retrieved from the Gulf of Mexico after fuel depletion, drone was reparable for reuse.

Blount Bros. Construction Co. and Todd Shipyard Corp. have been awarded a $419,100 contract to build, install and check the steel launch pedestal for Saturn launch Complex 37 at Cape Canaveral, Fla. The two companies joined to bid on the project, to be completed in six months.

General Electric CJ610 turbojet, civil version of the J85, has received FAA type certification. The CJ610-1 (2,850 lb. thrust) will power the Piaggio-Douglas PD-808 and Aero Commander's Model 1121 Jet Commander executive aircraft. The CJ610-2B (2,400 lb. thrust) will power the Swiss-American Aircraft Corp. SAAC-23.

Hoover Co.'s Electronics Division, Timonium, Md., will design, develop and manufacture electronic equipment to test the ground based portion of the Minuteman ICBM under a contract approximating $135,000 from the Boeing Co.

Rohr Aircraft Corp. stockholders have voted to change the company's name to Rohr Corp. in recognition of the Chula Vista, Calif., firm's expanding efforts in the over-all aerospace field.

Douglas Aircraft Co.'s Missile and Space Systems Division has received contracts totaling almost $2 million from Lockheed Missiles and Space Co. and Radio Corp. of America to build shrouds and spin tables for assorted Agena B payloads. The glass fiber shrouds will shield Nimbus weather satellites, stiffened Echo communications spheres and Samos or Midas surveillance satellites from aerodynamic heating during flights through the atmosphere and into outer space.

Cessna Aircraft Co., Wichita, Kan., has received a $3.2-million follow-on contract from Republic Aviation Corp. to produce fin, rudder and stabilizer components for the Republic F-105 Thunderchief.

North American Aviation, Inc., has received an initial contract of $1.7 million from the Air Force to begin rehabilitating 70 T-28 tactical trainer aircraft.

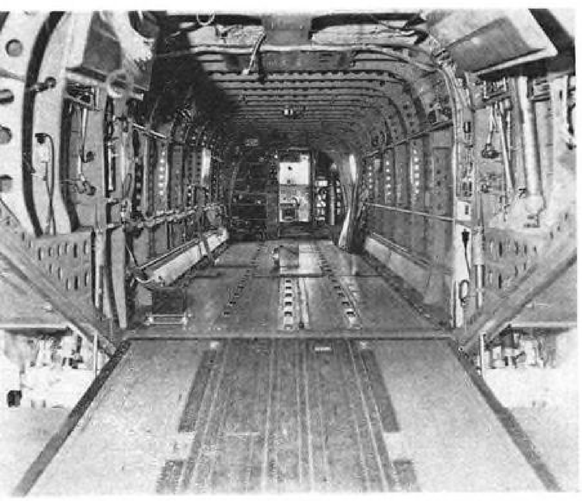
E. W. Bliss Co.'s Heavy Equipment Division, Canton, Ohio, will furnish aircraft catapult and arresting equipment for the Marine Corps Air Wing under a $2-million Navy contract. Equipment is designed to permit aircraft operation in forward areas where long runways are not available.

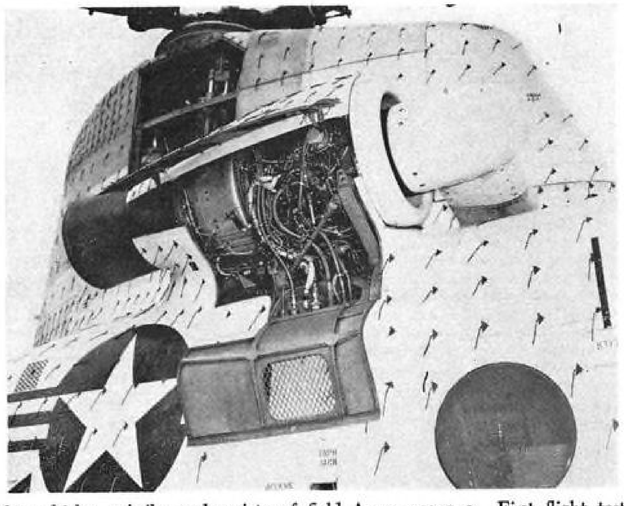
AiResearch Mfg. Co., division of the Garrett Corp., Los Angeles, will supply moisture separator systems for the B-52H ballistic missile bomber under contracts totaling $136,920 from the Boeing Co.

Third prototype of SM 67 turbine helicopter built by Merckle Flugzeugwerke GmbH, of Oedheim, Germany, was recently demonstrated to German defense ministry experts. Type tests of the helicopter (AW July 17, p. 119) are expected to begin in mid-1962.

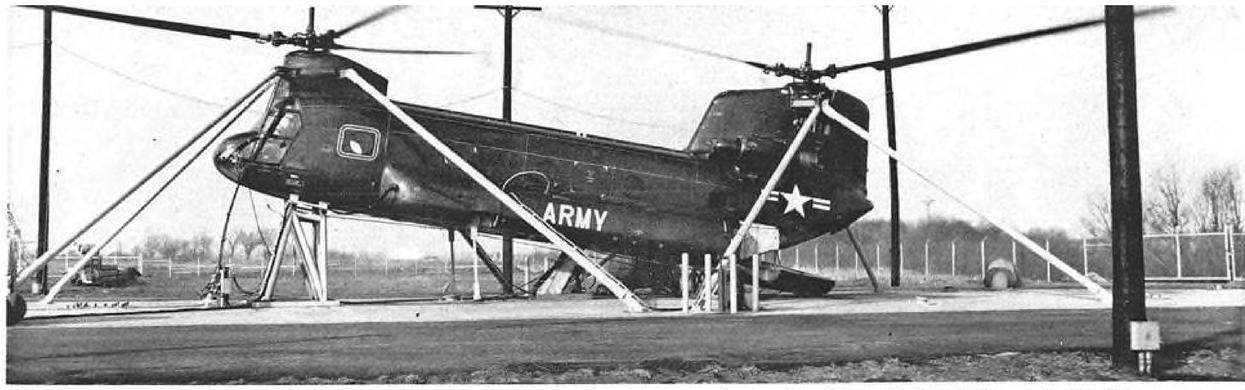
Second Vertol HC-1B Chinook helicopter for the U. S. Army carries more than 3,000 lb. of flight test instrumentation.

