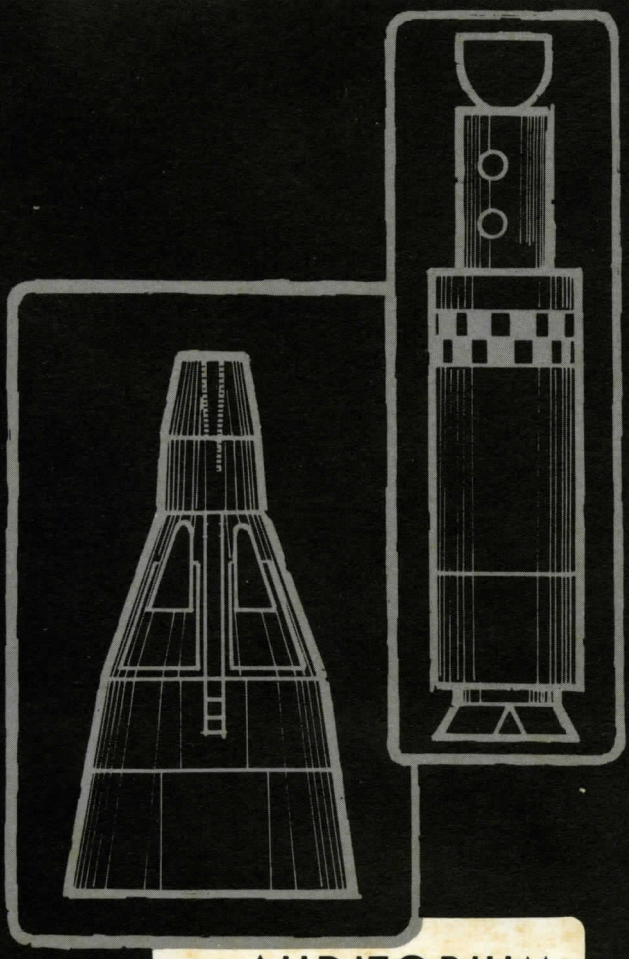
PROGRAM

GEMINI SUMMARY CONFERENCE



AUDITORIUM
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

FEBRUARY 1967

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONFERENCE INFORMATION

CONFERENCE ADMISSION: Admission to the conference will be by invitation only. At the time of registration, identification badges will be issued for admission to the auditorium during the conference. Seating limitation and the nature of the conference make it impossible for us to admit wives or guests of invitees. Identification cards should be worn at all times while on MSC premises.

EXHIBITS: The displays and exhibits shown during the Gemini Summary Conference are centered on the accomplishments of the Gemini Program. The Gemini V spacecraft, which carried Astronauts Cooper and Conrad 120 revolutions of the earth, can be viewed in a docked position with a full-scale mockup of the Gemini Agena Target Vehicle. The three types of space suits used by the Gemini flight crews are shown along with equipment utilized for extravehicular activity. Medical and scientific experiments flown on the Gemini missions are explained with hardware and photographs. Space food, training hardware, and space photography are also displayed. Additional exhibits include the Faith 7 Mercury spacecraft and scale models of the Apollo spacecraft and actual rocket engines that are being used in the manned space-flight programs.

LUNCHEON: Luncheon will be available to all conference attendees in the MSC cafeteria, Building 3, from 12:30 to 2:00 p.m. the two days of the conference.

MESSAGE CENTER: A message center will be established in the auditorium lobby. Persons who have need to contact you during the conference should be instructed to call Houston, Texas, HUnter 3-3336 (Area Code 713). There will be no paging during the conference. Messages will be posted on bulletin boards located near the message center in the auditorium lobby.

TRANSPORTATION CENTER: Travel office representatives from the commercial airlines will

also be available for confirming or changing airline reservations from Houston to your destination. This office is located in Room 120, Building 2, and a representative will be in the auditorium lobby.

CONFERENCE REPORT: Printed copies of the slides used by each speaker will be available during the conference. Copies of all papers will be included in the Gemini Summary Conference Report, which will be distributed to all attendees approximately 2 months after the conference. Additional copies, at a nominal cost, will be available from the Superintendent of Documents, United States Government Printing Office, Washington, D. C. 20402.

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GEMINI SUMMARY CONFERENCE

Auditorium, Manned Spacecraft Center
Houston, Texas

AGENDA

WEDNESDAY, FEBRUARY 1, 1967
MORNING SESSION

1. Welcoming Address—Dr. Robert R. Gilruth, 9:00-9:10 A.M.

2. Conference Introduction — Dr. George E. Mueller, 9:10-9:30 A.M.

Space Orbital Maneuvering Session

Session Chairman
MR. CHARLES W. MATHEWS

3. Summary of Rendezvous Operations—W. Bernard Evans and Marvin R. Czarnik (McDonnell), 9:30-10:10.

4. Ground Control and Monitoring of Rendezvous—Edward L. Pavelka, Edgar C. Lineberry, and Warren J. Kennedy (Lockheed), 10:10-10:35.

   Intermission—10:35-10:50.

5. Onboard Operations for Rendezvous—Astronaut Edwin E. Aldrin, Paul C. Kramer, and William E. Hayes (McDonnell), 10:50-11:25.

6. Operational Characteristics of the Docked Configuration—Homer W. Dotts, Roger K. Nolting (McDonnell), Wilburne F. Hoyler, John R. Havey (McDonnell), Thomas F. Carter, and Robert T. Johnson (Lockheed)—11:25-12:05.

7. Operations with Tethered Space Vehicles—David D. Lang and Roger K. Nolting (McDonnell), 12:05-12:45.

   Lunch—12:45-1:45.

AFTERNOON SESSION

Man's Activities In Space Session

Session Chairman
MR. KENNETH S. KLEINKNECHT

8. Life Support Systems for EVA—Harold J. McMann, Frederick T. Burns, Elton M. Tucker, and Marshall W. Horton, 1:45-2:15.

9. Body Positioning and Restraints During EVA—Astronaut Eugene E. Cernan, David C. Schultz, Hilary A. Ray, Jr., and Antoine F. Smith, 2:15-2:45.

10. EVA Maneuvering About Space Vehicles—Harold I. Johnson, Astronaut Michael Collins, Astronaut Edward H. White, and William C. Huber, 2:45-3:25.

Intermission—3:25-3:40.

11. Medical Aspects of Gemini EVA — Fred Kelly, M.D., and D. Owens, M.D., 3:40-4:10.

12. Summary of Gemini Extravehicular Activity—Reginald M. Machell, Larry E. Bell, James W. Prim, and Norman P. Shyken (McDonnell), 4:10-4:40.

THURSDAY, FEBRUARY 2, 1967
MORNING SESSION

Operational Experience Session

Session Chairman
DR. CHRISTOPHER C. KRAFT, JR.

13. Radiation Environment at High Orbital Altitudes—Peter W. Higgins, Joseph C. Lill, and Timothy T. White, 9:00-9:30.

14. Controlled Reentry—Lt. David M. Box, Jon C. Harpold, William H. Hamby, Astronaut Neil A. Armstrong, and Stephen G. Paddock (McDonnell), 9:30-10:00.

