MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEMINI XII FLIGHT AND GEMINI PROGRAM SUMMARY

Fact Sheet 291-I
December 1966

The National Aeronautics and Space Administration concluded the operational aspects of the Gemini Program with the flight of Gemini XII. That flight took place November 11-15, 1966. The flight had first been scheduled to start November 9, but one-day delays were announced successively on November 8 and 9. Both delays were caused by troubles in the secondary autopilot on the Gemini launch vehicle.

The Gemini XII flight crew—James A. Lovell, Jr., command pilot, and Edwin E. Aldrin, Jr., pilot—spent the added time working in the Gemini mission simulator at Cape Kennedy and reviewing the flight plan and mission checklists. Serving as backup crew for the Gemini XII flight were L. Gordon Cooper, Jr., as command pilot, and Eugene A. Cernan as pilot.

Several primary objectives were assigned to the last Gemini flight. They were:

- To rendezvous and dock with a target vehicle.
- To conduct extravehicular activity (EVA) at least three times during the mission.

These objectives were achieved.

Other objectives asssigned to and achieved by the Gemini XII flight were:

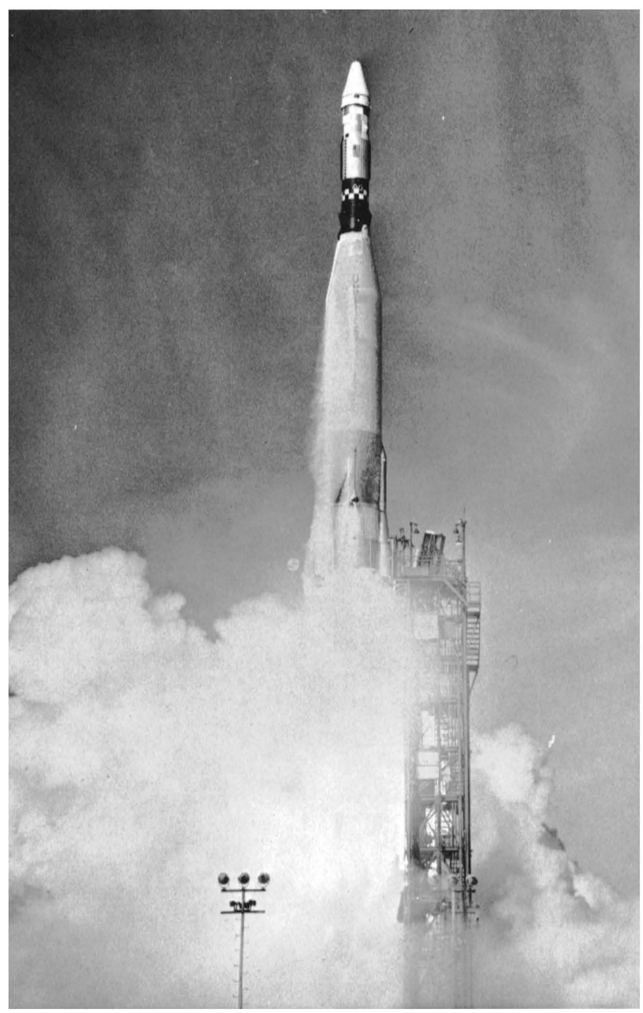
- To practice docking. (Achieved)
- To accomplish a tethered-vehicle station-keeping exercise by the gravity gradient technique. (Achieved)
- To conduct experiments. (Achieved)
- To perform maneuvers, using the Agena primary propulsion system to change the orbit.
- To use a controlled reentry technique as accomplished on Gemini XI. (Achieved)

On Veterans' Day, November 11, the now veteran space team of government and contractor employees successfully completed the last two launches in the Gemini Program.

On launch day, Lovell and Aldrin got up about 10:30 a.m. (All times used in this fact sheet are Eastern Standard Time). About an hour later they underwent their final physical examination and, with 10 astronauts as guests, had breakfast in the crew quarters on Merritt Island. The breakfast consisted of filet mignon, eggs, toast, coffee, and juice.

Meanwhile the countdown was proceeding smoothly on both the Atlas-Agena and the Gemini launch complexes. Lovell and Aldrin left the crew quarters at about 12:30 p.m. and proceeded to the ready room at launch complex 16. While there they suited up and received final briefings on the status of the mission in general, the spacecraft, the launch vehicles, and the weather. During the suiting-up process, a problem was encountered with air tubes in Aldrin's left sleeve. It was necessary for him to unsuit to make the required adjustment. This did pose a problem concerning time but did not require a hold. The crew then went to the launch pad, received the current countdown status from the backup crew, who had been participating in countdown activities since about 9:30 a.m., and were inserted into their spacecraft shortly before 2 p.m.

The Agena was scheduled for liftoff at 2:08 p.m. and the Atlas roared to life and lifted its payload to



THE GEMINI XII target vehicle and its Agena D payload as it lifted off from Launch Complex 14 at Cape Canaveral, Fla., November 11, 1966.

start its trip into space just one second before that time. During the first orbit, it was determined that the Agena was in an orbit with an apogee of 163.9 miles and a perigee of 159 miles (all mileage quoted in this fact sheet is nautical miles. One nautical mile is equal to 1.15 statute miles).

The scheduled liftoff time for the Gemini launch vehicle and spacecraft was 3:46:30 p.m. and the liftoff occurred within one-half second of that time. Gemini XII was placed into an orbit with an apogee of 146 miles and a perigee of 87 miles.

The next four days were to prove highly challenging to the flight crew, both from the standpoint of flight objectives and from operational constraints placed upon the mission by failure or partial failure of equipment.

From the time the crew lost valid radar lock-on, range and range rate indications while accomplishing the planned rendezvous with the Agena XII target vehicle early in the flight until trouble was encountered with the regulated pressure of one of the reentry control system rings several hours prior to the reentry, the Gemini XII flight crew and controllers on the ground were beset with a series of operational difficulties. However, the technological advancement in the hardware during the Gemini Program, and the skills shown both by Lovell and Aldrin in the spacecraft and the flight controllers on the ground proved beyond a shadow of a doubt that man has, in a very real sense, conquered many of the varied problems posed by space travel.

One of the operational problems occurred during the second docking. When the docking was effected it was only with sufficient force to make one of three of the latches catch. The result was an Agena-Gemini combined vehicle which could not be rigidized. The crew rapidly grasped the situation and applied sideward thrust from the latch which was caught. The spacecraft withdrew from the Agena and then completed the docking maneuver.

Not only were the operational problems overcome, one by one, throughout the flight, but also Lovell and Aldrin were able to successfully complete almost all of the many specific tasks assigned to them during the four-day mission. Following is a day-by-day account of the major activities of Gemini XII.

FIRST DAY

Atlas-Agena liftoff occurred at 2:07:59 p.m.

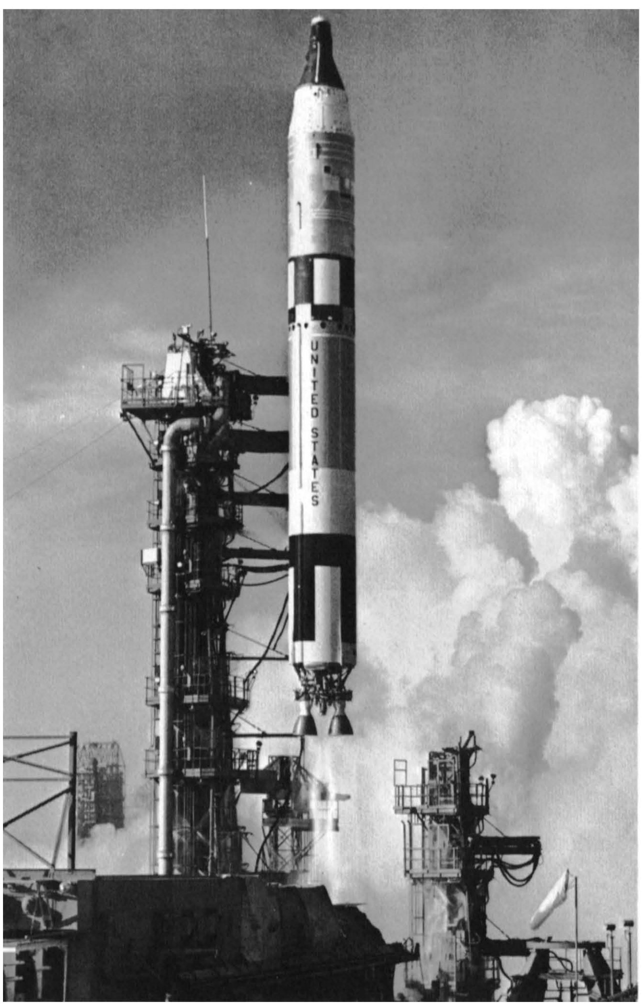
The Gemini liftoff occurred at 3:46:30 p.m. The crew performed a maneuver after 49 minutes and 40 seconds of the flight had elapsed in order to accomplish the rendezvous during the third revolution. The crew performed on-board computation throughout the period of rendezvous maneuvering.

Radar lock-on was reported at a range of 235 miles and the crew first saw the target at a range of 85 miles through use of the sextant telescope.

The terminal phase maneuver was initiated after three hours, five minutes and 58 seconds of flight. Rendezvous was accomplished after three hours and 46 minutes of the flight had elapsed, and the Gemini XII spacecraft was docked with its Agena target 28 minutes later.

The flight plan had called for Lovell and Aldrin to "fire up" the primary propulsion system of the Agena to boost the docked vehicles into an orbit with a 400-mile apogee and a 161-mile perigee after about eight hours of flight. This portion of the flight plan was cancelled by flight controllers after they noted fluctuations in the primary propulsion system thrust pressure chamber and turbine manifold pressure during the ascent maneuver.

With the launch originally scheduled for November 9, one of the assignments for the flight crew was to photograph the eclipse of the sun during the third day of the mission. With the delays, this portion of the flight plan was just about ruled out as a possibility. However, the trouble with the Agena's primary propulsion system resulted in a realtime planning change. Two docked maneuvers were completed using the Agena's secondary propulsion system to adjust the phase of the spacecraft orbit and provide for photography of the eclipse during the 10th revolution.



THE LAST LAUNCH of the Gemini Program placed astronauts James A. Lovell, Jr., and Edwin E. Aldrin, Jr., into orbit for the four-day mission which ended the operational phase of Gemini.

About seven hours after liftoff the fuel cell oxygen-to-water warning lights flashed on frequently. The lights went out each time the crew withdrew a substantial amount of drinking water. In addition there was an indication of degradation of fuel cell performance.

Aldrin completed the first of three scheduled extravehicular activites planned for the flight near the end of the first 24-hour period of the mission. Total elapsed time of this stand-up EVA was two hours and 29 minutes.

Also, during the first day, the crew performed activities required for seven experiments.