Photos Show Details of Army's HC-1B Chinook





Chinook cargo is loaded by rear ramp; hold will take light vehicles, missiles and variety of field Army weapons. First flight test aircraft is tufted on entire starboard side to study local flow with rotors operating.

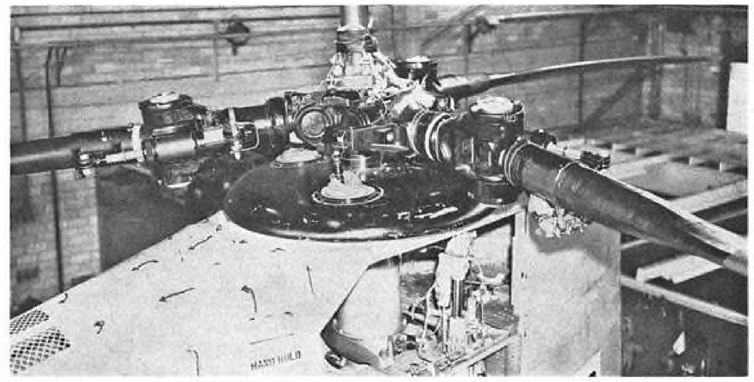


First Chinook built is tiedown aircraft for endurance tests of dynamic systems; development test is continuing. Below, rotor head is fitted with "pineapple" assembly of sliprings to transfer blade strain-gage readings to instruments in cabin.

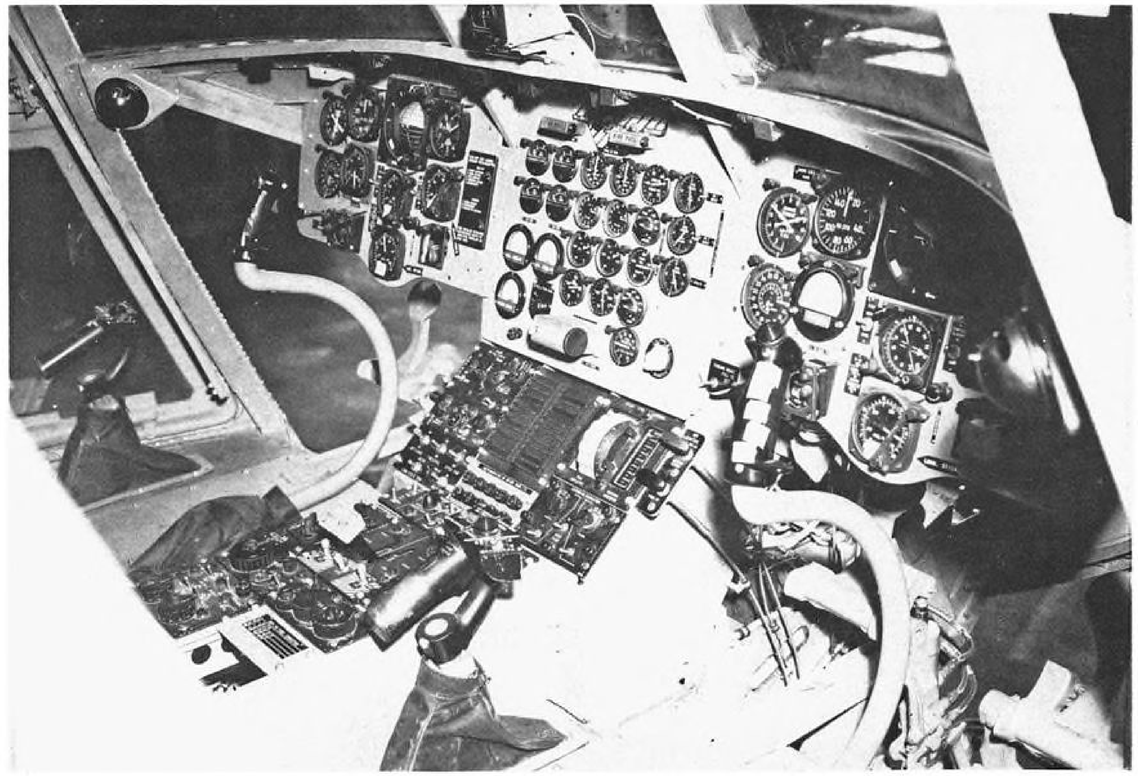
First details of Boeing-Vertol's HC-1B Chinook helicopter, being produced for U. S. Army, are shown in these photographs of the first and second aircraft.

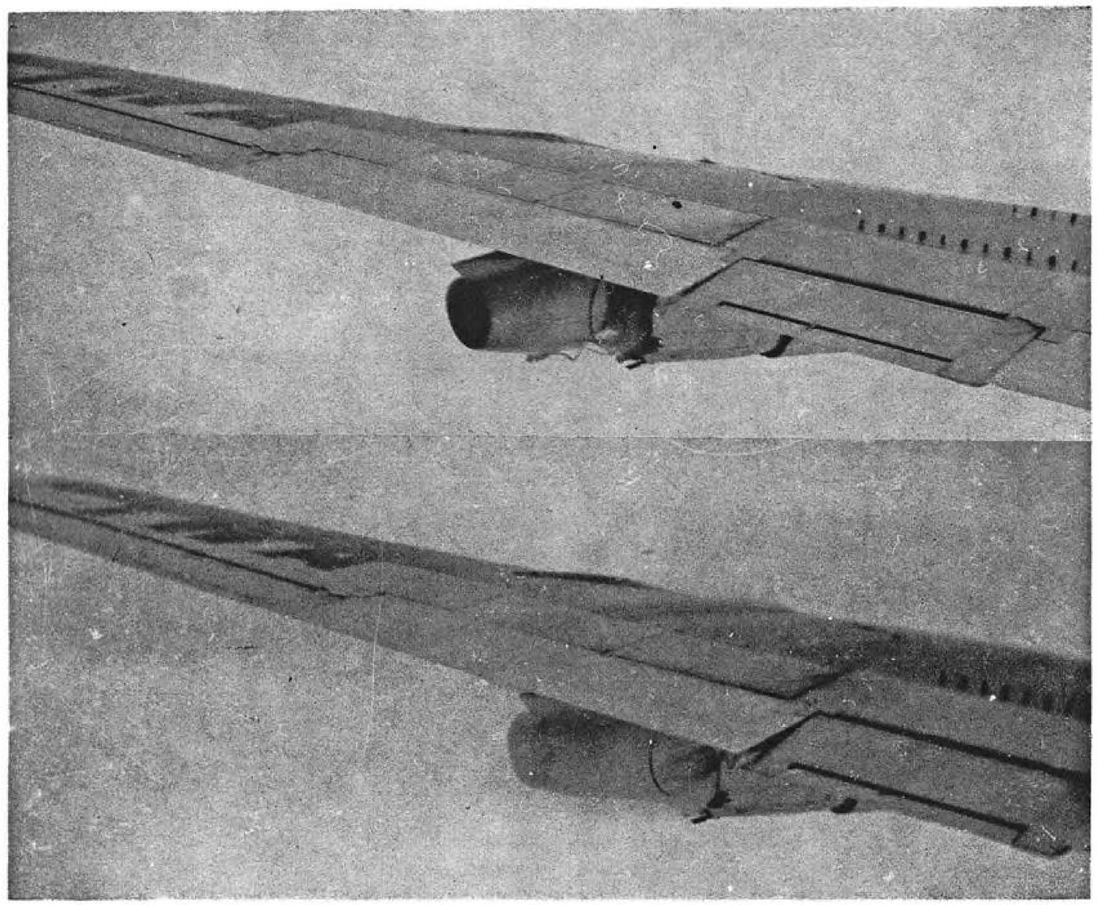
First Chinook built is a tiedown aircraft, being used to evaluate dynamic systems. Second HC-1B is the first flight article, is instrumented heavily for routine aerodynamic and structural investigations. Blades carry strain gages; associated instrumentation can transmit up to 120 readings to recorders in the Chinook cabin.