15. Launch and Target Vehicle Support by the Department of Defense—Colonel Alfred J. Gardner, 10:00-10:15.

16. Mission Support by the Department of Defense—Colonel Royce J. Olson, 10:15-10:30.

Intermission—10:30-10:45.

17. Pre-Gemini Medical Predictions Versus Gemini Flight Results—Charles A. Berry, M.D., and Allen D. Catterson, M.D., 10:45-11:30.

Gemini Onboard Experiments Activities

Session Chairman
MR. ROBERT O. PILAND

18. Gemini Experiments Program Summary—Norman G. Foster and Olav Smistad, 11:30-12:00.

19. Space Photography — Richard W. Underwood, 12:00-12:45.
Lunch—12:45-1:45.

AFTERNOON SESSION

20. Scientific Experiments Results Summary—Willis B. Foster, and Dr. Jocelyn R. Gill, 1:45-2:05.

21. DOD/NASA Gemini Experiments Summary—Colonel Wilbur A. Ballentine, 2:05-2:30.

Intermission—2:30-2:45.

22. Astronaut Flight and Simulation Experiences—Astronaut Thomas P. Stafford and Astronaut Charles Conrad, Jr., 2:45-3:15.

23. Gemini Results as Related to the Apollo Program—Willis B. Mitchell, Owen E. Maynard, and Donald D. Arabian, 3:15-3:45.

24. Summarization of Gemini Program — Mr. Charles W. Mathews, 3:45-4:15.

1. WELCOMING ADDRESS

DR. ROBERT R. GILRUTH, *Director, NASA Manned Spacecraft Center*

Biography

DR. ROBERT R. GILRUTH has served as Director of the Manned Spacecraft Center since its establishment in November 1961. Prior to this he was Director of the Space Task Group at Langley Field, Virginia, the organization responsible for design, development, and flight operation of Project Mercury spacecraft. Dr. Gilruth was born on October 8, 1913, in Nashwauk, Minnesota. He received his bachelor of science degree in aeronautical engineering from the University of Minnesota in June 1935, and his master of science degree in the same field in December of the following year. After graduation, he entered on duty at the Langley Memorial Aeronautical Laboratory of the NACA and began his career in flight research, his principal work in the field of stability, control, and handling qualities of airplanes. In 1945, Dr. Gilruth was assigned the job of organizing a research group and constructing a facility for conducting free-flight experiments with rocket-powered models for investigating flight at the transonic and supersonic-speed range. In 1952, he was appointed Assistant Director of the Langley Laboratory with the responsibility for directing research efforts in hypersonic aerodynamics at the Wallops Island Station and for research in high-temperature structures and dynamic loads at the Langley Laboratory. In October 1958, Dr. Gilruth was assigned the job managing the manned space-flight program later known as Project Mercury. During his career, Dr. Gilruth has participated on many scientific advisory committees for the military services and NASA. Dr. Gilruth has received many honors from aeronautical and rocket research societies and from universities. In 1962, doctor of science degrees were conferred upon him by his alma mater, the University of Minnesota, by the Indiana Institute of Technology, and by George Washington University. He received the NASA Distinguished Service Medal from the President of the United States in February 1962, and the Medal for Distinguished Federal Civil Service from the President in August 1962. In October 1966, Dr. Gilruth received the Daniel and Florence Guggenheim International Astronautics Award of the International Academy of Astronautics.

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VII XII

1.4×10^3 BTU/Hr

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2. CONFERENCE INTRODUCTION

DR. GEORGE E. MUELLER, *Associate Administrator, Office of Manned Space Flight, NASA*

Biography

DR. GEORGE E. MUELLER is associate administrator of the National Aeronautics and Space Administration, Office of Manned Space Flight. He assumed direction of the manned space-flight program on September 1, 1963. Dr. Mueller was born in St. Louis, Missouri, July 16, 1918. He received a bachelor of science degree in electrical engineering from the Missouri School of Mines in 1939, and a master of science degree in electrical engineering from Purdue University in 1940. He was awarded a doctorate in physics from Ohio State University in 1951. Following graduation from Purdue, Dr. Mueller joined the Bell Telephone Laboratories where he conducted television and microwave measuring experiments. He pioneered in the measurement of radio energy from the sun, in microwave propagation, and in the design of low-field magnetrons. In 1946, Dr. Mueller joined the faculty of Ohio State University as assistant professor of electrical engineering. In 1952, he was appointed professor of electrical engineering. His research included the study and design of broadside and end-fire dielectric antennas, cathode emission, low-field magnetrons, and traveling wave tubes. He designed and developed one of the first 6-millimeter traveling wave tubes and a scanning scintillometer for mapping radioactive iodine. Before joining NASA, Dr. Mueller spent five years with Space Technology Laboratories, Inc., Redondo Beach, California, serving successively as Director of the Electronics Laboratories, Program Director of the "Able" Space Program, Vice President of Space Systems Management, and Vice President for Research and Development. In the latter capacity between 1962 and 1963, he had overall responsibility for the technical operations of the company. While at Space Technology Laboratories, Dr. Mueller had overall responsibility for design, development, and testing of the systems and components basic to the Atlas, Titan, Minuteman, and Thor ballistic missile program; for the development of the first successful U.S. space probe, Pioneer I; for several other space projects including Explorer VI and Pioneer V, and the establishment of the U.S. Air Force SPAN satellite tracking network. Dr. Mueller was one of the originators of the concept and design of the Telebit digital telemetry system. He holds seven patents in electrical engineering and is the author of more than 20 technical papers. With E. R. Spangler, he is the co-author of a book, "Communication Satellites." Dr. Mueller is

a fellow of the Institute of Electronic and Electrical Engineers, an associate fellow of the American Institute of Aeronautics and Astronautics, and a member of the American Physical Society. He is a member of Commission 6 (Radio Wave and Transmission of Information) in the International Scientific Radio Union and is active in national and international conferences on space communications and space technology.

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SPACE ORBITAL MANEUVERING SESSION

Session Chairman, CHARLES W. MATHEWS, *Manager, Gemini Program Office, NASA Manned Spacecraft Center*

Biography

CHARLES W. MATHEWS was born February 16, 1921, in Duluth, Minnesota. He received a bachelor of science degree in aeronautical engineering from Rensselaer Polytechnic Institute, Troy, New York, in 1942. Mr. Mathews joined the Science staff of the NACA Langley Research Center in 1943 and was engaged in airplane flight research. Later, he conducted flight research on automatic control systems for aircraft. Mr. Mathews served as chairman of the group which developed the Mercury spacecraft specifications. When Project Mercury became an official program, he transferred to the Manned Spacecraft Center (then Space Task Group). His initial assignment with Space Task Group included directing the team that established the operating concepts for Mercury and directing early flight tests. Mr. Mathews served as Deputy Assistant Director for Engineering and Development at MSC prior to being named Manager of the Gemini Program Office. He has served in this position since November 5, 1963. While serving as Deputy Assistant Director for engineering and development, he was also Chief of the Spacecraft Technology Division. That division conducted studies of the methods of accomplishing manned lunar landings and was responsible for the systems studies on the lunar module. Mr. Mathews received the NASA Medal for Outstanding Leadership from President Lyndon B. Johnson in a White House ceremony in June 1965 for contributions in direction of the Gemini Program. He also was recipient of the Chairman's Citation of the Houston Section of the AIAA in May 1965. Mr. Mathews was a member of four groups which have received recognition for their contributions to the space effort, as follows: NASA Group Achievement Award – Mercury Project Office, October 1962; NASA Group Achievement Award–Assistant Directorate for Engineering and Development, October 1962; NASA Group Achievement Award–to members of Gemini Program Office Extravehicular Activity Development Team, June 1965; and NASA Group Achievement Award – to members of Gemini Program Office Rendezvous Operations Planning Team, January 1966.