SECOND DAY

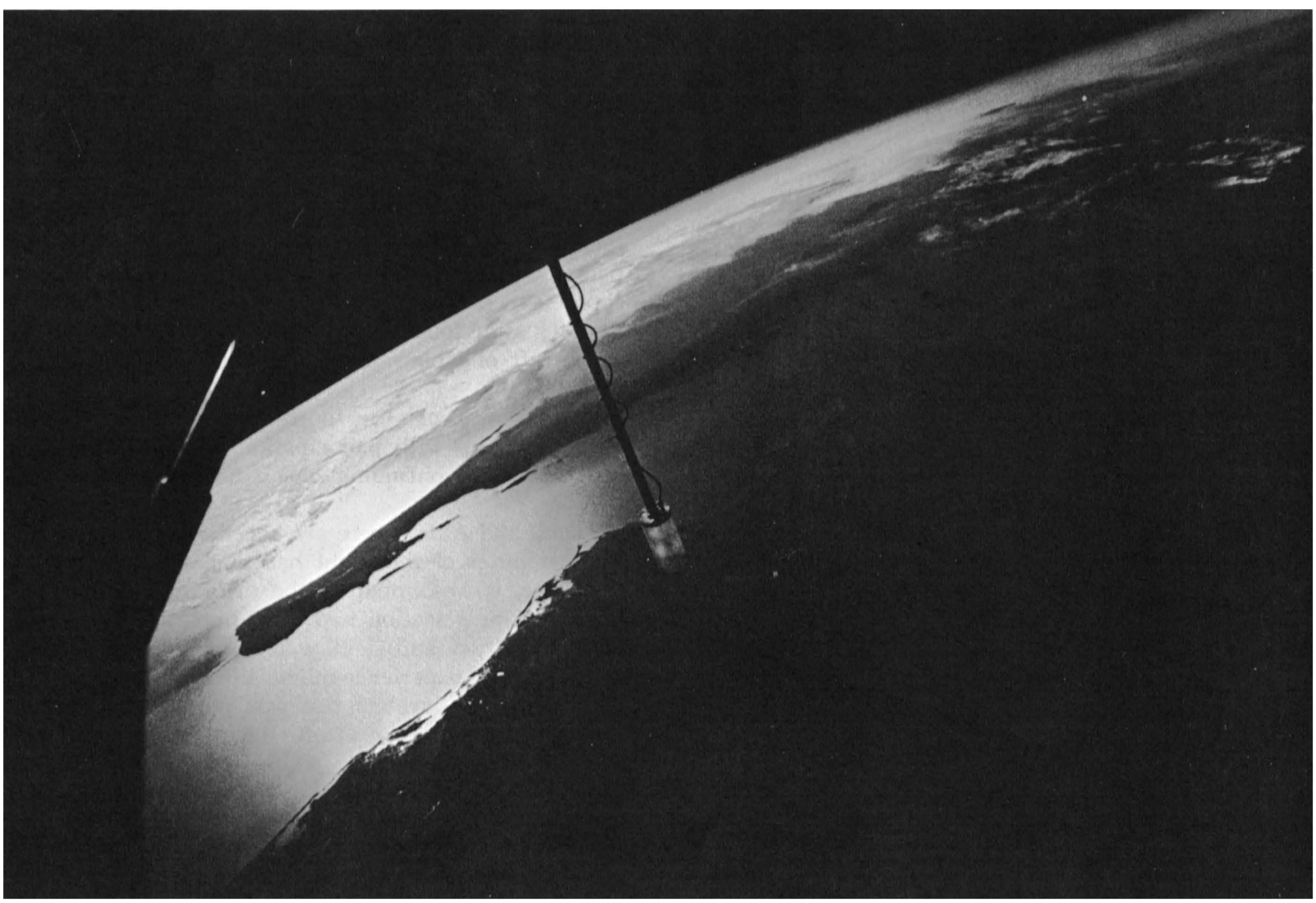
During the second day of the Gemini XII mission, the major accomplishments included umbilical extravehicular activity and the start of the spacecraft/Agena target vehicle tether evaluation.

After about 36 hours of flight, the power from stack B in the fuel cell was less than one-half what it had been, and less than two hours later it dropped to zero and was removed from the line.

Lovell and Aldrin reported difficulty with the orbital attitude and maneuver system after 39 hours and 30 minutes of the flight had elapsed. They later confirmed that they received little or no thrust from a pitch-down thruster and from a yaw-left thruster. During his period of EVA Aldrin reported that he observed vapor coming from the pitch thruster when it was commanded on and that it did not appear to be firing properly.

Aldrin performed many tasks during his two hour and eight minute EVA period. These tasks, carefully planned and prepared for by NASA officials and the flight crew, covered many facets of basic activity and utilized portable handrails, foot restraints and waist tethers. Additionally, he was allowed a number of brief rest periods between tasks in order to study the effect on the astronaut of a workload planned in such a manner. During this time period Aldrin found difficulty in installing a camera in the adapter section. When it did not appear to function normally, he brought it back to the spacecraft for postflight failure analysis.

The Agena target was used to pitch the docked vehicle to a vertical position for the tether evaluation. Following this, the spacecraft was undocked and the tether extended. The exercise which followed lasted about four and a half hours and it was believed that the gravity gradient stabilization which had been expected and desired was achieved.



THE GEMINI XII crew obtained this unusual photo during their 16th revolution. Looking from the spacecraft to the northwest are the coast of Mexico, the Gulf of California, and Baja California.

In order to alleviate the apparent difficulty resulting from an excess amount of water in the fuel cells, flight controllers instructed the crew to purge the cells with oxygen for 30 seconds during each revolution.

During the EVA exercise, Aldrin opened an Agena micrometeorite collection experiment package. Velcro, which had been provided to assure an open hardware position, was removed because it was charred and Aldrin set an alternate latching configuration to attain the objective. The crew continued work on other experiments.

THIRD DAY

The spacecraft/Agena target tether evaluation completion was a highlight of the third day of Gemini XII. In addition, Aldrin performed his third EVA exercise in as many days—this one consisting of standup extravehicular activities for 51 minutes. Also, during this time phase the final separation of the spacecraft and its Agena target occurred. The latter event happened after 52 hours and 14 minutes of the flight had elapsed.

The spacecraft/Agena tether was jettisoned after 51 hours and 51 minutes of the mission had been flown, and the separation maneuver was performed about 23 minutes later.

Immediately after completion of the EVA on the third day the crew reported that the yaw-right thruster had apparently failed, and an hour later, after 68 hours of the flight had elapsed, a yaw-left thruster also malfunctioned.

The Gemini XII flight crew tried to visually acquire the launch of a sodium rocket from the French launch site near Hammaguir, Algeria, on two successive revolutions. They were unable to see the rockets but did photograph the area through which those rockets should have passed.

Also, during the third day, the crew continued to stress experiment activities.

THE ABOVE PHOTOGRAPH shows Aldrin during his umbilical extravehicular activity. This photo, the best of a series, was taken during the 28th revolution.

FOURTH DAY

Perhaps the most important activities of the fourth day of the Gemini XII flight were those which concerned positioning the spacecraft in the proper attitude for retrofire, the retrofire preparations, the actual retrofire itself, and the landing in the western Atlantic some 35 minutes later. This was followed shortly by the pickup of the crew and the spacecraft and the Gemini Program was operationally closed on the same successful note which had permeated it from its inception.

Retrofire was initiated over Canton Island after 93 hours, 59 minutes, and 58 seconds of the flight had passed. The landing occurred 34 minutes and 33 seconds later at 2:21:04 p.m. The flotation collar was attached to the spacecraft about eight minutes after impact. Lovell and Aldrin had been picked up by helicopter and delivered to the deck of the USS *Wasp* 30 minutes after touchdown, and that ship picked up the spacecraft one hour and seven minutes after its historic landing.

Until that time, the fourth day of the flight had been taken up with participation in experiments and in keeping a continuing check on operational difficulties.

Lovell and Aldrin were awakened after 80 hours and three minutes of the flight had elapsed. Shortly after this time, it was apparent the drinking water supply in the adapter section had been depleted. They were able to extract sufficient water from the cabin container but did experience minor difficulties.

A propulsion system test was performed 88 hours and 57 minutes after liftoff. This test revealed that there was no discernible thrust from a yaw-left and a yaw-right thruster and that thrust from the pitch down and the other yaw left thruster was very low.

Between that time and the time for retrofire, it was noted that the two remaining stacks of fuel cell section number two were carrying less than half of their normal share of the load. To compensate for this the four main batteries of the spacecraft were put into service and all electrical current from fuel cell section number two was discontinued.

It was also noted, during this time, that the regulated pressure in one of the two reentry control rings was rising to almost 100 pounds per square inch (PSI) more than the normal range of 295 to 315 PSI. This situation was corrected prior to retrofire and reentry, and was the last operational difficulty of the Gemini Program.

A PHOTOGRAPHER ABOARD a rescue helicopter recorded this unusual picture which shows major elements of the recovery forces in action. After attaching the flotation collar to the spacecraft, pararescuemen inflated a raft, then aided Lovell and Aldrin egress from the spacecraft and await pick-up by the helicopter hovering over the scene. The helicopter then delivered the crew to the prime recovery ship, the USS Wasp, in the background.

EXPERIMENTS

One of the purposes of the four-day Gemini XII mission was to conduct experiments, and in this respect, a total of 14 were attempted.

These experiments were Manual Navigation Sightings, Synoptic Terrain Photography, Synoptic Weather Photography, Libration Regions Photography, Ion Sensing Attitude Control, Tri-Axis Magnetometer, Beta Spectrometer, and Bremsstrahlung Spectrometer.

Also: Frog Egg Growth, Agena Micrometeorite Collection, Sodium Vapor Cloud, Airglow Horizon Photography, Micrometeorite Collection, and Ultraviolet Astronomical Camera.

Basic objectives of these experiments and other experiments conducted in the Gemini Program appear in another portion of this fact sheet.

POST-RECOVERY NEWS CONFERENCE

The final post-recovery news conference of the Gemini program was conducted in Houston. It started about one hour after the Gemini XII spacecraft had touched down almost at the planned landing point. Participants in the conference were William C. Schneider, NASA Headquarters, Gemini XII Mission Director; Manned Spacecraft Center Director Robert R. Gilruth; MSC Gemini Program Manager Charles W. Mathews; MSC Assistant Director for Flight Operations Christopher C. Kraft, Jr.; MSC Assistant Director for Flight Crew Operations Donald K. Slayton; Gemini XII Flight Director Glynn S. Lunney of MSC; Dr. Charles A. Berry, MSC, Gemini XII Flight Surgeon; and Col. Royce G. Olson, Director of the Department of Defense Manned Space Flight Support Office, Patrick Air Force Base, Florida.

Champagne for the occasion was furnished by the newsmen at the site of the news conference, across the street from Manned Spacecraft Center. Gilruth started the conference by proposing a toast to the astronauts who had flown in the Gemini Program and to Mathews and Kraft for their contributions.