Chinook is powered by a pair of Lycoming T55-L-5 turboshaft engines rated at 2,200 shp. each. Gross weight is 33,000 lb. and cargo capacity exceeds seven tons. Helicopter has two-man crew, can carry 33 troops.



Pilot's cyclic stick mounts switches for stick-centering device, communications, cargo sling release and automatic flight control system. Collective stick holds switches for searchlight control and for speed trim of both engines.





Boeing 720B Passenger Photographs In-flight Mishap

No. 1 engine of a Trans World Airlines Boeing 720B was damaged over Albany, N.Y., en route from Los Angeles to Boston when lubrication failure led to turbine disk failure (AW Nov. 13, p. 35). Metal thrown in the failure pierced the passenger cabin at the coat rack, causing loss of pressurization. Particles also penetrated the wing, causing fuel leakage. Fuel spray and mist surround engine nacelle in bottom photo. Pictures were taken by a passenger, R. F. Mackey, of San Fernando, Calif.

NASA Contracts

Recent contracts and research grants of $50,000 or more awarded by the National Aeronautics and Space Administration:

HEADQUARTERS, Washington, D. C.:

Military Air Transport Service, Scott AFB, Ill.—$50,000 to furnish worldwide air transport services.

Bolt, Beranek & Newman, Cambridge, Mass.—$99,000-Joint NASA/FAA contract to establish criteria for evaluating subjective noisiness of aircraft sounds.

Dunlop & Associates, Stamford, Conn.—$64,000 to establish human factors criteria and control navigation display system requirements for spacecraft missions.

Air Force Systems Command, Kirtland AFB, N. M.—$225,000 to study biological significance of cosmic radiations and devise techniques for measuring selected phenomena.

Navy Bureau of Medicine, Pensacola, Fla.—$285,000 for research on physiological and psychological responses to force environments generated by rotational motions occurring in operation of aircraft and space vehicles.

Navy Bureau of Medicine, Bethesda, Md.—$62,000 for research on basic physiological mechanisms which defend the human body against heat and cold.

University of Chicago, Chicago, Ill.—$420,000 for studies of energetic particles and electrodynamical processes in interplanetary space and in vicinity of planets.

University of Michigan, Ann Arbor, Mich.—$89,000 to develop probe techniques for possible measurements of electromagnetic phenomena.

Space Technology Laboratories, Los Angeles, Calif.—$94,000 for study of high-speed impact phenomena.

Space Technology Laboratories, Los Angeles, Calif.—$225,000 for reduction and analysis of Explorer 6 and Pioneer 5 data.

Space Technology Laboratories, Los Angeles, Calif.—$96,000 for development of luminescent chambers for space research.

Department of Commerce, Bureau of Standards, Washington, D. C.—$100,000 for support in collection of solar geophysical data.

Atomic Energy Commission, Germantown, Md.—$652,000 for development of hydrogen turbopump system in support of Kiwi-B reactor.

AMES RESEARCH CENTER, Moffett Field, Calif.:

Western Scientific Instrument Co., Inc., Redwood City, Calif.—$75,000 for maintenance and repair of electronic instruments.

Burroughs Corp., San Francisco, Calif.—$50,000 for equipment maintenance service for computing systems.

LEWIS RESEARCH CENTER, Cleveland, Ohio:

Air Products & Chemical Co., Allentown, Pa.—$337,000 for service, labor and materials to design, furnish and install low-temperature cooling system for the electromagnet.

Aerojet-General Corp., Azusa, Calif.—$75,000 for two phase forced convection for Mercury corrosion loop support on the Snap 8.

MSA Research Corp., Callery, Pa.—$203,000 for services, labor and materials for design, installation and operation for performance testing of a liquid sodium pump test loop for use in propulsion energy conversion.

LANGLEY RESEARCH CENTER, Langley Field, Va.

Westinghouse Electric Co., East Pittsburgh, Pa.—$1,028,000 for arc heater system and conversion control equipment.

Pittsburgh Des Moines Steel Co., Pittsburgh, Pa.—$609,000 for centrifuge housing and vacuum system.

Ferguson Corp., Newport News, Va.—$66,000 for building additions and installing components in the 2,000 kv. arc jet.

Bryhn & Henderson, Williamsburg, Va.—$97,000 to construct building and gas storage shed.

GODDARD SPACE FLIGHT CENTER, Greenbelt, Md.:

International Telephone & Telegraph Co., Fort Wayne, Ind.—$59,000 for monopulse antenna tracking system.

D. S. Kennedy Co., Cohasset, Mass.—$95,000 for automatic aiming telemetry antenna system.

Bendix Corp., Baltimore, Md.—$1,250,000 for maintenance and operation of Project Mercury facilities in Mexico, Bermuda, Canary Islands, Nigeria and Zanzibar.

International Telephone & Telegraph Co., Fort Wayne, Ind.—$81,000 for monopulse automatic tracking receiver.