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3. SUMMARY OF RENDEZVOUS OPERATIONS

W. BERNARD EVANS, *Chief, Mission Planning Office, Gemini Program Office, NASA Manned Spacecraft Center*
Co-author: MARVIN R. CZARNIK

Abstract

One of the primary objectives of the Gemini Program was to develop and demonstrate techniques for rendezvous and docking of space vehicles. This is considered a mandatory requirement in many future manned space-flight programs. The main goal of the Gemini rendezvous mission operations was to obtain the highest probability of mission success. In establishing a mission plan to meet the objectives for rendezvous and docking, major considerations were launch procedures, system capabilities, and crew procedures.

Speaker's Biography

W. BERNARD EVANS was born in Mansfield, Louisiana, on February 8, 1926. He received a bachelor of science degree in electrical engineering from Louisiana State University in 1954. After graduation he was employed by the Sun Pipe Line Company, Beaumont, Texas, as a communications engineer. In August 1956, he joined the staff of Radio Corporation of America and was assigned to the Air Force Missile Test Center, Cape Kennedy, Florida, where he remained until he was appointed to the Manned Spacecraft Center in January 1962. As Chief of the Mission Planning Office, Gemini Program Office, Mr. Evans was responsible for the establishment of the basic mission plans to insure overall compatibility and integration with the launch and target vehicles, and with the spacecraft and the tracking network.

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4. GROUND CONTROL AND MONITORING OF RENDEZVOUS

EDWARD L. PAVELKA, *Flight Control Division, NASA Manned Spacecraft Center*
Co-authors: Edgar C. Lineberry and Warren J. Kennedy

Abstract

This paper discusses the ground control and monitoring function performed in support of the Gemini rendezvous missions. The primary rendezvous missions as well as other re-rendezvous operations which were conducted during Gemini flight are compared from a ground support view. Effective ground support and control has been demonstrated in the successful accomplishment of the rendezvous missions. Of key importance in this success was the flexible real-time planning capability which gave the necessary response to a variety of mission situations.

Speaker's Biography

EDWARD L. PAVELKA, JR., was born in Houston, Texas, on June 17, 1939. He received a bachelor of science degree in aerospace engineering from the University of Texas in 1964 and joined NASA in February of that year. He has served as a flight dynamics officer on Gemini missions IV through XII. He also serves as an aerospace engineer in flight dynamics.

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5. ONBOARD OPERATIONS FOR RENDEZVOUS

ASTRONAUT EDWIN E. ALDRIN, *NASA Manned Spacecraft Center*
Co-authors: Paul C. Kramer and William E. Hayes

Abstract

The onboard Gemini missions rendezvous procedures were planned for primary and failure-mode operations. This paper describes the application of the procedures to several rendezvous missions performed during the Gemini Program. Methods used for monitoring guidance and navigation performance and backup calculations for determination of terminal-phase maneuvers are described. The various types of rendezvous accomplished during the Gemini Program are compared, and major problem areas are discussed. Significant flight results are presented in terms of propellant, crew procedures, and time lines. Finally, terminal-phase rendezvous experiences are summarized.

Speaker's Biography

EDWIN E. ALDRIN, JR., Lieutenant Colonel, USAF, was born in Montclair, New Jersey, on January 20, 1930. He received a bachelor of science degree from the United States Military Academy at West Point, New York, in 1951, and a doctor of science degree in astronautics from Massachusetts Institute of Technology in 1963. After graduation, he flew 66 combat missions in F-86 aircraft while on duty in Korea with the 51st Fighter Interceptor Wing and was credited with destroying two MIG-15 aircraft and damaging one. Following his assignment as administrative assistant to the Dean of Faculty at the United States Air Force Academy, Aldrin flew F-100 aircraft as a flight commander with the 36th Tactical Fighter Wing at Bitburg, Germany. After receiving his doctorate, he was assigned to the Gemini Target Officer of the Air Force Space Systems Division, Los Angeles, California. While there, he was a member of the special study group which made recommendations concerning Air Force participation in the NASA Gemini Program. Lieutenant Colonel Aldrin was one of the third group of astronauts named by NASA in October 1963. Assigned as pilot during the Gemini XII mission, Lieu-

tenant Colonel Aldrin established a new record for time spent in extravehicular activity by accruing slightly more than 5½ hours outside the spacecraft. Lieutenant Colonel Aldrin was awarded the Distinguished Flying Cross and Air Medal with two Oak Leaf Clusters.

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6. OPERATIONAL CHARACTERISTICS OF THE DOCKED CONFIGURATION

HOMER W. DOTTS, *Deputy Manager, Office of Spacecraft Management, Gemini Program Office, NASA Manned Spacecraft Center*

Co-authors: Roger K. Nolting, Wilburne F. Hoyler, John R. Havey, Thomas L. Carter, and Robert T. Johnson

Abstract

After a systematic evaluation of the numerous docking concepts that had been advanced in the literature and by the designers, it was concluded that the docking maneuver had to be made with the spacecraft facing the target. The impact velocities and attitudes could thereby be controlled by the flight crew. The target docking systems were evaluated during the simulator training of the flight crews to develop proficiency for the docking and docked maneuvering phases of the actual flight. Actual flight experience with docking and undocking of the spacecraft and target vehicle demonstrated that design was sound, that testing had been adequate, and that crew training had resulted in a high degree of proficiency.

Speaker's Biography

HOMER W. DOTTS was born in Chicago, Illinois, on September 4, 1910. He received his bachelor of science degree in aeronautical engineering from the University of Michigan in 1933. Mr. Dotts worked for Curtiss-Wright Aircraft Corporation, where he served as Project Engineer on the C-46 aircraft. In 1945, he was transferred to Columbus, Ohio, by Curtiss-Wright, where he was Production Engineer-in-Charge of Design Section. In 1948, he was Project Engineer for the F-87 aircraft, and was later appointed Chief of Design and Developmental Engineering. In 1950, Mr. Dotts aided in the organization of the Columbia Research and Development Corporation, Columbus, Ohio, which did developmental work on airborne weapons for the Navy and Air Force. He served as Vice-President and Chief Engineer of that organization until he joined NASA in January 1962. Mr. Dotts served as Deputy Manager, Office of Spacecraft Management, Gemini Program Office. This office was responsible for all technical aspects of the de-

velopment and qualifications for flight of the Gemini spacecraft. This group of design specialists was responsible for the development of the many systems and component assemblies of the spacecraft. The office was also responsible for postflight analysis of the performance of the Gemini spacecraft during each mission.