With the Gemini Program operationally completed, the overall tone of the conference seemed to be based on two themes: first, a mutual exchange of congratulations covering all persons and organizations who had a part in the program. (This extended to news media. Paul Haney, Public Affairs Officer of MSC, praised the news representatives for their coverage of Gemini, and some of the media responded by voicing congratulations to all who had a part in the program.) The second theme of the conference concerned lessons learned in Gemini which will be applied in Apollo.

Gilruth said, "In order to go to the moon, we had to

THE GEMINI XII CREW spoke briefly to a crowd of Gemini workers who had gathered to greet them on their return to the Cape. Aldrin is shown at the podium set up next to a Gemini "scoreboard," while Lovell stands with G. Merritt Preston, Deputy Director of Kennedy Space Center for Launch Operations.

learn how to operate in space. We had to learn how to maneuver with precision, to rendezvous, to dock, to work outside the spacecraft in the hard vacuum of outer space, to learn how man could endure long duration in the weightless environment, and to learn how to make precise landings from orbital flight.

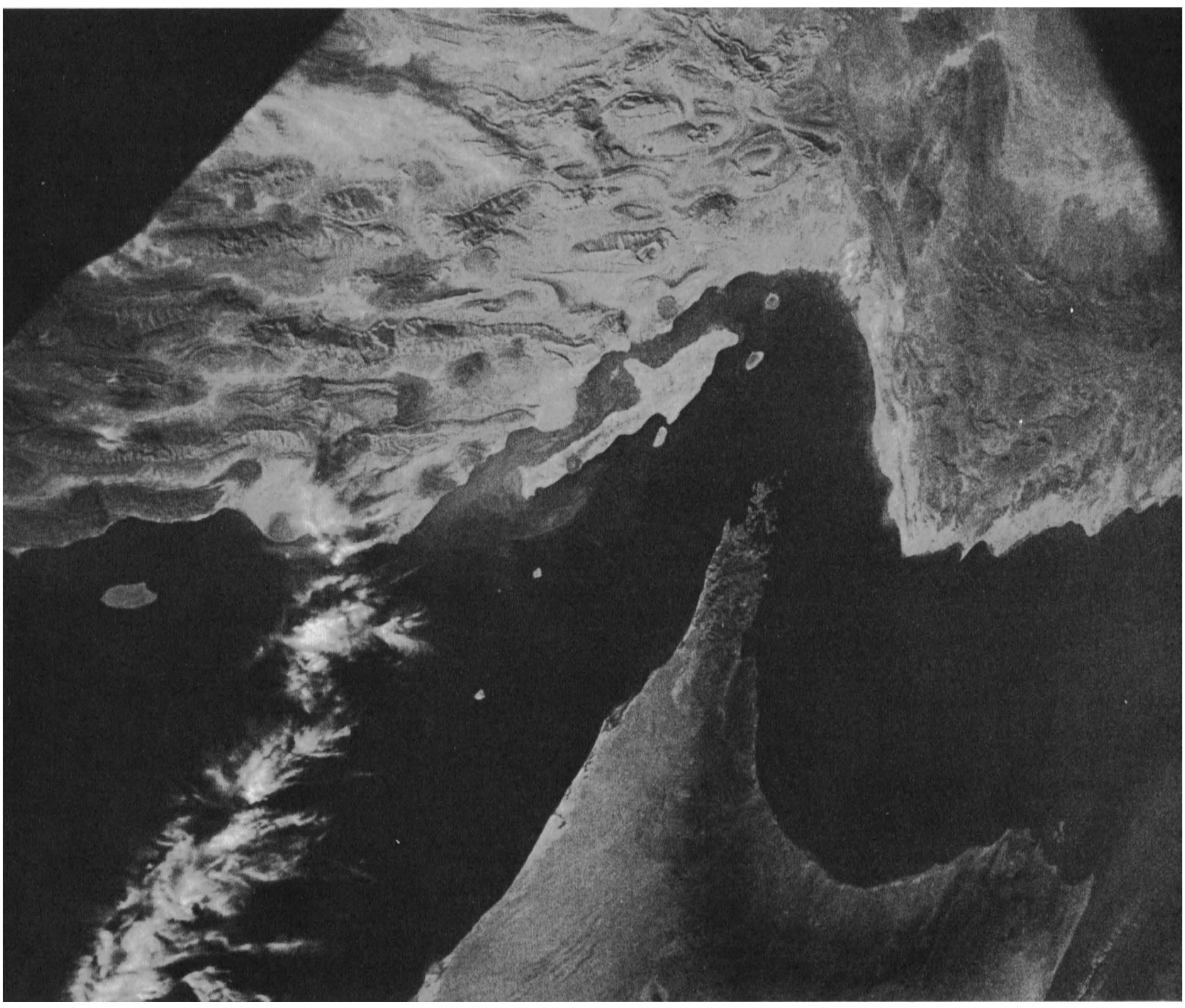
"This is where the Gemini Program came in. We have rendezvoused, I believe, 10 times, using different techniques and different orbits. [We did this] sometimes optically and sometimes using the radar. We have worked outside the spacecraft. We have demonstrated a system which can make precise landings."

Mathews praised the teamwork exhibited by all persons and organizations involved in the program, and Kraft stressed the operational skills which had been built up both in flight crews and ground crews. Dr. Berry said that proof that man can really operate in the space environment was one of the milestones of the Gemini Program.

In the question and answer session that followed, it was reiterated that the personnel who have been engaged in Gemini will find their skills fully utilized in other on-going programs such as Apollo and Apollo Applications.

Slayton pointed out that with the exception of the crews assigned to the Gemini XII mission all astronauts have been participating in the Apollo training program. Kraft added that the flight control teams not primarily concerned with Gemini XII have already been phased into the Apollo program for early flights and that those teams would be involved in a particular Apollo flight very quickly. He added there were plans for getting all control personnel involved in aiming for the ultimate lunar mission, in which case all the people would be used.

In answer to a question concerning the evaluation of the EVA experience of Aldrin during the mission, Gilruth said, "It appears at this point that we were



IRAN, THE PERSIAN GULF, Gulf of Oman, the Zagros Mountains, and Qeshm Island as seen from Gemini XII during the 54th revolution.

able to lay out a set of EVA tasks and train for them and accomplish them. [This] would indicate that we are making progress both in learning how to train for EVA and also how to plan supports for the EVA crewman so that he is able to do the assigned tasks. I would say it appears to be a milestone in understanding the extravehicular work."

Colonel Olson was asked if he foresaw a cutdown of major proportions in the Department of Defense support area in the Apollo Program. He replied that he did not see any major reduction and added that a number of lessons had been learned during Gemini which had resulted in a reduction of the support forces. Colonel Olson said this was a combination of more confidence in the spacecraft and the space flight program from the standpoint of the Flight Director and his personnel and the introduction of more modern equipment within the Department of Defense. He cited, for example, that the HC-130's replaced C-54's. The former are faster and have a greater range.

Kraft was asked what had been learned in the art of flight controlling and network support during the Gemini program beyond that available at the close of the Mercury Project.

He replied that at the end of the Mercury program "we had not maneuvered in space, nor measured the change as a result of maneuvering in space." Kraft remarked that this is fundamental to the Apollo program. He said "You have to make very large-scale maneuvers. And, in injection to the moon, you have to make midcourse corrections in order to rendezvous at the moon. You have to orbit around the moon and you have to rendezvous at the moon. All these things require precise measurements, precise computing. We have done this in the Gemini Program and it is directly applicable to the lunar flight."

Kraft said that one thing not gained out of Gemini was dealing with deep space distances, but added that data is being gathered from the Orbiter Program which is beneficial and which is being used. He said he had a strong confidence that we will be able to compute and carry out the maneuvers necessary to get to and from the moon.

PILOTS' NEWS CONFERENCE

The Gemini XII Pilots' News Conference was conducted at Houston November 23. Participants were Lovell and Aldrin, Robert C. Seamans, Jr., Deputy Administrator of NASA; and Robert R. Gilruth, Director of Manned Spacecraft Center.

During his brief introductory remarks, Seamans stressed the number of lessons learned during the Gemini program and the importance of these lessons to future operations. He said, "Let us also remember that the missions ahead are exceedingly complex. We are going to explore out to distances of a quarter of a million miles. These missions include, of course, the flights around the moon and the landing on the moon itself. So as we stand here today to listen to the accomplishments . . . let us not forget that there is much, much hard work ahead before we can say that we have attained our national goal of preeminence in space."

Gilruth said that each of the 10 manned Gemini flights had, in a very special way, added new knowledge and helped pave the way for the next flight. He added that each time it seemed most difficult to surpass the previous performance, yet each time it had been done.

In their discussion of the flight, Lovell and Aldrin particularly stressed rendezvous, extravehicular activity and the gravity gradient tether exercise.

In talking about the rendezvous, Lovell said, "We were extremely fortunate because we turned the radar on early and we had a solid lock-on at 235 miles. We were led to expect, before the flight, that this range was highly improbable and we would have a much shorter range. You can imagine our confidence and elation as we waited for the rendezvous to take place. At the time for terminal phase initiation for the final rendezvous Buzz noticed that the computer wasn't giving any change of range. I looked down at the little green light that tells us we had a radar lock-on and it was off.

"We just looked at each other. We said, 'Oh, no, it can't happen to us. Anybody else or any other time but not this time.' Then it suddenly dawned on us that our radar had indeed failed. We went to the radar backup procedures which we had practiced quite a bit in preflight training but never really expected to use.

"The first thing on my list was to acquire the target visually. I looked up there and couldn't see a thing. Buzz took out his trusty sextant, which had an eight-power scope, and put it up to the window and spotted the target. I looked up again and that speck on the windshield turned out to be the Agena. So, we bore-sighted on the target and the rest of the rendezvous is history. It was successful and now I am sort of glad that we had a radar failure because it gave us an opportunity to use the back-up charts that all the crews had been practicing with quite a bit but never really utilized."

Aldrin stressed the fact that this was the only time that the primary rendezvous had been accomplished by use of the back-up techniques, and added that the solutions they got were extremely close.

Extravehicular activity was discussed at length, primarily by Aldrin. He said that these phases of the flight went smoother than anticipated. Past EVA experiences were studied, especially the problem areas, in order that the same pitfalls might be avoided.

Aldrin contrasted the preparation for EVA with training required for the launch, rendezvous and reentry phases of a mission. In the latter phases simulators have been designed which create the situation accurately. However, EVA is so entwined with zero-g environment that it is impossible to set up such an environment on earth.

He pointed out that great success was achieved by underwater simulations in an effort to solve the EVA problems. He also praised the restraint system which had been devised. This system consisted of two flexible waist tethers that were attached to his parachute harness. He connected these hooks into two different rings, one of them was on the telescoping handrail and another was on the docking cone of the Agena.

Aldrin said, "With this restraint system I was able to completely ignore where my body was going because I knew it wasn't going very far and I was going to be able to devote my full effort to the work task I had." After completing work tasks around the Agena, Aldrin moved to the adapter section of the spacecraft to perform tasks in that area and, at the same time, to evaluate the restraint system there. The primary difference was that foot restraints had been positioned there. These, too, proved to be very effective and Aldrin said "there really is nothing better than this type of restraint system. The situation is very similar to being in one-g environment."