Spectrolab, Inc., Hollywood, Calif.—$50,000 for solar paddles aboard S-51 satellite.

Smithsonian Institution, Astrophysical Observatory, Washington, D.C.—$1,696,000 to design, develop, fabricate and test data reduction and evaluation techniques for the OAO astronomical experiment.

Zimney Corp., Monrovia, Calif.—$71,000 to design, develop and fabricate payloads for the Aerobee sounding rockets.

Barnes Engineering Co., Stamford, Conn.—$100,000 for construction of four medium range radiometers for Tiros.

Ball Bros. Research Corp., Boulder, Colo.—$75,000 for mechanical design and fabrication of high energy gamma ray experiment.

Space Technology Laboratories, Los Angeles, Calif.—$250,000 for range and range rate systems for Project Syncom.

American Optical Co., Pittsburgh, Pa.—$420,000 for vacuum chamber and complete vacuum optical bench.

Aerojet-General Corp., Azusa, Calif.—$72,000 for Aerobee sounding rockets with nose cones, boosters and recovery systems.

Army Ordnance Missile Command, Huntsville, Ala.—$84,000 for Sergeant XM-20 rocket motor.

Navy Bureau of Weapons, China Lake, Calif.—$50,000 to develop techniques for soft lunar landings.

SPACE TASK GROUP, Langley Field, Va.:

Avco Everett Research Laboratory, Everett, Mass.—$80,000 for study of thermoradiation associated with non-equilibrium flow in Apollo flight regime.

MARSHALL SPACE FLIGHT CENTER, Huntsville, Ala:

Electro Missile Facility, New York, N.Y.—$3,996,000 to construct central laboratory and office building.

Bendix Corp., Davenport, Iowa—$135,000 for fabrication of components for discrete liquid level gaging systems.

Noble Co., Oakland, Calif.—$235,000 for relocation and modification of portable missile service structure in support of Saturn.

General Electric Co., Birmingham, Ala.—$58,000 for aircraft energizers in support of Saturn.

Atomic Energy Commission, Oak Ridge, Tenn.—$150,000 for proton radiation shielding experiments.

HEADQUARTERS, Washington, D. C.:

Cornell University, Ithaca, N. Y.—$63,000 for research on magnetometers for use on interplanetary space vehicles, including studies, materials, circuits and components for fluxgate magnetometer.

National Research Corp., Cambridge, Mass.—$98,000 for investigation of adhesion and cohesion of metals in ultra-high vacuum.

Stanford Research Institute, Menlo Park, Calif.—$187,000 to measure internal interference characteristics of satellite payload in the solar observatory program.

Commerce Department, Bureau of Standards, Boulder, Colo.—$136,000 for research on electron content distribution and temperature variation in ionosphere by scintillation and faraday rotation of satellite radio transmission to spaced ground stations.

University of California, Berkeley, Calif.:—$100,000 for research on techniques and instrumentation for measuring physiological variables in mammals under space flight conditions; $70,000 for scientific research on dynamic behavior of porous electrode systems; $80,000 for research on hemodynamic and related physiological functions in primates.

Rensselaer Polytechnic Institute, Troy, N. Y.—$160,000 for research in fundamental atomic chemistry with applications to upper atmosphere.

North American Aviation, Inc., Canoga Park, Calif.—$74,000 for analytical study of system integration problems.

National Engineering Science Co., Pasadena, Calif.—$71,000 to investigate thrust vector control by secondary injection.

Army Ordnance Fuse Laboratory, Washington, D. C.—$400,000 for radiation-resistant electrical component suitable for satellites.

Aerospace Corp., El Segundo, Calif.—$435,000 for support of DOD-NASA large launch vehicle planning group.

University of Arizona, Tucson, Ariz.—$142,000 for basic research on selenodetic and physical studies of lunar surface.

Electronic Communications, Timonium, Md.—$76,000 to develop techniques of superheterodyne receiver.

Arinc Research Corp., Washington, D. C.—$301,000 for Saturn reliability study.

Commerce Department, Bureau of Standards, Washington, D. C.—$100,000 to develop radiometric standards for extreme ultraviolet.

Atomic Energy Commission, Germantown, Md.—$105,000 for theoretical studies of space vehicle shielding.

Air Force Systems Command, Wright-Patterson AFB, Ohio—$50,000 for support activities, radiation effects information center.

AMES RESEARCH CENTER, Moffett Field, Calif.:

S & Q Construction Co., San Francisco, Calif.—$349,000 for test sections, components and auxiliary piping systems.

Enviratron Co., Van Nuys, Calif.—$60,000 for controlled atmosphere room in hypervelocity research laboratory.

LEWIS RESEARCH CENTER, Cleveland, Ohio:

Hughes Aircraft Co., Culver City, Calif.—$96,000 for feasibility study for low temperature thermionic energy converter.

Electronic Associates, Long Branch, N. J.—$184,000 for analog computer system and major assemblies.

LANGLEY RESEARCH CENTER, Langley Field, Va.:

A. O. Smith Corp., New York, N. Y.—$195,000 for service and materials to furnish 6,600 psig. helium storage field hypersonic aerothermal dynamics facility.

J. F. Pritchard & Co.—$124,000 for service and materials to design, fabricate, deliver and install heat exchanger for hypersonic aerothermal dynamics facility.

Doyle & Russell, Norfolk, Va.—$989,000 for construction of a dynamics research laboratory.

Marquardt Corp., Van Nuys, Calif.—$95,000 for booster heater system for 9 x 6 ft. thermal tunnel.

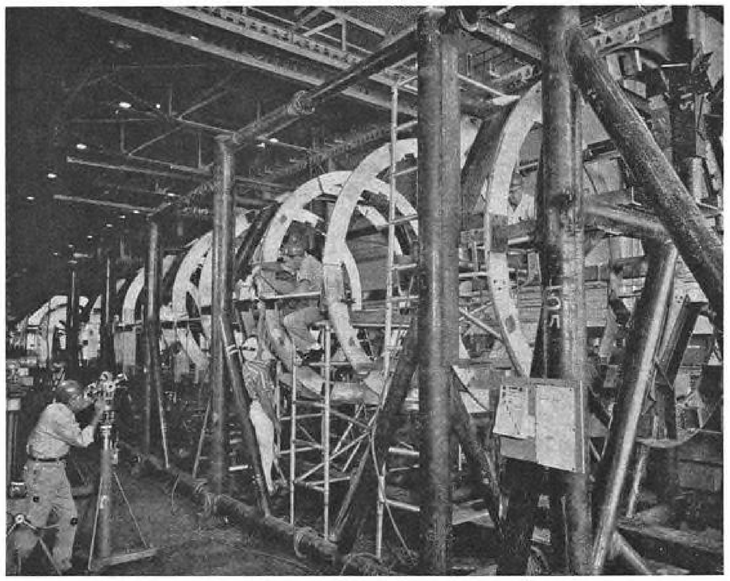
Trio Technology Co., Burbank, Calif.—$64,000 for service and materials to design, fabricate and furnish a centrifuge acceleration test machine.