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7. OPERATIONS WITH TETHERED SPACE VEHICLES

DAVID D. LANG, *Flight Crew Support Division, NASA Manned Spacecraft Center*
Co-author: Roger K. Nolting

Abstract

Two modes of tethered space-vehicle operation explored in the Gemini Program are individually discussed. One mode of operation, used with Gemini XI, consisted of intentionally inducing an angular velocity in the tethered system by means of translational thrusting with the spacecraft propulsion system. The other mode of operation, used with Gemini XII, involved tethered drifting flight, during which the effect of gravity gradient on the motion of the system was of interest.

Speaker's Biography

DAVID D. LANG was born March 20, 1935, in Enid, Oklahoma. He received his bachelor of science degree in mechanical engineering in 1959 at Rice University, Houston, Texas. From 1958 to 1960, he worked for Ling-Temco-Vought, Structural Loads Group. From 1960 to 1963, he worked for Ling-Temco-Vought, Structural Dynamics Group. While there, he was responsible for methods development in spacecraft dynamics and tethered space-station analysis. In his present position as Chief of Flight Procedures Section, he is responsible for implementation of two hybrid real-time flight procedures development and for astronaut training. This work has involved simulation of booster dynamics for abort training, reentry, rendezvous, station keeping, and tethered-vehicle dynamics. This effort involves both the Gemini and Apollo Programs. The simulation implementation requires development of mathematical models and subsequent hybrid programming.

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MAN'S ACTIVITY IN SPACE SESSION

Session Chairman, KENNETH S. KLEINKNECHT, *Deputy Manager, Gemini Program Office, NASA Manned Spacecraft Center*

Biography

KENNETH S. KLEINKNECHT was graduated from Purdue University in 1942 with a bachelor of science degree in mechanical engineering. He subsequently joined the professional staff of the Lewis Research Center. While there he served as project engineer for several test programs. In January 1951, Mr. Kleinknecht transferred from Lewis Research Center to the Flight Research Center, Edwards AFB, California, where he remained until 1959. At Edwards he served successively as Head of the Project Engineering Section and as an aeronautical research scientist. During this period of service, he was operationally associated with research aircraft and was designer and project engineer on the modification of the X-1E aircraft. Later, in the capacity of Advanced Projects Management Officer, he worked on the development of the X-15 from its inception through its early flights. He was a member of the X-15 Joint Operating Committee until his transfer to the Manned Spacecraft Center, then the Space Task Group. In addition, he represented the Flight Research Center during early Dyna-Soar evaluations and development. Mr. Kleinknecht was appointed to the position as Deputy Manager, Gemini Program, in November 1963, at the end of Project Mercury on which he had served as Manager since February 1962. Prior to that time, he served as Technical Assistant to the Director of the Manned Spacecraft Center. In this capacity, he was responsible for development of the detailed functioning of an Operational Flight Safety Program. He also reviewed reports, schedules, and proposed operating procedures for vital areas such as launch preparations for the Mercury spacecraft and launch vehicle. He directed the establishment of Mercury checkout facilities at Cape Kennedy. Mr. Kleinknecht has authored or co-authored several NASA technical documents. The Mercury Project Office was awarded the Group Achievement Award by the NASA Administrator in October 1962. Mr. Kleinknecht received the NASA Medal for Outstanding Leadership from the President of the United States on May 20, 1963. He was also presented the John J. Montgomery Award by the San Diego Chapter of the National Society of Aerospace Professionals on December 5, 1963.

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8. LIFE SUPPORT SYSTEMS FOR EXTRAVEHICULAR ACTIVITY

H. J. McMANN, *Crew Systems Division, NASA Manned Spacecraft Center*
Co-Authors: Elton M. Tucker, Marshall W. Horton, and Frederick T. Burns

Abstract

The development of space suits, environmental control systems, umbilicals, and related components from the original concepts through the modifications imposed by specific Gemini missions is traced in this paper. The specific experiments and operations of each flight required some modifications to the suits. The Ventilation Control Module System and Extravehicular Life Support System operated within the design requirements, but problems associated with high work levels occurred. Extravehicular activity while using umbilicals was found to be a useful, operational mode.

Speaker's Biography

HAROLD J. McMANN was born in Olahoma City, Oklahoma, June 28, 1937. He received a bachelor of science degree in chemical engineering from the University of Notre Dame and worked as a staff application engineer for the Liquid Carbonic Division of General Dynamics. Mr. McMann joined the Manned Spacecraft Center in October 1961. In his present position as Chief, Environmental Control Systems and Extravehicular Life Support Systems Office he assisted in the development of the Portable Environmental Control System.

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9. BODY POSITIONING AND RESTRAINTS DURING EXTRAVEHICULAR ACTIVITY

ASTRONAUT EUGENE A. CERNAN, *NASA Manned Spacecraft Center*
Co-Authors: David C. Schultz, Hilary A. Ray, Jr., and Antoine F. Smith

Abstract

A foremost conclusion to be drawn from extravehicular activity experience on Gemini is that without proper restraint provisions, almost nothing can be done; but with the proper restraint provisions, almost anything can be done. This paper describes the types of extravehicular restraint equipment used on the Gemini Program and the major problems encountered. As a result of this experience, four types of restraint devices are highly recommended for future extravehicular activity.

Speaker's Biography

EUGENE A. CERNAN, Commander, USN, was born in Chicago, Illinois, on March 14, 1934. He received a bachelor of science degree in electrical engineering from Purdue University and a master of science degree in aeronautical engineering from the U.S. Naval Postgraduate School. Commander Cernan was one of the third group of astronauts selected by NASA in October 1963. He was pilot during the Gemini IX-A mission and completed 2 hours and 10 minutes of extravehicular activity. Commander Cernan has been awarded the NASA Exceptional Service Medal and the Navy Astronaut Wings.

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10. EXTRAVEHICULAR ACTIVITY MANEUVERING ABOUT SPACE VEHICLES

HAROLD I. JOHNSON, *Flight Crew Support Division, NASA Manned Spacecraft Center*

Co-Authors: William C. Huber, Astronauts Edward A. White and Michael Collins

Abstract

The first portion of this report describes, in general, the maneuvering equipment used for extravehicular activity during the Gemini Program. The second portion describes the ground training equipment and the methods used in preparing the astronauts for extravehicular maneuvering. The third portion recounts the results obtained with the Hand Held Maneuvering Unit during the Gemini IV and Gemini X missions, and draws a comparison between flight performance and ground training.