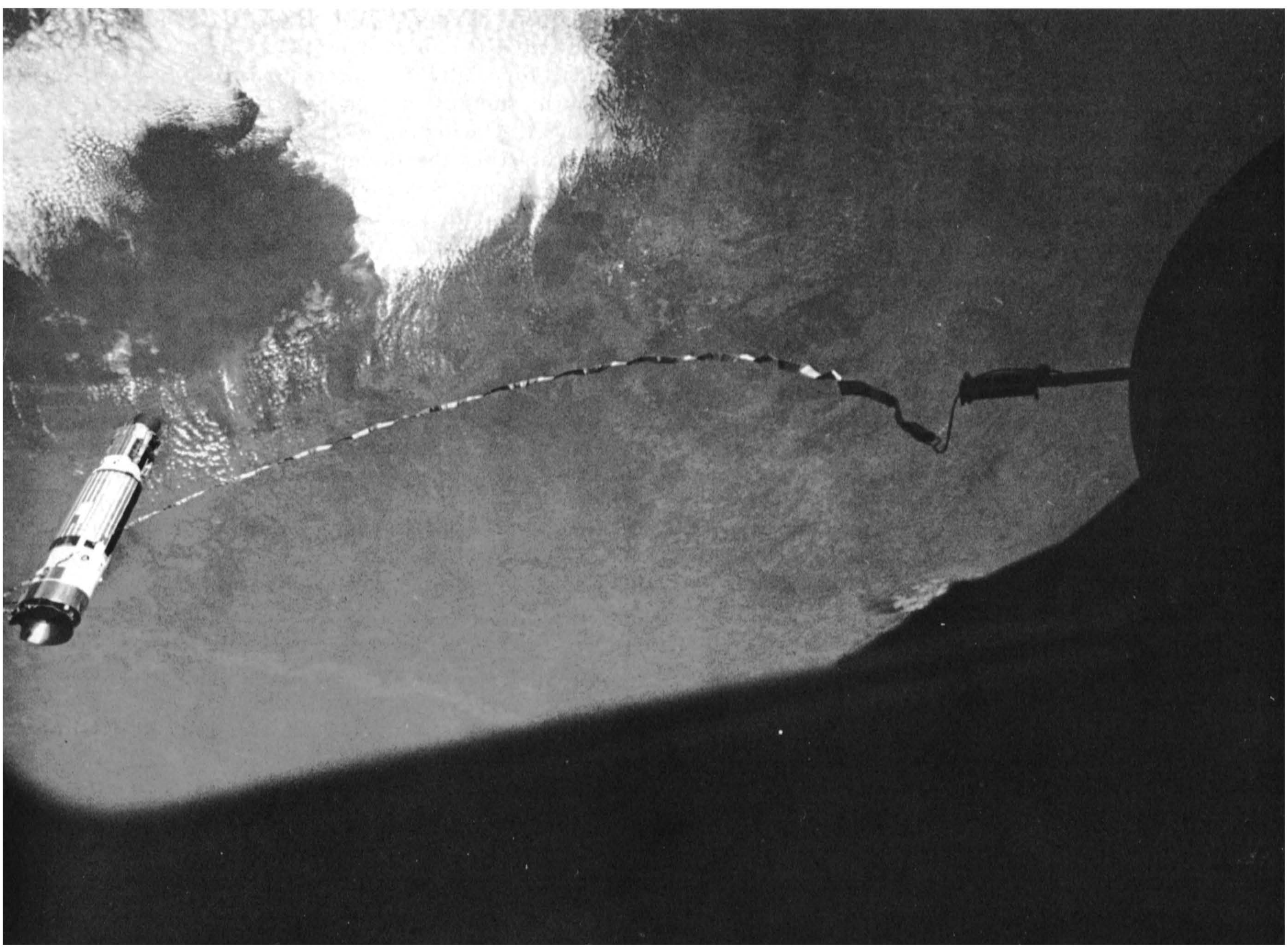
In summarizing the lessons learned concerning extravehicular activity on the Gemini XII flight, Aldrin said: "First, I think we learned the great value of a restraint system. In order to perform a task in EVA, we first must take time to set up a restraint on the body that will substitute for the one-g we have down here where our feet are in contact with the ground. We have to fix the body in a position where we then can devote our entire effort to the task at hand.

"The second lesson we learned concerns the value of the underwater training that we had. This was extremely valuable to us in letting us go through the entire time link of the EVA mission. The third lesson I think we learned is that sincere and intense training and very close attention to equipment familiarization really pays off in this type of effort."

At this point, Lovell interrupted. "The fourth lesson I learned was the fact that sometimes I was working harder in the cockpit changing film and voice tapes than Buzz was outside."

In talking about the tether exercise, Lovell explained that the crew had the task of performing a gravity gradient type of exercise which utilizes the differential gravitational attraction of two bodies in a vertical position above the earth and attempting to stabilize these bodies in a vertical position. He said, "It's actually a matter of station-keeping without using any fuel."

Lovell continued, "About this time we had a little thruster problem as you may know. Both the two and four thrusters were out and every time I wanted to



THE GEMINI XII crew photographed the Agena XII and its tether as the spacecraft and target passed over the Texas Gulf coast during the 47th hour of the mission.

pitch up or yaw, I would roll. It really got to be quite frustrating. I got mad at it occasionally because I couldn't do anything. Everytime I wanted to do anything, I'd always roll. But we finally, through a learning curve, determined how to handle the situation by using a maneuver thruster—actually blipping it a little bit to bring it around and counteract this roll."

Lovell said that in practice they had decided that Aldrin would control attitudes and Lovell translational movements. The idea was to maintain the position and then let go when all the rates had stopped to determine whether gravity had captured the spacecraft and was keeping it in position going around the earth. After running into problems with attitude control they decided to try to accomplish the goal by use of translational maneuvers.

This continued through one night pass, and during the next day pass they gave it another try. Lovell said, "Buzz got the slide rule out and made a few fast calculations, and we got above the Agena again, maintained this position, and it appeared to us then that our rates had indeed dampened. We let it go for the next two revolutions and finally we let the Agena go, too, and there we were—two dead vehicles captured by gravity in a vertical position going around the earth."

GEMINI AWARDS CEREMONY

The Gemini Awards Ceremony was held in the Manned Spacecraft Center Auditorium Wednesday, November 23, 1966, following the Gemini XII Pilots' News Conference.

At that time a number of people and organizations were officially recognized for their contributions to the Gemini Program. The following awards were made: Distinguished Service Medal (2), Exceptional Service Medal (5), Outstanding Leadership Medal (3), Exceptional Scientific Achievement Medal (1), Public Service Award (17), Group Achievement Award (7), and Superior Achievement Award (8).

The NASA Distinguished Service Medals were presented by NASA Administrator James E. Webb. The recipients were George E. Mueller, Associate Administrator of NASA for Manned Space Flight "for his outstanding contributions to United States manned space flight as Director of the Gemini program in addition to directing the entire manned space flight program . . ."; and Charles W. Mathews, MSC, "for outstanding contributions to United States manned space flight as Manager of the Gemini program . . ."

Webb also presented Exceptional Service Medals to the Gemini XII crew, command pilot James A. Lovell, Jr., and pilot Edwin E. Aldrin, Jr. The citations commented on their specific contributions toward the completion of the overall flight plan.

Public Service Awards "for outstanding contributions as key leaders of the government-industry team responsible for success of the Gemini Program" were made to the following group of Gemini executives: William Bergen, President, Martin Company; Jack L. Bowers, President, General Dynamics/Convair; George M. Bunker, Chairman of the Board, Martin Marietta Corporation; Brigadier General Paul T. Cooper, Commander, Air Force Space Systems Division; Daniel J. Haughton, President, Lockheed Aircraft Corporation; Roger Lewis, President, General Dynamics; James S. McDonnell, Jr., Executive Officer, McDonnell Aircraft Corporation; R. I. McKenzie, President, Aerojet General Corporation; L. Eugene Root, President, Lockheed Missiles and Space Company; and David S. Lewis, President McDonnell Aircraft Corporation.

Public Service Awards with individual citations for specific contributions were made to Walter F. Burke and John F. Yardley of McDonnell Aircraft Corporation; Bastian Hello and Walter D. Smith of Martin Company; Bernhard A. Hohmann, Aerospace Corporation; Lawrence A. Smith, Lockheed Aircraft Corporation; and Louis D. Wilson, Aerojet General Corporation.

NASA's Associate Administrator, Robert C. Seamans, Jr., presented the other Exceptional Service Medals, the Outstanding Leadership Medals, the Outstanding Scientific Achievement Medal, and the NASA Group Achievement Awards. Exceptional Service Medals were awarded to: Colonel John G. Albert, Air Force Eastern Test Range, "for directing the checkout and launch operations of Gemini launch vehicles, especially for directing launch vehicle operations in support of Gemini VII-Gemini VI . . ."; to Ozro M. Covington, Goddard Space Flight Center, "for directing the design, engineering, and operation of the Manned Space Flight Network in support of the Gemini Program . . ."; and to John D. Hodge, Manned Spacecraft Center, "for planning and directing the flight control aspects of manned space flight missions and in developing highly proficient flight control teams necessary for the conduct of the missions . . ."

Outstanding Leadership Medals were awarded to: Robert F. Thompson, Manned Spacecraft Center, "for significant contributions in developing and organizing recovery plans and operational procedures and for effecting their implementation by Department of Defense forces . . ."; John J. Williams, Kennedy Space Center, "for technical direction of spacecraft operations at the John F. Kennedy Space Center and for his significant contributions to the completion of the Gemini Program"; and Major General Vincent G. Huston, Commander, Eastern Test Range, "for his significant contributions in directing the efforts of the Eastern Test Range of the United States Air Force in providing the critical launch and operations support and in coordinating and directing the total efforts of the Department of Defense operational support forces for the Gemini Program."

The Exceptional Scientific Achievement Medal was awarded to James A. Chamberlin, Manned Spacecraft Center, "for his outstanding scientific contributions and conceptual design of the Gemini spacecraft and program; for his leadership and technical guidance in the engineering of the basic and underlying design principles for the Gemini spacecraft; and for his development of many operational concepts for the Gemini Program."