Task Corp., Anaheim, Calif.—$110,000 for service and materials to design, fabricate, instrument and calibrate internal strain gage balances.

Aerojet-General Corp., Sacramento, Calif.—$300,000 for development of Algol rocket motors.

Cooper Bessemer Corp., Washington, D. C.—$177,000 for service and materials for helium compressor unit.

Ling-Temco-Vought Corp., Dallas, Tex.—$300,000 for engineering, coordination, design, development, service and materials for launch facility at the Pacific Missile Range.



Jigs Built for B-70 Fuselage Sections

North American Aviation is completing tooling jigs for fuselage sections of the B-70 Mach 3 bomber at the Palmdale, Calif., plant. Fabrication of most major sections of the USAF aircraft is under way. The B-70 is scheduled to make its first flight by the end of 1962.

CAB Accident Investigation Report:

Alouette 2 Has Power Loss Over Water

An Alouette 2 helicopter, N 526, owned and operated by Petroleum Helicopters, Inc., crashed in the Gulf of Mexico approximately 25 miles south-southwest of Cameron, La., in the early afternoon of Dec. 2, 1958.* The pilot and the three passengers received fatal injuries. The aircraft was a total loss from impact damage and subsequent salt water corrosion.

N 526 was used to transport personnel and supplies to various offshore drilling platforms in the Gulf of Mexico under a contract between Petroleum Helicopters, Inc., and the Shell Oil Co. On Dec. 2, four normal flights were completed in accordance with this purpose. During the fifth, about eight minutes after a normal takeoff, the helicopter crashed in the Gulf.

Following an exhaustive search the wreckage was located in the water six miles from its takeoff point and on course for Cameron. The time of the accident was approximately 1320 CST.

Although there is insufficient evidence to determine the probable cause, the available evidence suggests that the accident resulted from an autorotational touchdown under hazardous sea conditions. It appears further that the autorotational descent may have been induced by the inadvertent closing of the emergency fuel shutoff valve or by some indeterminable malfunctioning of the powerplant.

As a result of this investigation the FAA took corrective action by issuing Airworthiness Directives 59-2-3 and 59-5-6 which require a rework of the emergency fuel shutoff lever. These directives also made mandatory several other changes in this model helicopter; none of these latter, however, appear to pertain to the cause of this accident.

Investigation

N 526, an Alouette 2 helicopter, had been dispatched from Morgan City, La., to an oil-drilling rig located in the Gulf of Mexico. It departed the Morgan City Heliport at 1135[1] and arrived at the rig, located in an area known as Block 82, at 1240. The flight was without incident and the aircraft did not require refueling at the rig. This type of offshore flight is customarily flown at 500 feet altitude in accordance with established company practice.

At approximately 1314 the company radio at Cameron received a message from N 526 advising that the flight left the rig at 1312 and was estimating Cameron Heliport at 1345. A call to the flight was made at 1335 by the company radio but was not answered. Another company helicopter, N 5166B, was directed by radio to proceed to Block 82 and check on N 526. After it reported that N 526 was not on the platform at Block 82, it was ordered to take a direct course from Block 82 to Cameron Heliport. After flying this course about five to seven minutes the pilot sighted a large oil slick and two helicopter floats in the water. Closer investigation revealed two persons in lifejackets floating face down. (Lifejackets are customarily worn by passengers and pilots during offshore flights.) The pilot was unable to land because of high swells but hovered over the area directing to the scene a boat whose crew subsequently picked up two bodies and floating helicopter wreckage. The two men, identified as passengers, were examined by a doctor and pronounced dead. Their injuries were multiple and severe, indicating violent impact.

Weather at the time was: Ceiling unlimited; visibility unrestricted except for patches of haze, at least 5 miles of visibility at all times; wind north 5-10 mph.; sea condition 3- to 4-ft. swells; Lake Charles barometer 30.16 in.

Search Operations

Search operations began on Dec. 3, 1958; however, the main wreckage was not located until Dec. 11 when it was found by U. S. Navy minesweepers and divers at a point 25 mi. south-southeast of Cameron (lat. 29 deg. 27 min. N., long. 93 deg. 06 min. W.) and approximately on course. Bodies of the pilot and third passenger were found with the wreckage. The following day all major components of the helicopter were recovered and taken to the company base at Lafayette, La.

The shock damper tubes connecting the center fuselage structure and the float assembly cross tubes had failed in compression as though from a hard level landing. Damage to the tail boom and tail rotor was also indicative of a dipping of the tail rotor in the water.

Except for these failures, all other damage appeared to have resulted from a second and much more severe impact with the water while the aircraft was in an inverted attitude. Nearly all damage from this second contact was consistent and indicated that the helicopter was traveling inverted and primarily downward with a slight forward speed and some rotation to the right (as viewed from above).

Relative to the aircraft's normal attitude, the cabin overhead structure, back, and sides were crushed downward, slightly aft, and to the right. The two front seats were broken downward and to the rear. The fuel tank was forced upward and forward and the seams near the top had burst. One main rotor blade sleeve was broken downward and all three blades had overtraveled downward. The top of the engine combustion chamber housing, tailpipe, and sheet metal accessory covers were crushed in by water impact. The horizontal stabilizers were both bent downward and showed severe hydraulic forming on the upper surfaces. The float assemblies were torn from the helicopter and away from the fuselage but were only slightly damaged.

The entire airframe was studied in an attempt to find pre-impact damage, to relate damage patterns, and to separate impact from recovery and handling damage. All functional units were disassembled and carefully examined. No evidence of pre-impact damage to, or failure of, the mechanical and structural components was found during the study of the wreckage. The mechanical linkage in the flight control systems was studied and all failures in the systems were determined to have resulted from impact forces and the breakup of the helicopter. The components of the swashplate bearing assembly (star assembly) were examined for evidence of binding but none was found. No evidence of pre-impact mechanical interference or jamming was found on any of the control system components.