Speaker's Biography

HAROLD I. JOHNSON was born January 6, 1920, in Joliet, Illinois. He received his bachelor of science degree in aeronautical engineering at the University of Michigan. In 1941, he joined the staff of the NACA Langley Aeronautical Laboratory, where he worked in the stability and control field. He served as the project engineer on a number of flight-test investigations and contributed to the development of airplane handling qualities requirements. From 1947 to 1953, Mr. Johnson worked on transonic stability and control investigations of aircraft models and components, using the NACA Wing-Flow method, which he helped pioneer. From 1953 to 1958, he was a section head in the Flight Stability and Control Branch. During this period he developed the first whole-body moving-base simulator of airplane short-period oscillations (the NAP chair) and also the first two-degree-of-freedom moving-base extravehicular space simulator. In February 1959, Mr. Johnson transferred to the National Aeronautics and Space Administration Manned Spacecraft Center (then the Space Task Group) where he headed the group responsible for the design and use of simulators in the Mercury astronauts training program. During this period he invented the highly successful air-bearing Air-Lubricated Free-Attitude Trainer, which was instrumental in training the astronauts

to control the Mercury spacecraft in space. In December 1963, Mr. Johnson was appointed to a position as Technical Assistant for Advanced Planning and Requirements, with responsibility for study and design of advanced manned spacecraft simulators. Mr. Johnson, as Chief of the Advanced Applications Office, Flight Crew Support Division, plans and develops new space hardware for crew use, such as the Hand Held Maneuvering Unit for Gemini IV. He is also developing simulation equipment for extravehicular activity as well as partial gravity simulators to be used in training astronauts for lunar duties in the Apollo Program. His present position also includes technical management in activating the new water-immersion facility at the Manned Spacecraft Center.

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11. MEDICAL ASPECTS OF GEMINI EXTRAVEHICULAR ACTIVITIES

G. FRED KELLY, M.D., *Medical Operations Office, NASA Manned Spacecraft Center*
Co-Author: D. Owen Coons, M.D.

Abstract

The physiological factors which are considered important to the success of Gemini extravehicular activities are discussed in this paper. The physiological data collected during each period of extravehicular activity are presented. The method of postflight evaluation and the utilization of these data in preflight planning are discussed. It is concluded that life-support planning has been essentially sound, and that time lines and work tasks for extravehicular activity can be tailored to accomplish flight objectives. No medical contraindications to presently planned extravehicular and lunar surface activities are anticipated.

Speaker's Biography

GLENN F. KELLY, M.D., was born November 4, 1926, in Baton Rouge, Louisiana. He received his doctor of medicine degree from Louisiana State University in 1951. While serving in the Navy, Dr. Kelly was medical monitor for Mercury, and was designated Naval Flight Surgeon/Aviator. In 1964, Dr. Kelly joined NASA Manned Spacecraft Center in the Medical Operations Office, where he worked as the Center Medical Officer Representative in matters of medical significance on the Gemini Program. Dr. Kelly is the head of the Programs Support Branch in the Medical Operations Office. He is responsible for medical assistance in the Apollo Program Office and the Apollo Applications Office. Dr. Kelly is a member of the American Medical Association, and the Aerospace Medical Association.

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12. SUMMARY OF GEMINI EXTRAVEHICULAR ACTIVITY

R. M. MACHELL, *Office of Spacecraft Management, Gemini Program Office, NASA Manned Spacecraft Center*

Co-Authors: Larry E. Bell, Norman P. Shyken, and James W. Prim

Abstract

The Gemini missions have demonstrated the basic techniques that are needed for productive use of extravehicular activity. Some of the problems encountered during the equipment evaluation shifted the emphasis from maneuvering equipment to body restraint devices. Underwater simulation of extravehicular space environment is effective for crew training. The Gemini Program has indicated that extravehicular activity should be considered for use in future missions where a specific need exists.

Speaker's Biography

REGINALD M. MACHELL was born in La Jolla, California, on April 9, 1927. He graduated from the U.S. Naval Academy in 1949 with the degree of bachelor of science. Thereafter, he served in the Navy as a fighter pilot and aeronautical engineering specialist for 14 years. In 1955, he received the degree of bachelor of science in aeronautical engineering from the U.S. Naval Postgraduate School, Monterey, California, and in 1956, the professional degree of aeronautical engineer from the California Institute of Technology. From 1958 to 1961, he was assigned to the Fighter Aircraft Design Office of the Bureau of Naval Weapons, where he was project officer for several versions of the F8U Crusader aircraft. In 1961, he was detailed to the NASA Langley Research Center, Hampton, Virginia. Working in the Scout Project Office he managed the design, construction, and activation of the Scout Launch Complex at Point Arguello, California. In the following year he was appointed Head of the Langley Center Field Project Office at the Pacific Missile Range. In this position he was responsible for all Langley Research Center activities at the range. He also served as NASA Test Director for the NASA/DOD Scout Launch Operations at Point Arguello. Mr. Machell joined the NASA Manned Spacecraft Center in 1963. He was subsequently designated as Head, Crew Integration Group, Gemini Program Office. In this posi-

tion he has been responsible for cockpit design, flight-crew equipment, and extravehicular systems for the Gemini spacecraft. In June 1965, he received the NASA Group Achievement Award as a member of the Gemini IV Extravehicular Activity Development Team.

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OPERATIONAL EXPERIENCE SESSION

Session Chairman, CHRISTOPHER C. KRAFT, JR., *Director of Flight Operations, NASA Manned Spacecraft Center*

Biography

CHRISTOPHER C. KRAFT, JR., was born February 28, 1924, in Phoebus, Virginia. He received his bachelor of science degree in aeronautical engineering from the Virginia Polytechnic Institute in Blacksburg, Virginia, in 1944. Mr. Kraft joined the staff of the Langley Research Center Flight Research Division in 1949. While at Langley, he worked on gust alleviation and designed an automatic gust alleviation system for the C-45 airplane. Other projects included an experimental study of trailing vortices, which has been used extensively by the Flight Safety Foundation and all military services; various g-limiting devices; and automatic stability and control studies and flight tests. He also served as the NACA project engineer on flights tests of the Chance Vought F8U-1 airplane. As Director of Flight Operations, Mr. Kraft is responsible for functioning as NASA Flight Director during manned space flights. In this capacity he exercises the critical responsibility of controlling the flight from the lift-off of the launch vehicle to the landing of the spacecraft in the recovery area. Mr. Kraft has decision making responsibility with regard to Go–No-Go decisions, aborts, and the redesignation of landing areas which may be required at any time during manned missions. In addition to his mission-related duties, Mr. Kraft exercises full authority and directs management responsibility over the efforts of several hundred technical and professional personnel engaged in the conceptual development and establishment of systems requirements in support of the Apollo Program. During Project Mercury, Mr. Kraft, then Chief of the MSC Flight Operations Division, served as Flight Director of all missions. Mr. Kraft accepted the Group Achievement Award for the Flight Operations Division from the NASA Administrator in October 1962. In 1963, he was presented the NASA Medal for Outstanding Leadership by the late President John F. Kennedy in a ceremony at the White House. Mr. Kraft was awarded the Distinguished Alumni Citation by Virginia Polytechnic Institute November 12, 1965.