Group Achievement Awards were made to:

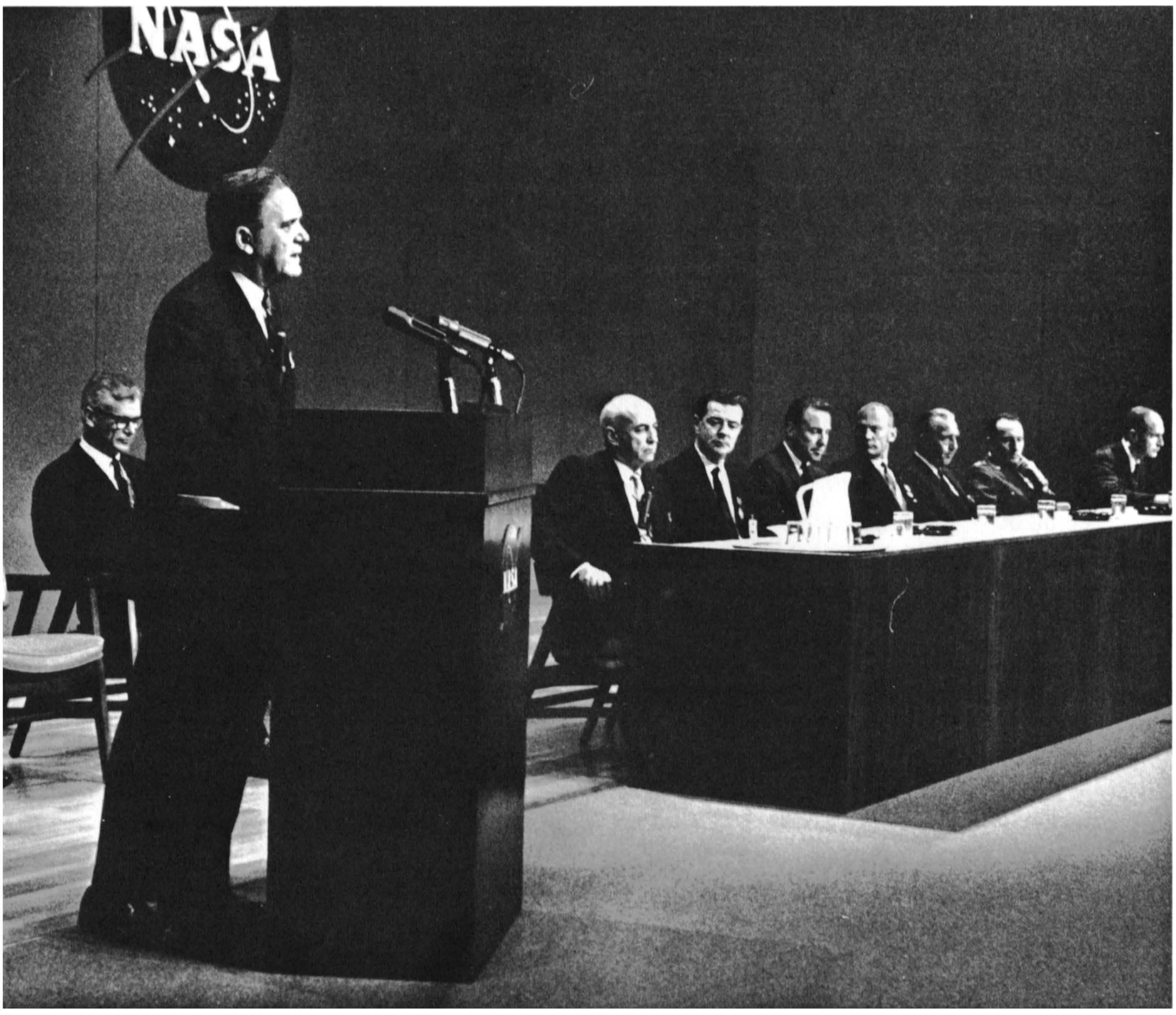
• The Gemini Astronaut Team, Manned Spacecraft Center, "for successfully completing the specific objectives of the Gemini Program in proving that man can live in space for periods of up to 14 days, perfecting rendezvous and docking techniques, demonstrating man's capabilities in extravehicular activity, landing a spacecraft with great precision, and executing important scientific experiments.

• The Manned Space Flight Network Team, Goddard Space Flight Center, "for superior technical achievement in designing, engineering, and operating the worldwide instrumentation facilities of the Manned Space Flight Network . . ."

• The Gemini Spacecraft Launch Team, Kennedy Space Center "for outstanding team effort in conducting spacecraft test and checkout activities for all Gemini flights to insure systems reliability and astronaut safety within the constraints of tight schedules and short launch intervals."

• The Gemini Launch Operations and Range Support Team United States Air Force "for outstanding teamwork by the 6555th Aerospace Test Wing in conducting launch operations and the Eastern Test Range Team for range support for Gemini space flight missions . . ."

• The Gemini Program Office Manned Spacecraft Center, "for the management of the Gemini Program which demonstrated the operational proficiency of the United States in manned space flight, including rendezvous and docking, controlled reentry, high altitude



THE GEMINI AWARDS CEREMONY participants included, left to right, Deputy NASA Administrator Robert C. Seamans, Jr., NASA Administrator James E. Webb (at podium), MSC Director Robert R. Gilruth, Gemini Program Manager Charles W. Mathews, astronaut James A. Lovell, Jr., astronaut Edwin E. Aldrin, Jr., Kennedy Space Center Director Kurt H. Debus, Eastern Test Range Commander Maj. Gen. Vincent G. Huston, and MSC Deputy Director George M. Low.

maneuvers, extravehicular activities, and flights of up to 14 days duration."

• The Gemini Program Office, NASA Headquarters, "for the overall direction of the Gemini Program, which demonstrated the operational proficiency of the United States in manned space flight . . ."

• The Gemini Support Team, Manned Spacecraft Center, "for important contributions in direct support of the Gemini Program in their specialty areas. The exceptional support of this team was a key factor in the outstanding success of the Gemini Program.

Superior Achievement Awards were made to:

• Arthur W. Vogley, Langley Research Center, "for his early vision in anticipating the problems of rendezvous and docking and for his concept and major contributions to the design and operation of a basic rendezvous and docking simulator which has contributed to the success of the Gemini-Agena Program.

• Richard J. Allen, NASA Headquarters, "for significant contributions to the establishment of the Gemini configuration management program."

• LeRoy E. Day, NASA Headquarters, "for significant contributions to the overall direction of the Gemini Program, especially in the area of test planning and execution."

• John A. Edwards, NASA Headquarters, "for significant contributions to the overall direction of the Gemini Program, especially in the area of flight operations."

• Eldon W. Hall, NASA Headquarters, "for organizing and leading the Headquarters Gemini system engineering, experiments integration, and mission analysis effort.

• Vearl N. Huff, NASA Headquarters, "for significant contributions to Gemini Program mission analysis, mission contingency planning and assessment of performance capability of the flight systems."

• Anthony L. Liccardi, NASA Headquarters, "for significant contributions to the establishment of the Gemini configuration management program."

• William A. Summerfelt, NASA Headquarters, "for significant contributions to Gemini program planning, and schedule and fiscal analysis."

In addition to the aforementioned awards, Administrator Webb recognized individuals who had received major awards on previous occasions but who were not specifically honored at this ceremony. Those recognized included G. Merritt Preston, Kennedy Space Center; Kenneth S. Kleinknecht, Christopher C. Kraft, Jr., George M. Low, and Walter J. Kapryan, all of Manned Spacecraft Center; and William C. Schneider of NASA Headquarters.

Author's Note: Several of the aforementioned awards were made by President Lyndon B. Johnson at his

THE GEMINI XII flight crew — command pilot James A. Lovell Jr., left, and pilot Edwin E. Aldrin, Jr. — after their recovery.

ranch near Austin, Texas, where he was host at a luncheon.

THE PILOTS

James Lovell

James A. Lovell, Jr., command pilot of the Gemini XII crew, was born in Cleveland, Ohio, March 25, 1928. He is a graduate of the United States Naval Academy.

After graduating from the Academy, Lovell received flight training, then served in a variety of assignments before being selected as a NASA astronaut in September 1962. These assignments included a three-year tour as a test pilot at the Naval Air Test Center, Patuxent, Maryland. His duties during that period encompassed service as program manager for the F4H Weapon System Evaluation.

Lovell was graduated from the Aviation Safety School of the University of Southern California, and served as flight instructor and safety officer of Fighter Squadron 101, Naval Air Station, Oceana, Virginia. He has logged more than 3300 hours flying time, including more than 2200 hours in high performance aircraft.

He served as pilot for the long-duration mission, Gemini VII, which flew December 4-18, 1965; as backup pilot for the Gemini IV flight; and as backup command pilot for Gemini IX.

Lovell is married to the former Marilyn Gerlach of Milwaukee, Wisconsin. They have four children: Barbara L., born October 13, 1953; James A., born February 15, 1955; Susan K., born July 14, 1958; and Jeffrey Carl, born January 14, 1966.

Edwin E. Aldrin, Jr.

Pilot for Gemini XII was astronaut Edwin E. Aldrin, Jr., a native of Montclair, New Jersey, who was born January 20, 1930.

Aldrin was graduated from the United States Military Academy with a bachelor of science degree and received a doctor of science degree in astronautics from Massachusetts Institute of Technology.

He flew 66 combat missions in Korea, flying in F-86 aircraft with the 51st Fighter Interceptor Wing. Later he served as aerial gunnery instructor at Nellis Air Force Base, Nevada, then attended the Squadron Officer's School at Air University, Maxwell Air Force Base, Alabama.

Aldrin then served a tour as administrative assistant to the Dean of Faculty, Air Force Academy, followed by a tour at Bitburg, Germany, where he was a flight commander with the 36th Tactical Fighter Wing.

His doctoral thesis at MIT concerned guidance for manned orbital rendezvous, and after his graduation he was assigned to the Gemini Target Office of the Air Force Space Systems Division, Los Angeles, Cali-

UNITED STATES SPACE FLIGHT LOG

MISSION	PILOTS	DATE(S)	ELAPSED TIME	TOTAL U.S. MANNED HOURS IN SPACE
Mercury-Redstone 3	Shepard	May 5, '61	00:15:22	00:15:22
Mercury-Redstone 4	Grissom	July 21, '61	00:15:37	00:30:59
Mercury-Atlas 6	Glenn	Feb. 20, '62	04:55:23	05:26:22
Mercury-Atlas 7	Carpenter	May 24, '62	04:56:05	10:22:27
Mercury-Atlas 8	Schirra	Oct. 3, '62	09:13:11	19:35:38
Mercury-Atlas 9	Cooper	May 15-16, '63	34:19:49	53:55:27
Gemini-Titan III	Grissom-Young	Mar. 23, '65	04:53:00	63:41:27
Gemini-Titan IV	McDivitt-White	June 3-7, '65	97:56:11	259:33:49
Gemini-Titan V	Cooper-Conrad	Aug. 21-29, '65	190:55:14	641:24:17
Gemini-Titan VII	Borman-Lovell	Dec. 4-18, '65	330:35:31	1302:35:19
Gemini-Titan VI-A	Schirra-Stafford	Dec. 15-16, '65	25:51:24	1354:18:07
Gemini-Titan VIII	Armstrong-Scott	Mar. 16, '66	10:41:26	1375:40:59
Gemini-Titan IX-A	Stafford-Cernan	June 3-6, '66	72:21:00	1520:22:59
Gemini-Titan X	Young-Collins	July 18-21, '66	70:46:39	1661:56:17
Gemini-Titan XI	Conrad-Gordon	Sep. 12-15, '66	71:17:08	1804:30:33
Gemini-Titan XII	Lovell-Aldrin	Nov. 11-15, '66	94:34:31	1993:39:35

fornia. While there, he was a member of the special study group which made recommendations concerning Air Force participation in the Gemini program. Aldrin was transferred to the Air Force Field Office at Manned Spacecraft Center which was responsible for integrating Department of Defense experiments into Gemini flights, and was with this office when he was selected as a NASA astronaut in October 1963. He served as backup pilot for the Gemini IX flight.