On Jan. 17-18, 1959, the star assembly, with its uniball and bearing cones, was operated in a test jig to see if there was any inherent tendency for the unit to bind. This was done because binding had occurred on another star assembly installed on N 526, and had also occurred on other Alouette 2 helicopters in service. Binding in the unit endangers the control of the helicopter and could conceivably make the helicopter uncontrollable if the binding were severe since it causes the cyclic stick to rotate in a circle at rotor rpm. Binding also prevents the pilot from sending an emergency radio message since the microphone button is located on top of the cyclic control stick. No binding tendency was noted in the test run of 10 hr. although the test rig closely but not exactly simulated inflight loads on the star assembly. Previous known occurrences of swashplate bearing binding on this model aircraft have left detectable evidence of the malfunction on the uniball assembly. No such evidence was found in this instance.

No Structural Failure

An examination and teardown of the turbine engine disclosed no indication of an inflight structural failure, operational difficulty, or indication of fire prior to or subsequent to the accident. However, examination indicated that the engine was not developing appreciable power at the final impact.

Damage to the emergency fuel shutoff valve control linkage was such as to indicate the valve was halfway between open and closed at the time of impact. In this position, the fuel flow would be impaired and a power loss would result. The emergency fuel shutoff valve control is located on the cock-

---

* This report is a revision of the Board's report of Aug. 8, 1959, and reflects new evidence adduced since that date.
[1]All times herein are central standard based on the 24-hr. clock.

pit floor between the two pilot seats. It is a lever which is vertical when the valve is open. Rearward motion closes the valve. It is not only readily accessible to the occupant of either pilot seat but is, in fact, so placed as to be readily moved inadvertently. As a result of this accident the manufacturer has modified the control to prevent inadvertent movement of the lever. One of the items of emergency procedure, in the event of a flameout, is to close this fuel valve.

Pilot McCann had nearly 2,400 hr. of helicopter pilot flight time, as well as over 1,000 hr. of fixed-wing pilot flight time, and had acted in supervisory capacities for Petroleum Helicopters, Inc. He had flown Alouette helicopters 37 hr.

Petroleum Helicopters, Inc., has an extensive background of helicopter operation in various parts of the world. The company was organized in 1949 and pioneered the use of helicopters in the offshore transportation of personnel and material. It operates in excess of 3,000 hr. of helicopter time a month and since the start of its operation has transported nearly a million passengers. During the fiscal year of 1958 it operated as many as 46 helicopters and is currently operating 38.

Analysis

A reconstruction of events immediately preceding this accident must necessarily be based largely on premise for there were no survivors, no witnesses, no radio message indicative of trouble, and no evidence of a malfunction.

The first premise is that the helicopter was cruising at 500 ft. which is where it normally should have been. This altitude would have been ample from which to start and execute an autorotational landing from cruising speed. It would not have been high enough to allow restarting the engine in event of a flameout. For this, some 1,800 ft. is required.

The second premise is that the descent from 500 ft. was autorotational and dictated by power loss. This could have been caused by inadvertent movement of the emergency fuel shutoff lever, as mentioned under "Investigation," or it could have resulted from some indeterminable malfunctioning of the powerplant. However, nothing was found to suggest the latter, as stated.

In either event, an immediate autorotational descent must have been started. The rate of such a descent would have been about 1,500 ft. a minute and consequently the time of descent would have been in the order of 20 sec. The airspeed would have been in the neighborhood of 40 kts. Patches of haze at the surface coupled with a light wind and swells three or four feet high posed an extremely hazardous landing condition. It is entirely possible that initial touchdown may have been on the upslope of a swell with slight forward speed. Under these conditions impact could have been hard enough to cause the previously described damage to structural members between fuselage and floats. The failure pattern found in the shock strut tubes is indicative of a level and skipping type of landing prior to the inverted impact. Substantiation of such a hard level landing is evidenced by the failure of the tail boom downward at the forward attach lugs, allowing the tail rotor to strike the water while rotating, which bent the blades inward, causing one to strike and break the upper right tail boom longeron. Damage from water impact along the upper side of the helicopter indicated a severe, inverted, nearly vertical impact with slight forward motion and clockwise rotation (as viewed from above) and could only have followed a fairly large skip or bounce during which the helicopter went on its back.

From the available evidence the Board concludes that a power loss occurred necessitating an autorotational descent and the helicopter first contacted the water hard and while upright and with some forward speed. The tail boom was damaged and the function of the tail rotor was destroyed at this time which was followed by a maneuver resulting in the secondary inverted contact.

As a result of these investigations the FAA issued Airworthiness Directives 59-2-3 and 59-5-6 providing a locking detent for the emergency fuel shutoff lever. It also became apparent that certain other changes should be made to this make and model helicopter. These were: (1) to filter or protect the vent air openings of the lateral trim bungee unit to prevent jamming of the piston by foreign objects, and (2) to prevent binding of the swashplate bearing assembly. Accordingly, the FAA instructed all Regional Administrators, on January 9, 1959, that there must be immediate compliance with the following Republic Aviation Corporation Service Bulletins:

Service Bulletin No. 3.45-1 to prevent inadvertent loosening of the lateral trim cylinder cap nut.

Service Bulletin No. 8.10-3 specifying rework of the emergency fuel shutoff lever to prevent accidental closing of the valve during flight.

Service Bulletin No. 732-2 to insure positive and adequate lubrication of the main rotor swashplate assembly.

In addition, the directive requested compliance with Republic Aviation Corporation's instructions for increasing the clearance of the swashplate ball assembly. On Mar. 9, 1959, the FAA issued Airworthiness Directive 59-5-6, superseding AD 59-2-3 (which covered FAA Jan. 9 telegraphic instruction) which required replacement of the swashplate oilite bearings and spacer with redesigned parts.

The Board determines that there is insufficient evidence on which to base the probable cause of this accident. However, circumstances suggest a power loss with a resulting autorotational descent and an unsuccessful touchdown during hazardous sea conditions.

By The Civil Aeronautics Board: Alan S. Boyd, Chairman; Robert T. Murphy, Vice Chairman; G. Joseph Minetti, Member; Whitney Gillilland, Member.