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13. RADIATION ENVIRONMENT AT HIGH ORBITAL ALTITUDES

PETER W. HIGGINS, *Space Science-Radiation and Fields, NASA Manned Spacecraft Center*

Co-Authors: Joseph C. Lill and Timothy T. White

Abstract

The Gemini X and XI space flights established high-altitude apogee records, going further into the Van Allen trapped radiation belts than previous flights. The effect of the radiation environment on the missions is considered. During each mission, the radiation dose was determined by the interaction of the environment with the spacecraft and man. A minimum dose of radiation is possible in higher altitude flights. The preflight calculations agreed reasonably with the measured radiation dose.

Speaker's Biography

PETER W. HIGGINS was born October 19, 1941, in Buffalo, New York. He received his bachelor of science degree in physics in 1963 at the University of Houston, Houston, Texas. From 1963 to 1965, Mr. Higgins was Technical Assistant to the Branch Chief, Radiation and Fields Branch at the Manned Spacecraft Center. Then from December 1965 to January 1967, he was the Section Chief of the Radiation Analysis Section of the Radiation and Fields Branch. At the present time, Mr. Higgins is Technical Assistant to the Branch Chief of the Astronomy Branch, Space Physics Division, Science and Applications Directorate at MSC. He is responsible for leadership of an experimental project to measure the solar constant and its variations with solar activity on future Apollo flights and to provide technical assistance to other branch interests such as the Apollo telescope mount and the solar physics programs. Mr. Higgins has received the NASA Sustained Superior Performance Award.

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14. CONTROLLED REENTRY

LIEUTENANT DAVID BOX, *Mission Planning and Analysis Division, NASA Manned Spacecraft Center*

Co-Authors: Jon C. Harpold, Stephen G. Paddock, Neil A. Armstrong, and William H. Hamby

Abstract

Landing-point control by modulating the direction of the inherent lift vector of the spacecraft during reentry was successfully achieved by the Gemini Program. This paper presents a brief description of the two sets of reentry guidance logic and a detailed description of the results obtained from the reentry of each Gemini flight. Reentry of the Gemini spacecraft was successfully controlled both manually and automatically.

Speaker's Biography

DAVID M. BOX was born October 3, 1941, in Cleveland, Ohio. He received his bachelor of science degree from Western Reserve University in 1964. He served as Minuteman Launch Control Officer and Deputy Missile Combat Crew Commander at Strategic Air Command from 1964 to 1965. Lieutenant Box is currently assigned to the Mission Analysis Branch of the Mission Planning and Analysis Division where he is responsible for reentry guidance and studies and development.

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15. LAUNCH AND TARGET VEHICLE SUPPORT

COLONEL ALFRED J. GARDNER, *Program Director, Gemini Target Vehicle, Space Systems Division, USAF*

Abstract

A description of the support provided by the United States Air Force for launch and target vehicles to achieve the goals of the Gemini Program is given in this paper. The Space Systems Division of the Air Force Systems Command coordinated with the appropriate NASA organizations to provide for development, procurement, and launch. Program offices were established to manage the Gemini Launch Vehicle, the Gemini Agena Target Vehicle, and the Atlas Target Launch Vehicle.

Speaker's Biography

COLONEL ALFRED J. GARDNER, USAF, was born in New Jersey and received his bachelor of science and master of science degrees in aerospace engineering from New York University, and a master of science degree in industrial engineering from Ohio State University. From 1952 to 1956, he was attached to the Power Plant Laboratory at Wright Air Development Center; from 1956 to 1958, he was in the Special Projects Office at the Headquarters Air Research and Development Command. Colonel Gardner served with NASA's Centaur Project Office from 1958 to 1961 and as Chief of the Engineering Division of Gemini Launch Vehicle Directorate from 1962 to 1964. In July 1965, Colonel Gardner was named Director of the Gemini Target Vehicle Program. His responsibilities include: Program Director of the Agena, Deputy Launch Vehicles, Headquarters Space Systems Division (Los Angeles), and Air Force Space Systems Command. Colonel Gardner holds the Distinguished Flying Cross and is an Associate Fellow of the American Institute of Aeronautics and Astronautics.

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16. MISSION SUPPORT BY THE DEPARTMENT OF DEFENSE

COLONEL ROYCE G. OLSON, *Director, Department of Defense Manned Space Flight Support Office, Patrick Air Force Base*

Abstract

The Department of Defense supported the Gemini Program in several areas of responsibility. Launch and network, recovery, communications, meteorology, bioastronautics, public affairs, and miscellaneous logistics. Prior to each mission, a joint staff served as the single point of contact for the final coordination and marshalling of all supporting resources. Facilities in the cooperative effort were provided by North American Air Defense Command, Australian Weapons Research Establishment, and the U. S. Army, Navy, and Air Force.

Speaker's Biography

COLONEL ROYCE G. OLSON is the Director of the DOD Manned Space Flight Support Office at Patrick Air Force Base, Florida. This office is composed of a small joint staff to assist General Leighton I. Davis in his responsibilities as the DOD Manager for Manned Space Flight Support Operations. Colonel Olson has been the Director during the greater part of the Gemini Program, having transferred from a tour of duty with the Joint Chiefs of Staff in Washington, D.C. Among his duties with the Joint Staff J-3 (Operations) was to act as the point of contact for the Joint Chiefs of Staff with the DOD Representative for Project Mercury Support Operations. Colonel Olson served on the USAF Air Staff in Operations Management from 1960 to 1962, and in the Strategic Air Command from 1954 to 1960, in B-36 and B-52 Wings as Squadron Commander, Wing Operations, and Deputy Wing Commander. Colonel Olson is a graduate of the National War College and has been awarded the Legion of Merit and the USAF Air Medal.

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17. PRE-GEMINI MEDICAL PREDICTIONS VERSUS GEMINI FLIGHT RESULTS

CHARLES A. BERRY, M.D., *Director Medical Research and Operations, NASA Manned Spacecraft Center*
Co-Author: A. D. Catterson, M.D.

Abstract

Biomedical interests in the Gemini Program centered on identifying the physiological cost, if any, which man must pay in adapting to space environment and in readapting to ground environment. The nature and significance of physiological changes in Gemini flights are discussed in this paper as a review of body systems. Lessons learned about conducting medical studies as well as results of the studies and the implications for future manned space-flight activities are discussed. The physiological responses of astronauts who have been twice exposed to space environment are discussed.