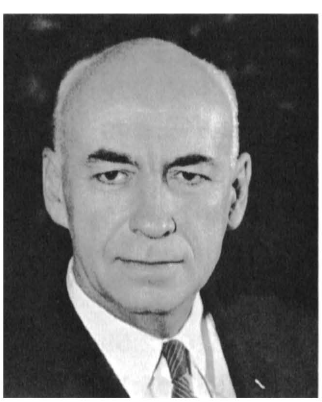
Aldrin has logged more than 2800 hours flying time, including more than 2400 hours in jet aircraft. He is married to the former Joan A. Archer of Ho-Ho-Kus, New Jersey. They have three children: James M., born September 2, 1955; Janice R., born August 16, 1957; and Andrew J., born June 17, 1958.

GEMINI PROGRAM SUMMARY

The National Aeronautics and Space Administration announced December 7, 1961, a plan to extend the existing manned spaceflight program by development of a two-man spacecraft. The program was officially designated Gemini on January 3, 1962. It was named after the third constellation of the zodiac, featuring the twin stars Castor and Pollux. The program was operationally completed with the Gemini XII flight.

MUELLER

SCHNEIDER



GILRUTH

MATHEWS

The Gemini program was managed by the Manned Spacecraft Center, Houston, Texas, under direction of the Office of Manned Space Flight, NASA Headquarters, Washington, D.C. Dr. George E. Mueller, Associate Administrator of NASA for Manned Space Flight, served as acting director of the Gemini program. William C. Schneider, Deputy Director of the Office of Manned Space Flight for Mission Operations, served as Mission Director on all Gemini flights beginning with Gemini V.

The Manned Spacecraft Center Gemini effort was headed by Dr. Robert R. Gilruth, director of the Center, and Charles W. Mathews, Gemini Program Manager.

PROGRAM OBJECTIVES

The Gemini Program was conceived after it became evident to NASA officials that an intermediate step was required between Project Mercury and the Apollo Program. The major objectives assigned to Gemini were:

- To subject two men and supporting equipment to long duration flights—a requirement for projected later trips to the moon or deeper space.
- To effect rendezvous and docking with other orbiting vehicles, and to maneuver the docked vehicles in space, using the propulsion system of the target vehicle for such maneuvers.
- To perfect methods of reentry and landing the spacecraft at a pre-selected land-landing point.
- To gain additional information concerning the effects of weightlessness on crew members and to record the physiological reactions of crew members during long duration flights.

A brief summary of each of the Gemini flights follows. A study of the flight results reveals how successful the Gemini Program has been. All of the major objectives have been met as well as many other objectives assigned to each mission, with the exception of land landing which was canceled from the Gemini Program in 1964. However, the precision control necessary to achieve the land landing objective was demonstrated.

GEMINI I

The first Gemini flight, on April 8, 1964, was an unmanned flight with no recovery planned. Primary objectives of that mission were to check the overall dynamic loads on the structural shell spacecraft during the launch phase and to demonstrate the structural compatability of the spacecraft and the Gemini launch vehicle. The spacecraft was not separated from the second stage of the launch vehicle.

The spacecraft was placed in an elliptical orbit with a perigee of 86.6 miles and an apogee of 173 miles. The spacecraft entered the earth's atmosphere during its 64th orbit while over the South Atlantic, and burned up.

In addition to achieving all its major objectives, this flight served to demonstrate the performance of the tracking network, provided training for flight controllers, and demonstrated the operational capabilities of the prelaunch and launch facilities.

GEMINI II

Gemini II, the second and final unmanned flight in the Gemini Program, was a suborbital flight. It was launched from Cape Kennedy January 19, 1965, at 9:04 a.m., EST, and the flight was completed 18 minutes and 16 seconds later.

Gemini II had been scheduled for launch December 9, 1964. On that date the countdown reached zero and the stage one engines were ignited. The launch vehicle's Malfunction Detection System detected technical troubles due to a loss of hydraulic pressure and shut down the engines about one second later.

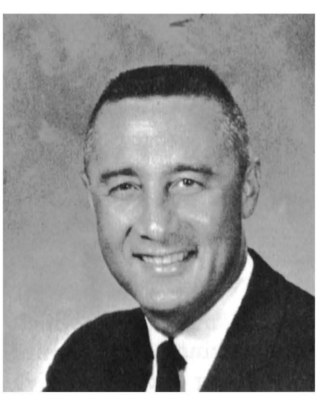
Primary objectives were to demonstrate the adequacy of the reentry module's heat protection equipment during a maximum reentry heating rate, to demonstrate the structural integrity and capability of the spacecraft from lift-off through recovery, and to demonstrate satisfactory performance of the spacecraft systems. Sequencers simulating crewmen were installed on seat pallets.

During the brief flight, Gemini II attained an altitude of 92.4 miles and traveled 1848 miles down-range. Recovery was effected by the aircraft carrier, USS *Lake Champlain* in the mid-Atlantic one hour and 48 minutes after lift-off. The Gemini II mission served as the final flight qualification of the total Gemini space vehicle prior to manned flights.

GEMINI III

The first manned flight of the Gemini Program was on March 23, 1965. Astronauts Virgil I. Grissom and John W. Young served as command pilot and pilot, respectively. It was a three-orbit mission.

Major objectives of the Gemini III mission were: to demonstrate manned orbital flight in the Gemini spacecraft, to demonstrate and evaluate the capability to maneuver the spacecraft, to demonstrate and evaluate the operation of the worldwide tracking network, to evaluate the performance of spacecraft systems, and to recover the spacecraft and evaluate the recovery system.



GRISSOM

YOUNG

Gemini III was launched at 9:24 a.m., EST, on a flight that was to continue four hours, 52 minutes, and 31 seconds. Highlights of the mission were:

• An orbital maneuver over Texas during the first orbit which changed the orbital path of a manned spacecraft for the first time.

• The forward and aft thrusters were fired in series of maneuvers to accomplish minute changes in the orbital path. This occurred over the Indian Ocean during the second orbit.

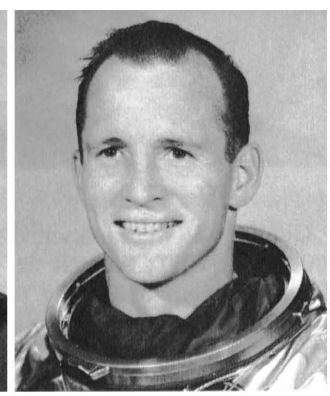
The maximum apogee during the flight was 121 miles, the lowest perigee, 87.5 miles. The spacecraft landed about 50 miles up-range from the predicted landing point at 2:16:31 p.m., EST. The crew was recovered at 3:28 p.m., and the spacecraft was picked up at 5:03 p.m. The prime recovery ship was the USS *Intrepid*.

GEMINI IV

The Gemini IV mission was a four-day flight during the period June 3-7, 1965. This was the first of three successive long duration missions during the Gemini Program. The flight crew—Astronauts James A. McDivitt and Edward H. White II—was the first American crew to open a spacecraft hatch and have one member participate in extravehicular activity.

The hatch was open for 36 minutes and White was outside the spacecraft for 20 minutes of that time.

MC DIVITT



WHITE

Major mission objectives were:

• To demonstrate and evaluate the performance of spacecraft systems for a period of approximately four days in space.

• To evaluate the effects of prolonged exposure to the space environment—a requirement in preparation for missions of longer duration.

• To demonstrate the feasibility of extravehicular activity.

• To execute 11 experiments.

During its flight Gemini VI attained a maximum apogee of 159.9 miles and a low perigee of 86.1 miles. Touchdown, in the western Atlantic, occurred after 97 hours, 56 minutes, and 12 seconds of flight at 12:12:12 p.m., EST, on June 7. The impact point was approximately 50 miles up-range from the prime recovery ship, the USS *Wasp*. The crew recovery was effected at 1:09 p.m., and the spacecraft was recovered at 2:28 p.m.

GEMINI V

During the period August 21-29, 1965, the Gemini V mission was flown. Astronaut L. Gordon Cooper, Jr., was the command pilot, and Astronaut Charles Conrad, Jr., served as pilot for that eight-day flight.

Major objectives of the Gemini V flight were: to demonstrate and evaluate performance of the Gemini spacecraft for a period of eight days; to evaluate the performance of the rendezvous guidance and navigation system, using the radar evaluation pod; and to evaluate the effects of prolonged exposure of the crew to the space environment. In addition, a total of 17 experiments were assigned to the flight. Gemini V also marked the first flight on which fuel cells were used to provide electrical power.

COOPER

CONRAD

Gemini V was launched from Cape Kennedy at 9:00 a.m., EST, August 21. During the early phases, the flight went according to plan but a rapid drop in pressure in the cryogenic storage tanks which supplied the fuel cells required that many of the planned activities be curtailed or abandoned.

Flight Director Christopher C. Kraft, Jr., decided to have Gemini V perform a rendezvous with a "Phantom Agena" target during the third day of the mission. Cooper and Conrad were instructed to perform four maneuvers during a period of two revolutions. These maneuvers were accomplished and ground tracking indicated that the simulated rendezvous maneuver would have placed the spacecraft within three-tenths of a mile of the target.

During the flight, Gemini V attained a maximum apogee of 188.9 miles and a low perigee of 87.4 miles. Following retrofire the Gemini V spacecraft touched down in the western Atlantic approximately 90 miles short of the predicted impact point. The touchdown time was 7:55:14 a.m., EST, August 29, following a flight which had lasted 190 hours, 55 minutes and 14 seconds. The crew was recovered at 9:26 a.m., and the spacecraft was picked up by the prime recovery ship, the USS *Lake Champlain,* at 11:50 a.m.

GEMINI VI

Gemini VI was scheduled for launch by NASA October 25, 1965. On that date the Gemini Agena Target Vehicle and the target launch vehicle lifted off from the launch pad at 10:00:04 a.m., EST.

At that time the Gemini VI spacecraft was being readied for launch and the flight crew, Astronauts Walter M. Schirra, Jr., and Thomas P. Stafford, were inside the spacecraft and participating in the countdown.

Six minutes and 16 seconds after lift-off a propulsion failure and subsequent breakup of the target vehicle occurred. The flight of Gemini VI was postponed and later re-scheduled to fly during the time Gemini VII was in space.

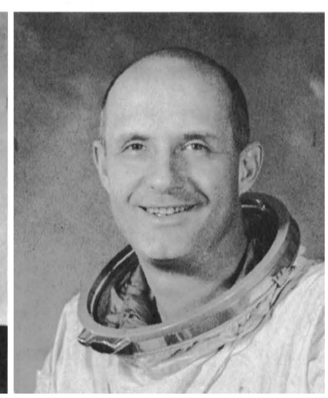
GEMINI VI-A

On December 15, 1965, Gemini VI-A was launched from Cape Kennedy at 8:37:26 a.m., EST. Command pilot Schirra and Pilot Stafford had as their primary objective a rendezvous with the Gemini VII spacecraft during the fourth revolution of their flight.