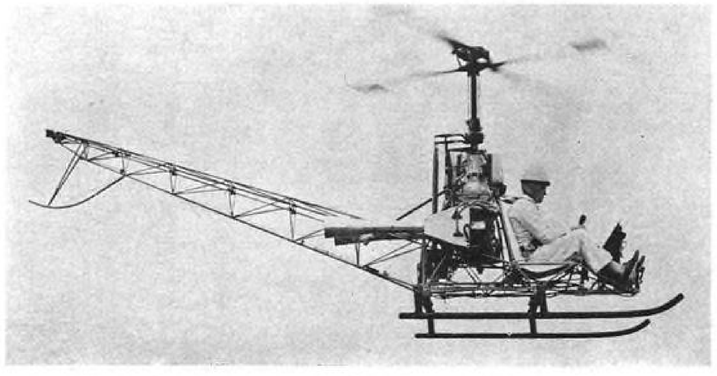
Chan Gurney, Member, did not take part in the adoption of this report.

Supplemental Data

The Civil Aeronautics Board was notified of the accident at 1400 est, Dec. 2, 1958. An investigation was immediately begun in accordance with the provisions of Section 702(a)(2) of the Civil Aeronautics Act of 1938, as amended. Depositions were taken at Lafayette, La. Jan. 29, 1959.

The aircraft was owned and operated by Petroleum Helicopters, Inc., of Lafayette, Louisiana, and was under contract to the Shell Oil Co. (Offshore Division). N 526 was used to transport personnel and supplies to various offshore oil-drilling sites in the Gulf of Mexico, operated by the Shell Oil Co.

N 526, a Republic Aviation Corporation Alouette 2 helicopter, serial No. 1139, was manufactured in 1958, and was received by Petroleum Helicopters, Inc., on June 19, 1958. The helicopter had a total time of 410:40 hr. with no overhauls. The engine, a Turbomeca Artouste, single shaft gas turbine, serial No. 392, was installed new on N 526 on Sept. 11, 1958, and had a total time of 171:50 hr. since manufacture. The three main rotor blades, serial Nos. 911, 915, and 916, were installed on Nov. 8, 1958, and had a total time of 61:30 hr. The two tail rotor blades serial Nos. 904 and 905, were installed on Nov. 1, 1958, and had a total time of 74.15 hr. The swashplate—No. 4—had 190.05 hr. total time.



West German Bo 103 Begins Flight Tests

Bo 103 single-seat helicopter is undergoing flight evaluation trials. Built by Bölkow-Entwicklungen K. G., Ottobrunn near Munich, aircraft is a development of the company's Bo 102 fixed-base helicopter trainer (AW July 24, p. 67). Powerplant is an 82-hp. Agusta engine. Gross weight is 880 lb.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE:
The advertising rate is $31.00 per inch for all advertising appearing on other than a contract basis. Contract rates on request.
AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.
EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE:
$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
PROPOSALS, $1.80 a line an insertion.
BOX NUMBERS count as one line additional in undisplayed ads.

Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 645 N. Michigan Ave.
SAN FRANCISCO 11: 255 California St.

FOR SALE

1960 Super G Beechcraft—Total time 600 hours—Feature full instrumentation radio, long range tanks—Convertible executive 5 seat interior to 9 place high density seating. 1961 Beech "Debonair"—only 145 hours total time—Auxiliary wing tanks—Dual VHF with omni, and ADF. PBY-5A-two man crew—cargo doors and floor-seating 16 passengers—no corrosion. Grumman "Mallard"—Mfg. 1950—Airframe only 3500 hours—Deluxe executive interior seating 10 passengers plus 2 crew—considerable spares—no corrosion. FS-8052, Aviation Week.

SEARCHLIGHT Equipment Locating Service

No Cost or Obligation

This service is aimed at helping you, the reader of "SEARCHLIGHT", to locate Surplus new and used aviation equipment and components not currently advertised. (This service is for USER-BUYERS only).

How to use: Check the dealer ads to see if what you want is not currently advertised. If not, send us the specifications of the equipment wanted on the coupon below, or on your own company letterhead to:

Searchlight Equipment Locating Service
c/o AVIATION WEEK
P. O. Box 12, N. Y. 36, N. Y.

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

Searchlight Equipment Locating Service
c/o AVIATION WEEK
P. O. Box 12, N. Y. 36, N. Y.

Please help us locate the following equipment components.

.....
.....
.....

NAME .....
TITLE .....
COMPANY .....
STREET .....
CITY .....ZONE .....
STATE 1/1/62

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, JANUARY 1, 1962

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

PROBLEMATICAL RECREATIONS 99

A circle of radius 1 inch is inscribed in an equilateral triangle. A smaller circle is inscribed at each vertex, tangent to the circle and two sides of the triangle. The process is continued with progressively smaller circles. What is the sum of the circumference of all circles?

—Contributed

Add the equipment from our Products Marketing Department and you'll find you can answer the support and test needs of your digital components, sub-systems and systems with extreme accuracy. To enumerate: encoder testers, clock track recorders, drum fill equipment, tape editors, card test units, and automatic checkout equipment. More from: Products Marketing Department, Litton Systems, Inc., Woodland Hills, California.

ANSWER TO LAST WEEK'S PROBLEM: The weights are opposite immediately after 3 and 9 o'clock, a.m. and p.m., so Maynard must retire at 9 p.m. or 3 a.m.

LETTERS

Airline Motivation

As a regular subscriber of your excellent magazine, I found your editorial on the Eastern air shuttle in your Dec. 4 issue quite interesting.

I feel that in your enthusiastic effort to approve of this concept you omitted certain facts and obvious conclusions.

First let me say that in spite of the fact this new service undoubtedly serves the interest of a large segment of the traveling public, there are those of us who appreciate the comfort, reliability, speed and catering to be had on first-class flights. In any case, your unequivocal approval of this new service seems inspired by the fact that it serves the public interest so well. It is a fact that this shuttle, over the short-haul Boston-New York-Washington route, with its low fare structure has yet to prove in any way that it can be profitable. In view of this fact I think the motivation for Eastern's implementation of this new service at this time is of primary importance. The public interest was never particularly served on this route until Northeast Airlines, four years ago, introduced its excellent, every-hour Viscount service. This enabled Northeast to acquire over 50% of all traffic flown on this route. None of the major carriers, including Eastern, serving this route found it in the public's interest to offer any effective, competitive service to Northeast.