Speaker's Biography

DR. CHARLES A. BERRY was born September 17, 1923, in Rogers, Arkansas. Raised in Indio, California, he attended the University of California at Berkeley and was graduated in 1945 with a bachelor of arts degree. He received his medical degree in 1947 from the University of California Medical School. Dr. Berry served in the U.S. Air Force from 1951 to 1963; he attained the rank of lieutenant colonel and was rated as a Senior Flight Surgeon. He received the USAF Certificate of Achievement in recognition of outstanding qualifications in the specialty of aerospace medicine. He is a diplomate of the American Board of Preventive Medicine (Aerospace Medicine). He received the American Medical Associa- Special Aerospace Medicine Honor Citation in 1962, and the Arnold D. Tuttle Award in 1961. Dr. Berry is past President of the Space Medicine Branch of the Aerospace Medical Association and Chairman of the Scientific Program Committee. He received the NASA Exceptional Service Medal from President Johnson in September 1965 during a White House ceremony. Dr. Berry is a member of the American Medical Association, the American Institute of Aeronautics and Astronautics, a Fellow of the American College of Preventive Medicine,

and an Associate Fellow of the American College of Physicians. He has authored more than 40 aerospace medical papers in addition to several chapters of book-length work. In May 1966, the Center Medical Operations Office of which Dr. Berry had been chief since August 1963, was expanded and reorganized into the Directorate of Medical Research and Operations with Dr. Berry as the director. In his present position, Dr. Berry is responsible for planning, implementing, and continually evaluating the medical research and operations efforts at MSC and serving as the medical spokesman and primary point of contact with the medical community.

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GEMINI EXPERIMENTS SESSION

Session Chairman, MR. ROBERT O. PILAND, *Deputy Director of the Science and Applications Directorate, NASA Manned Spacecraft Center*

Biography

ROBERT O. PILAND was born in Portsmouth, Virginia, on October 12, 1927. He attended William and Mary College, where he received a bachelor of science degree in mathematics in 1947. Mr. Piland served as a research assistant at Langley Research Center from 1947 to 1958, when he was appointed as a technical assistant to the President's Advisor in the space and missile fields. In 1959, he became Assistant Chief of the Flight Systems Division at MSC and early in 1960 was assigned to manage the early planning and study efforts which led to the present Apollo Program. Mr. Piland was Deputy Manager of the Apollo Program Office and then Assistant Director for Engineering and Development before assignment to his present post as Deputy Director of the Science and Applications Directorate. In this position he is responsible for the planning and the implementation of MSC programs in the areas of space science and its applications, and for acting as the point of contact at MSC for the scientific community. In 1962, Mr. Piland received the Lawrence Sperry Award from the Institute of Aeronautical Sciences for notable contributions made for the advancement of the aerospace sciences.

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18. GEMINI EXPERIMENTS PROGRAM SUMMARY

NORMAN G. FOSTER, *Experiments Program Office, NASA Manned Spacecraft Center*
Co-Author: Olav Smistad

Abstract

This paper briefly describes the Gemini Experiments Program, including the general program, program scope, integration of the experiments into the mission and selective illustrative results. The selection of experiments was based primarily on the requirement or desirability of crew participation. Experiments during Gemini showed that late perturbations to general flight plan, to onboard equipment, and to activity should be expected. If spacecraft problems are not considered, a remarkable overall success of the Gemini Experiments Program is indicated.

Speaker's Biography

NORMAN G. FOSTER was born in Kannapolis, North Carolina, on April 3, 1929. He received a bachelor of science degree in mechanical engineering from North Carolina State University in 1955. After graduation he was employed by Champion Paper Company from 1955 to 1957, and by Western Electric Company from 1957 to 1962. In 1962, Mr. Foster joined the NASA Manned Spacecraft Center as an aerospace technologist in the Mercury Project Office. In November 1963, he transferred to the Gemini Program Office, and was Chief of the Experiments Office from 1964 until the program was terminated.

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19. SPACE PHOTOGRAPHY

RICHARD W. UNDERWOOD, *Photographic Technology Laboratory, NASA Manned Spacecraft Center*

Abstract

The photographic equipment carried on the Gemini flights to produce a series of color photographs is briefly described in this paper. Representative photographs from various missions and pictures of specific interest to scientists and aerospace engineers are presented along with a description of some of the informational content.

Speaker's Biography

RICHARD W. UNDERWOOD was born in Newport, Rhode Island, on July 15, 1927. He received a bachelor of science degree in geology from the University of Connecticut. Mr. Underwood began his public service career with the Army Map Service in 1951. While in the employment of this service, he held a number of positions, starting as project engineer for securing mapping and intelligence aerial photography in Europe, Asia, and Latin America. In 1958, Mr. Underwood became Chief of Operations for Photogrammetry, and in 1961, he became Chief of Photography Products. Mr. Underwood's current assignment is Aerospace Technologist, Space Optics in the MSC Photographic Laboratory, where he serves as an MSC representative to NASA Headquarters, Office of Space Science and Applications on the Remote Sensor Program for determining photographic instrumentation of Apollo Applications lunar and earth orbit flights. He is assisting in the design of the photographic portion of the proposed Geoscience Data Management Center at MSC to handle Apollo data, as well as the preliminary design and construction of the photographic laboratory in the Lunar Receiving Laboratory. He is responsible for identification of Gemini photography and serves as a consultant to staff offices and other divisions for problems and photogrammetry. Mr. Underwood is also the technical monitor for scientific photographic experiments carried onboard Gemini and Apollo spacecraft.

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20. SCIENTIFIC EXPERIMENTS RESULTS SUMMARY

DR. JOCELYN R. GILL, *Staff Scientist, and* WILLIS B. FOSTER, *Director, Office of Space Science and Applications, NASA*

Abstract

A summary of the results of the 19 scientific experiments carried on the 10 manned Gemini missions is presented. Emphasis in this brief review is placed on those experiments flown during the latter part of the program. Attention is drawn to the significant scientific conclusions that can be made at this time. These 19 experiments covered a wide range of disciplines appropriate to the study of our planet from a near-earth orbit.

Speaker's Biography

DR. JOCELYN R. GILL was born in Flagstaff, Arizona. She received a bachelor of arts degree in mathematics from Wellesley College in 1938, a master of science degree in astronomy and astrophysics from the University of Chicago in 1941, and a doctorate in astronomy from Yale University in 1959. After three years with the Radiation Laboratory at MIT, she taught astronomy at Smith College and at Mount Holyoke College. In 1959, she went to Arizona State College as associate professor of physics and mathematics and the following year was a visiting lecturer at Wellesley. Dr. Gill joined NASA in 1961 as a staff scientist in the Office of Space Science and Applications, where her early work included the selection of astronomical experiments to be flown on unmanned space missions. She was later instrumental in formulating the experiments and investigations for the highly successful science program of the Mercury missions, and in selecting methods of training Mercury astronauts to accomplish their scientific roles in space. From November 1963 to 1966, she was Chief, In-Flight Sciences, Manned Space Programs, with responsibility for planning, selecting, and implementing scientific experiments for the Gemini flights. Dr. Gill is now a staff scientist with the Manned Flight Experiments Office and also serves as Gemini and Apollo Earth-Orbital Science Manager.

WILLIS B. FOSTER, Director of Manned Flight Experiments at NASA Headquarters, is responsible for coordinating space environmental data support to the Manned Space Flight Program and for assuring that

good science and application investigations are provided for execution on manned space flights. Mr. Foster is also responsible for developing the criteria for the recruitment and selection of scientist-astronauts, and for the scientist training of all of the astronauts. Immediately prior to assuming his duties at NASA in 1963, Mr. Foster was active in directing the basic research program of the Department of Defense. Mr. Foster has also worked with the Central Intelligence Agency and with the U.S. Weather Bureau as a meteorologist. He served in the U.S. Navy during World War II, also as a meteorologist, doing some of the early work in typhoon reconnaissance and research. Mr. Foster did his undergraduate work at California State College in California, Pennsylvania, and his graduate work at the U.S. Naval Academy and the American University. He is a member of the American Meteorological Society, the American Geophysical Union, and the American Association for the Advancement of Science.