Other objectives were to conduct station keeping exercises with Gemini VII, to evaluate the reentry guidance capability of the spacecraft and to conduct a limited number of experiments.

Three days earlier, Schirra and Stafford had been ready and waiting in their spacecraft. The countdown had proceeded uninterrupted toward the scheduled ignition and the subsequent liftoff at 9:54:06 a.m. Ignition occurred on time but the engines were automatically shut down 1.2 seconds later. Schirra and Stafford correctly assessed the situation and determined it was safe to remain in the spacecraft. It was later determined that a small electric plug in the tail of the launch vehicle had dropped out prematurely, and that a plastic dust cover had obstructed the oxidizer inlet line of a gas generator. Either of these would have prevented liftoff.

SCHIRRA



STAFFORD

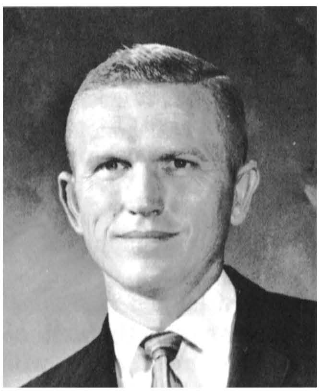
Schirra completed a number of maneuvers which resulted in Gemini VI-A rendezvousing with Gemini VII and performing station keeping exercises five hours and 56 minutes after lift-off. During the station keeping period which lasted five hours, 18 minutes, and 29 seconds the two spacecraft were maneuvered so that less than a foot separated them. The highest apogee reached was 168.1 miles, lowest perigee, 86.9 miles.

Gemini VI-A touched down in the western Atlantic 25 hours, 51 minutes, and 24 seconds after its launch. The impact point was within seven miles of the planned landing point. Schirra and Stafford elected to remain with the spacecraft until it was picked up by the USS *Wasp*, the prime recovery ship. The pick-up time was at 11:32 a.m., EST.

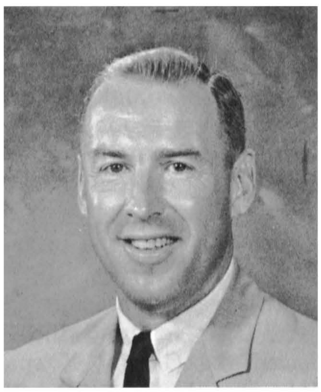
GEMINI VII

Astronauts Frank Borman and James A. Lovell, Jr., were command pilot and pilot, respectively of Gemini VII, longest manned space flight in history through the close of the Gemini Program.

Gemini VII, a 14-day mission, was primarily designed to conduct long duration flight and to evaluate the effects on the crew. In addition, they provided a target for Gemini VI-A, conducted station keeping



BORMAN



LOVELL

with the spacecraft, conducted 20 experiments, conducted the mission in lightweight pressure suits, and evaluated the spacecraft reentry guidance capability.

Gemini VII was launched from Cape Kennedy at 2:30:03 p.m., EST, December 4, 1965, and touched down in the western Atlantic recovery zone, just 6.4 miles from the planned landing point at 9:05:34 a.m., EST, on December 18, after a flight which had lasted 330 hours, 35 minutes, and one second. The USS *Wasp* recovered the second crew of Gemini astronauts within a three-day period. Borman and Lovell went aboard the *Wasp* in a helicopter at 9:37 a.m., and their spacecraft was taken aboard at 10:08 a.m.

During the flight, Gemini VII attained a maximum apogee of 177.1 miles and a low perigee of 87.2 miles.

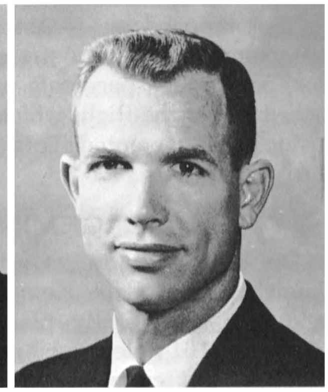
Lovell removed his pressure suit on the second day and from that time until the end of the flight either one or both of the crewmen were out of their suits most of the time. The total elapsed time of the flight was about twice that anticipated necessary for a lunar landing mission.

GEMINI VIII

Gemini VIII was launched from Cape Kennedy March 16, 1966. Neil A. Armstrong was command pilot and David R. Scott, pilot, of the flight which established several records prior to its early termination.

The Gemini VIII Agena target vehicle was launched from the Cape at 10:00:04 a.m., EST. This launch was followed by that of Gemini VIII at 11:41:02 a.m., as scheduled.

ARMSTRONG



SCOTT

Six hours after lift-off the rendezvous of a spacecraft and an unmanned target vehicle had been effected for the first time. This was followed shortly by the first docking of two vehicles in space. The elapsed flight time of this historic event was six hours, 33 minutes, and 22 seconds after the Gemini VIII lift-off.

Approximately 27 minutes after docking, the spacecraft-target vehicle combination encountered greater than expected yaw and roll rates. They attempted to bring the vehicles under control by giving various commands to the Agena. When it became evident this action would not be effective, Armstrong and Scott suspected some part of the spacecraft control system might be involved.

The rates increased to a point where the crew felt the structural integrity of the combination might be in jeopardy, and they then succeeded in reducing the rates to a point where they could safely undock from the target and back away as quickly as possible.

After completing this maneuver it was evident that the spacecraft's attitude control system had caused the problem. Roll and yaw rates of the spacecraft rapidly increased to such an extent that it was making almost one full revolution per second. The roll was brought under control by deactivating the orbital attitude maneuver system and by activating the reentry control system.

Flight Director John D. Hodge assessed the situation, and ordered the mission terminated during the seventh revolution. This required a landing in a secondary recovery area in the Pacific. Gemini VIII touched down in the western Pacific, east of Okinawa, after an elapsed flight time of 10 hours, 41 minutes, and 26 seconds. Touchdown was about 1.1 miles south of the planned landing area at 10:22:28 p.m., EST. The crew was picked up by the USS *Mason*, a destroyer, at 1:28 a.m., EST, March 17, and the spacecraft was picked up an hour and nine minutes later.

GEMINI IX

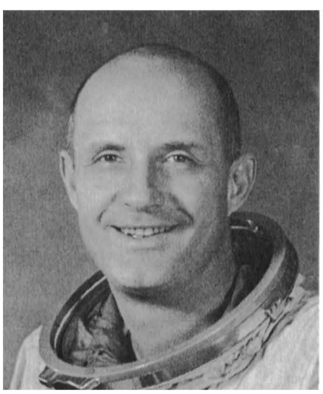
Gemini IX was scheduled to be another rendezvous mission. The Agena target was launched from Cape Kennedy May 17, 1966, at 10:15:03 a.m., EST. The target launch vehicle booster engine number two was lost two minutes and one second after lift-off and the Gemini IX mission was terminated.

The assigned crew—Astronaut Thomas P. Stafford, command pilot, and Astronaut Eugene A. Cernan, pilot—left their spacecraft and returned to a training schedule for the flight which was scheduled for June 1, using an Augmented Target Docking Adapter as the target vehicle.

GEMINI IX-A

On June 1, the target vehicle for Gemini IX-A was launched from Cape Kennedy at 10:00:04 a.m., EST, and was successfully placed into an orbit with an apogee of 161 miles and a perigee of 159 miles.

The flight crew was in the spacecraft and participated in the countdown. Stafford and Cernan were ready to go and then, there was a hold initiated at T minus one minute and 40 seconds. The count was recycled to T minus three minutes. Launch Control announced that the guidance system update of the spacecraft computer could not be transferred from the ground equipment to the spacecraft. After two additional holds for the same cause, Mission Director William Schneider postponed the launch attempt and rescheduled it for June 3.



STAFFORD

CERNAN

That day, the countdown went smoothly and Gemini IX-A was launched at 8:39:33 a.m., EST. Major objectives of the mission were to rendezvous with the target during the third revolution, to re-rendezvous during the fourth revolution, to rendezvous from above during the 12th revolution, to conduct extravehicular activities, to demonstrate a controlled reentry, and to conduct docking practice. All of these objectives except the last were achieved.

Gemini IX-A rendezvoused with the ATDA four hours and 15 minutes after lift-off and performed station keeping activities 46 minutes. Stafford and Cernan re-rendezvoused with the target after six hours and 36 minutes of the mission had elapsed. This time the period of station keeping lasted 39 minutes.

The third rendezvous (from above) was the most difficult to achieve because of the terrain in the background. This rendezvous was accomplished after 21 hours and 42 minutes of flight and the station keeping period lasted one hour and 17 minutes.

The hatch was open for extravehicular activity 49 hours and 23 minutes after lift-off and the hatch was closed again after 51 hours and 30 minutes—a total extravehicular time of two hours and seven minutes.

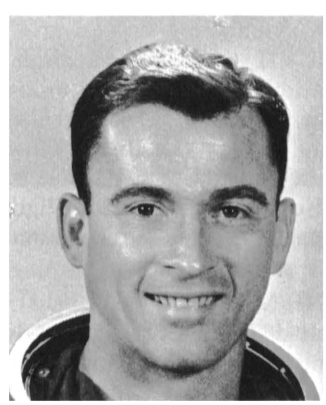
The Gemini IX-A spacecraft touched down in the western Atlantic 72 hours, 20 minutes, and 50 seconds after lift-off at 9:00:33 a.m., EST, June 6. It landed an estimated .38 miles west of the planned landing point. During the flight Gemini IX-A reached a high apogee of 168.2 miles, a low perigee of 85.7 miles. The crew and spacecraft were recovered by the USS *Wasp* at 9:53 a.m.

GEMINI X

Astronauts John W. Young and Michael Collins were command pilot and pilot, respectively, for the Gemini X mission. The flight was conducted July 18-21, 1966. The major objectives of the flight were: to rendezvous and dock with an Agena target vehicle, to use large propulsion systems in space, to conduct extravehicular activities, and to conduct docking practice. These objectives, with the exception of the last, were achieved.

On July 18, the Agena target was launched at 3:39:46 p.m., EST.

This was followed by the Gemini launch at 5:20:27 p.m. This followed the flight plan exactly and allowed the Gemini X spacecraft to rendezvous with its target five hours and 21 minutes later. The docking of the two craft was accomplished 31 minutes later and the two vehicles operated in the docked configuration for 38 hours and 47 minutes. During this period of time they performed six major maneuvers, three of which used the Agena's primary propulsion system and three which used the Agena's secondary propulsion system. The first of the major maneuvers placed the Gemini X-Agena X in an elliptical orbit with an apogee of 412.2 miles and a perigee of 158.5 miles. During the docked period, the Gemini X crew participated in the first of two major extravehicular activities. This occurred after 23 hours and 24 minutes



YOUNG

COLLINS

of the flight had elapsed. The hatch was open 49 minutes during which time Collins performed tasks assigned to that phase of the mission. The standing EVA was terminated when both crew members experienced eye irritation.