Now Eastern finds itself in the position of attempting to inhibit Northeast from receiving permanent rights to serve the route. It is an unusual coincidence that Eastern did not see fit to conceive the shuttle concept, "in the public interest," until the time that Northeast's right to permanently serve the route was to be decided. The obvious conclusion is that the public interest being served, in this case, is an effect and not the motivation. The motivation is an attempt to eliminate the competition, that up to this time has given the only decent service on the route, regardless of the financial loss that must be absorbed. This, of course, brings us to the point of conjecturing the continuance of this new service should the effective competition that Northeast offers be eliminated.

The primary motivation of any airline conceiving and executing any new service concept, that may as an effect serve the public interest, is the effective competition it must contend with on the route. Remove the competition and you remove the motivation. In any case, no concept can endure that is economically unsound.

M. Joseph Sheehan
Plainview, N. Y.

Golden Goose

NASA's handling of the Saturn S-1 booster contract seems a fine example of what Bernard Benson calls "laying the egg that kills the golden goose."

Surely NASA knew that nobody else in the industry could match Chrysler's experience with Redstone and Jupiter or its long association with the Marshall team.

How is it, then, that NASA got the industry all worked up to fever pitch with a two-week schedule and a 400-page limit on proposals?

Maybe the only way to beat this kind of game is do as Aerojet did and "bid as a member of five of the seven teams in the competition." Then, at least, you have a chance.

This is not West Coast sour grapes, only an appeal for the common sense and fairness all around that you proposed in your editorial on procurement a couple of months ago.

P. M. Zall
Los Angeles, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Initial Confusion

Will you allow me to make a small correction? Verduzio's initial (AW Nov. 27, p. 35) is not "G" but "R".

Rodolfo Verduzio was the designer of the SVA (Savoia-Verduzio-Ansaldo), author of many important technical contributions, beloved teacher and example as a gentleman to a whole generation of aeronautical engineers in Italy.

Carlo Riparbelli
San Diego, Calif.

(Dr. Riparbelli refers to a Leach Corp. advertisement which appeared in Aviation Week. The advertisement described how a squadron of Italian S.V.A.-5 pursuit planes dropped leaflets over Vienna in World War I.—Ed.)

Security Activities

Your editorial of Nov. 13 (Required Reading), presents the most illuminating framework in which to view current national security activities. Only by adequate preparation now can the physical encounter of our own "Battle of Britain" be avoided or, if necessary, carried through to success.

The current debate of procurement procedures by Messrs. Mela and Koelle in your letters column (AW Nov. 6, p. 120; Dec. 11, p. 128) is therefore most disturbing. Both gentlemen seem not to appreciate "the determination and ingenuity of the economic and technical support" required to prepare for, as well as to sustain such an encounter. In fact, Mr. Koelle delineates procurement procedures geared to mitigating the supposed "ruinous competition" decried by Mr. Mela rather than furthering the national security.

His technique of establishing bid lists based on an agency conducted "industrial survey" presupposes virtual omniscience on the part of the surveying agency. With so great a proportion of current technical endeavor cloaked in security this is hardly practical. Even allowing this limitation, his procedure does not provide for the entry of new competitors or for the cross breeding of technologies so essential to success. Carried to its logical conclusion it eliminates all competition, beneficial as well as ruinous.

This logical termination was actually achieved by NASA in the case of the guidance and navigation system for the Apollo spacecraft.

Frederick J. Howard
Freeport, N. Y.

PT6 Mounting Points

Your article describing the Canadian Pratt & Whitney PT6 (AW Nov. 6, p. 74) closes with the paragraph: "The engine has a three point mounting system with all three points in the same plane for conventional aircraft."

Using either common meaning of the word "plane," it would truly be unconventional to find three mounting points (or any other type of points) that are not in the same plane.

Robert C. Williams
Manchester, Conn.

(Following is Canadian Pratt & Whitney Aircraft Co.'s answer to the foregoing query.—Ed.)

This is in reply to your recent note regarding mounting of the PT6 engine. One cannot disagree with either the story or the letter, but both could be more explicit.

The reader states that any three points can be said to be in the same plane. This is theoretically true but somewhat general and, as such, tends to cloud the immediate question.

The statement that is made in the last paragraph of the article on p. 74 of the Nov. 6 issue probably stems from comments made about the turboprop mounting arrangement where it is generally stated that all three mount points on the diffuser case are in the same plane, referring more specifically to the same radial plane. The association to single (radial) plane mounting here stems from all the past experience of P&WA with radial piston engines where all the mounts were also in the same radial plane. The arrangement makes the mounting of the engine considerably easier permitting the use of a symmetrical space frame to transmit the engine and propeller loads to the airframe.

This differs from pure jet and large turboprop mountings where there are usually two mounts in one radial plane and the third mount is either well forward or aft of this plane. Small flat piston engines have different mounting schemes.

I hope that this answers the reader's query and clarifies the situation.

J. N. Clark
Applications Engineer
Canadian Pratt & Whitney Aircraft
Jacques Cartier, Quebec

When airborne radar requires the very best:

BOMAC K_U BAND MAGNETRONS

Designers of radar equipment will find Bomac Laboratories' new BLM-071 K_U-band pulse magnetron meets exacting requirements for airborne systems: lightweight, rugged, powerful. This newest contribution from Bomac is a fixed-frequency tube (15.9-16.1 kMc) rated at 100 kW peak, at 0.001 duty cycle.

Cathode structure is greatly improved over similar magnetrons. Operable at high ambient temperatures, with input/output terminals permitting pressurization to 30 psia. Special construction minimizes leakage current. High power output and low operating voltage are combined in a compact, ruggedized unit. Long life. Weight: less than 8½ lbs.

The many advantages to Bomac's BLM-071 magnetron make it readily adaptable to navigation, high-altitude mapping, airport surveillance, and similar applications. Write for full technical details.

FEATURES: Frequency 15.9-16.1 kMc.
Peak Power 100 kW.
Normal efficiency 30%.
Duty cycle 0.001 Max.
Pulse width 0.06 to 1.2 usec.

BOMAC laboratories, inc.

BEVERLY 22, MASSACHUSETTS

A Varian Subsidiary

Other Subsidiaries of Varian Associates:
S-F-D LABORATORIES, INC.
VARIAN ASSOCIATES OF CANADA, LTD.
SEMICON ASSOCIATES, INC.
SEMICON OF CALIFORNIA, INC.
VARIAN A.G. (SWITZERLAND)