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21. DOD/NASA GEMINI EXPERIMENTS SUMMARY

COLONEL WILBUR A. BALLENTINE, *Space Systems Division, USAF*

Abstract

The Department of Defense/NASA Gemini Experiments Program consisted of 15 experiments which could be accomplished with minimum effect on the Gemini Program and which would contribute to the solution or evaluation of space technical development problems. Of the 15 programmed experiments, 11 were successfully completed. Although flight test objectives of the 4 remaining experiments were not completely attained, valuable data were acquired. This paper outlines the experiments and discusses the results.

Speaker's Biography

WILBUR A. BALLENTINE, Colonel, USAF, was born in Houston, Texas, in August 1923. He received a bachelor of science degree in aeronautical engineering from Texas Agricultural and Mechanical College, College Station, Texas, in 1951. From August 1960 to August 1963, he was Chief of the Engineering Division, Program 461, Space Systems Division Detachment 2, AFSC, at the NASA Manned Spacecraft Center. He is responsible for the engineering management associated with integration of Department of Defense experiments into the Gemini and Apollo Programs. Colonel Ballentine holds the Distinguished Flying Cross and the Air Medal.

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22. ASTRONAUT FLIGHT AND SIMULATION EXPERIENCES

ASTRONAUT THOMAS P. STAFFORD, *NASA Manned Spacecraft Center*
Co-Author: Astronaut Charles Conrad

Abstract

Launch, rendezvous, special task, systems operation, and reentry training and flight experiences are discussed in this paper. The fidelity of the flight simulations is compared with actual flight experience. In most cases, flight simulations were accurate and data from these simulations had close correlation with actual inflight data.

Speaker's Biography

THOMAS P. STAFFORD, Lieutenant Colonel, USAF, was born September 17, 1930, in Weatherford, Oklahoma. He received a bachelor of science degree from the United States Naval Academy in 1952. He received a commission in the United States Air Force upon graduation from Annapolis. Following his flight training, Lieutenant Colonel Stafford flew fighter interceptor aircraft in the United States and Germany and later attended the USAF Experimental Flight Test School at Edwards Air Force Base, California. He served as Chief of the Performance Branch at the USAF Aerospace Research Pilot School at Edwards. He was also an instructor in flight-test training and specialized academic subjects. Lieutenant Colonel Stafford was selected as an astronaut by NASA in September 1962. He has since served as backup pilot for the Gemini III flight. On December 15, 1965, he and command pilot Walter M. Schirra were launched into space on the history-making Gemini VI-A mission and subsequently participated in the first successful rendezvous of two manned maneuverable spacecraft by joining the already orbiting Gemini VII crew. He made his second flight as command pilot of the Gemini IX-A mission, which began on June 3, 1966. He has since been named as backup senior pilot for the second three-man Apollo flight. Lieutenant Colonel Stafford was awarded two NASA Exceptional Service Medals, the Air Force Astronaut Wings, the AIAA Astronautics Award; and was corecipient of the 1966 Harmon International Aviation Trophy.

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23. GEMINI RESULTS AS RELATED TO THE APOLLO PROGRAM

WILLIS B. MITCHELL, *Manager, Office of Vehicles and Missions, Gemini Program Office, NASA Manned Spacecraft Center*
Co-Authors: Owen E. Maynard and Donald D. Arabian

Abstract

The contributions of the Gemini Program to the Apollo Program are discussed. Rendezvous and docking processes necessary to the lunar mission were explored. Human capabilities in space environment were investigated for periods up to 14 days. Problems of extravehicular activity were explored, and guidelines for Apollo crews were generated. Advancements in spacecraft design, systems, and materials substantiate Apollo approaches and concepts. The Gemini Program provided training for personnel who will participate in the Apollo Program.

Speaker's Biography

WILLIS B. MITCHELL was born in Tulsa, Oklahoma, on September 30, 1920. He was graduated from the University of Oklahoma in 1942 with a bachelor of science degree in mechanical engineering. Following World War II, he worked for a short time for McDonnell Aircraft Corporation in armament design and joined the Convair staff as an aerodynamics engineer. From 1955 to 1960, he was an aerodynamics group engineer on the Atlas ICBM weapons system at General Dynamics/Convair. In 1960, he joined General Dynamics/Astronautics as Chief of Aerophysics for the Atlas and Centaur Programs. He joined the Manned Spacecraft Center in April 1962 as manager of Launch Vehicle Integration Office in the Gemini Program Office. In this position he was responsible for the development of the Gemini Launch Vehicle and Atlas-Agena Target Vehicle as well as for the configuration management system. He is a member of Phi Eta Sigma and Tau Beta Pi at the University of Oklahoma and has written various technical reports and papers relating to the Atlas weapons system and ballistic missile design.

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24. SUMMARIZATION OF GEMINI PROGRAM

CHARLES W. MATHEWS, *Manager, Gemini Program Office, NASA Manned Spacecraft Center*

Biography

CHARLES W. MATHEWS was born February 16, 1921, in Duluth, Minnesota. He received a bachelor of science degree in aeronautical engineering from Rensselaer Polytechnic Institute, Troy, New York, in 1942. Mr. Mathews joined the Science staff of the NACA Langley Research Center in 1943 and was engaged in airplane flight research. Later, he conducted flight research on automatic control systems for aircraft. Mr. Mathews served as chairman of the group which developed the Mercury spacecraft specifications. When Project Mercury became an official program, he transferred to the Manned Spacecraft Center (then Space Task Group). His initial assignment with Space Task Group included directing the team that established the operating concepts for Mercury and directing early flight tests. Mr. Mathews served as Deputy Assistant Director for Engineering and Development at MSC prior to being named Manager of the Gemini Program Office. He has served in this position since November 5, 1963. While serving as Deputy Assistant Director for engineering and development, he was also Chief of the Spacecraft Technology Division. That division conducted studies of the methods of accomplishing manned lunar landings and was responsible for the systems studies on the lunar module. Mr. Mathews received the NASA Medal for Outstanding Leadership from President Lyndon B. Johnson in a White House ceremony in June 1965 for contributions in direction of the Gemini Program. He also was recipient of the Chairman's Citation of the Houston Section of the AIAA in May 1965. Mr. Mathews was a member of four groups which have received recognition for their contributions to the space effort, as follows: NASA Group Achievement Award – Mercury Project Office, October 1962; NASA Group Achievement Award–Assistant Directorate for Engineering and Development, October 1962; NASA Group Achievement Award–to members of Gemini Program Office Extravehicular Activity Development Team, June 1965; and NASA Group Achievement Award–to members of Gemini Program Office Rendezvous Operations Planning Team, January 1966.

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