The second EVA period started 48 hours and 41 minutes after lift-off. This was an umbilical EVA activity with Collins emerging from the spacecraft and lasted 39 minutes. During this time Collins retrieved an experiment package which had been attached to the Agena VIII since March.

The crew un-docked from the Agena X target after 44 hours and 40 minutes of flight and prepared to rendezvous with the Agena VIII target vehicle which had been in a parking orbit since March 16.

The highest apogee reached during the flight was 412.2 miles and the lowest perigee, 86.3 miles. The Gemini X spacecraft touched down in the Atlantic at 4:07:06 p.m., EST, July 21, at an estimated 3.4 miles from the planned impact point. The crew chose to be recovered by helicopter and they were landed aboard the USS *Guadalcanal* 27 minutes after landing. Another 27 minutes passed before the *Guadalcanal* picked up the Gemini X spacecraft.

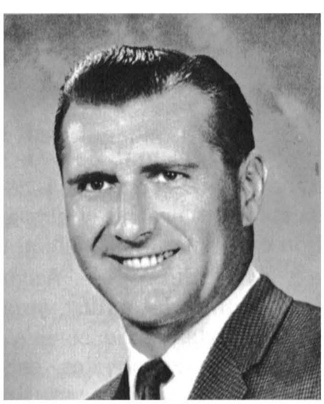
GEMINI XI

Astronauts Charles Conrad, Jr., and Richard F. Gordon, Jr., served as command pilot and pilot, respectively, of the Gemini XI mission which was conducted September 12-15, 1966. The Atlas-Agena was launched at 8:05:02 a.m., and at 9:42:26.5 a.m. the Gemini liftoff occurred.

Gemini XI had an ambitious flight plan and most of the mission objectives were achieved. One of the most important accomplishments of the flight was the successful rendezvous and docking with the Agena target vehicle during the spacecraft's first revolution.

Another important achievement of the Gemini XI mission was that of attaining the highest altitude ever reached in a manned flight. During the second day of the mission, and while docked with the Agena, the Agena's primary propulsion system was fired up and boosted the combined vehicles into an elliptical orbit with an apogee of 742.1 miles and a perigee of 156.3 miles.


CONRAD


GORDON

Gordon completed fastening the tether to the spacecraft's docking bar during his umbilical EVA at the expense of a great amount of energy and the crew decided to terminate that activity because of pilot fatigue. The hatch was open 33 minutes.

Shortly after the third day of the flight was started, the Gemini XI crew racked up another first. They undocked from the Agena and started a successful tethered operation. The two spacecraft made about two revolutions around the earth while fastened together.

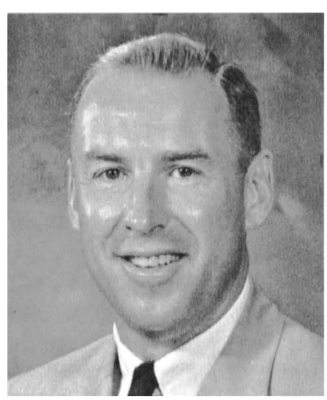
There were other notable achievements of the Gemini XI flight. For the first time in manned space flight history the rendezvous was accomplished by using onboard computations. Docking practice was carried out for the first time in space as both the command pilot and the pilot performed the docking maneuvers twice.

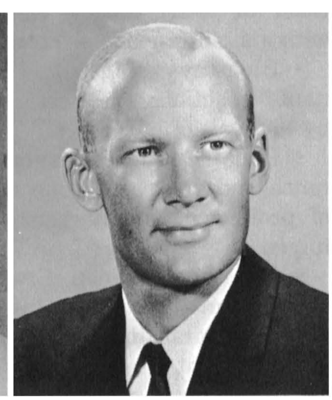
Another important first—the automatic reentry—was attempted for the first time in the Gemini program. Retrofire occurred over the Canton Island tracking station at an elapsed time of 70 hours, 41 minutes, and 36 seconds. The impact was achieved about 35 minutes later, approximately one-and-a-half miles from the prime recovery ship, the USS *Guam*. Conrad and Gordon were taken to the *Guam* by helicopter 24 minutes after they landed, and the spacecraft was retrieved 59 minutes after landing.

GEMINI XII

The final flight of the Gemini Program began November 11, 1966, and ended four days later. On launch day the Atlas-Agena liftoff occurred at 2:07:59 p.m., one second earlier than planned. This launch was followed by the Gemini liftoff at 3:46:30 p.m., within a half-second of the planned time.

Gemini XII was designed to gain additional information about the extravehicular activity requirements, to rendezvous and dock with a target, and to perform a number of experiments. The final Gemini flight was an unqualified success.


LOVELL


ALDRIN

In addition to achieving these and other objectives command pilot James A. Lovell, Jr., and pilot Edwin E. Aldrin, Jr., set several individual space records. Lovell has logged more hours in space flight than any other man—425 hours, ten minutes, and two seconds.

Aldrin logged more extravehicular time than any man —a two hour, 27-minute standup EVA; a two hour and eight-minute umbilical EVA; and another 51-minute standup EVA for a total of five hours and 26 minutes.

A total of 14 experiments were performed. These activities were spread over the four day flight period.

Use of handrails, foot restraints, and waist tethers during the umbilical EVA period proved to be most effective and Aldrin completed all 19 assigned tasks.

Retrofire was initiated over Canton Island at 93 hours, 59 minutes, and 58 seconds elapsed time. The landing occurred 34 minutes and 33 seconds later at 2:21:04 p.m. within 3.8 miles of the planned landing point. The flotation collar was attached eight minutes after impact and Lovell and Aldrin were picked up by helicopter and taken to the deck of the USS *Wasp* 30 minutes after they had landed. The last Gemini spacecraft to fly in the program was brought aboard the *Wasp* one hour and seven minutes after splashdown.

EXPERIMENTS

There were a total of 51 experiments scheduled for investigation during the Gemini Program. Many of these experiments were carried on more than one flight and most of them were completed. Results of the experiments will be published in later documents.

Following are a list of the experiments and the basic objectives of each:

• Cardiovascular Conditioning—to determine the effectiveness of pneumatic cuffs as a preventative measure for the heart and blood distribution system deterioration induced by prolonged weightlessness, and to establish the occurrence and degree of heart and blood distribution system deterioration induced by prolonged weightlessness.

• In-Flight Exerciser—to assess the capacity of an astronaut to perform a measured amount of work in the space environment.

• In-Flight Phonocardiogram—to serve as an indicator of heart muscle deterioration when compared with a simultaneous electrocardiogram.

• Bioassays of Body Fluids—to determine astronauts' reactions to stress requirements of space flight by analysis of hormones.

• Bone Demineralization—to establish the occurrence and degree of bone demineralization as a result of prolonged weightlessness by a direct X-rays technique.

• Calcium Balance Study—to establish the rate and amount of calcium lost to the body under conditions of orbital flight.

• In-Flight Sleep Analysis—to assess the state of alertness, level of consciousness, and depth of sleep of astronauts in-flight.

• Human Otolith Function—to measure changes in the otolith (gravity sensors in inner ear) function and to determine astronauts' orientation capability under dark conditions during prolonged weightlessness.

• Electrostatic Charge—to detect and measure any accumulated electrostatic charge that may be created on the spacecraft surface by ionization from engine exhausts.

• Proton Electron Spectrometer—to measure the radiation immediately outside the spacecraft while in orbit.

• Tri-Axis Magnetometer—to monitor the direction and amplitude of the earth's magnetic field with respect to the spacecraft.

• Basic Object Photography—to investigate technical problem areas associated with man's ability to observe, evaluate, and photograph objects in space.

• Nearby Object Photography—to demonstrate human proficiency and spacecraft functional compatability in space while maneuvering, station keeping and observing in a manual control mode.

• Mass Determination—to investigate the feasibility of a direct contact method of determining the mass of an orbiting vehicle.

• Celestial Radiometry—to provide information on the spectral analysis of regions of interest, supplied by the star fields, the principal planets, the earth and the moon.

• Surface Photography—to investigate problems associated with man's ability to acquire, track, and photograph terrestrial objects.

• Space Object Radiometry—to measure the radiometric intensity of space objects such as the Agena target vehicle.

• Radiation in Spacecraft—to make accurate measurements of absorbed dose rate and total dose inside the spacecraft, to evaluate dosimeters of radiation in space, and to study the distribution of dose levels inside the astronaut and inside the spacecraft.

• Simple Navigation—to develop and test sighting procedures for development of an on-board, manual navigation system, and to obtain information on the accuracies of horizon determination, use of a green line as horizon, and astronaut experience in sighting.

• Astronaut Visibility—to measure the ability of astronauts to identify ground objects under controlled conditions.

• Zodiacal Light Photography—to obtain color photographs of the zodiacal light (a cloudy, hazy, misty light seen in the west after twilight and in the east before dawn) and the airglow (a faint background illumination of the night sky).

• Sea Urchin Egg Growth—to evaluate the effects of zero-G orbital environment on the growth of simple cells.

Radiation and Zero-G Effects on Blood—to determine whether or not a combined action relationship exists between the effects of weightlessness and radiation on human white blood cells.

• Synoptic (Wide Angle) Terrain Photography—to obtain high-quality, small scale photographs of selected parts of the earth's surface for use in research in geology, geophysics, geography, oceanography, and other fields, and for use in planning photography for future space programs.

• Synoptic (Wide Angle) Weather Photography—to learn about the earth's weather systems as revealed by the detail possible from high-quality cloud photographs made selectively.

• Cloud Top Spectrometer—to obtain quantitative information on atmospheric oxygen absorption in support of a method under development for determining cloud top altitudes from meteorological satellites.

• Visual Acuity—to investigate the limiting visual performance of the astronauts in the detection and recognition of objects on the earth's surface with and without the assistance of a magnifying device.

• Nuclear Emulsion—to perform a qualitative study of the heavy particles in the galactic cosmic radiation, and to study the trapped proton flux of the Van Allen belts in the vicinity of South America.

• Airglow Horizon Photography—to study the spectra of the airglow on a global scale.

• Micrometeorite Collection—to collect micrometeorites to study the physical and chemical nature of interplanetary dust in its primary form.

• Night Image Intensification—to test the usefulness and performance of a low-light-level television system as a supplement to unaided vision in observing surface features primarily when such features are in darkness and spacecraft pilots are not dark-adapted.

• Ultraviolet Astronomical Camera—to test the techniques of ultraviolet photography under vacuum conditons and to obtain ultraviolet radiation observations of stars in the wave length region of 2000 to 4000 Angstroms by spectral means.

• Ion Wake Measurement—to determine and measure the ion and electron wake structure and perturbation of the ambient medium produced by an orbiting vehicle.

Dim Light Photography/Orthicon—to obtain photographs of various faint and diffuse astronomical phenomena such as airglow layer in profile, brightest Milky Way, zodiacal light at 60-degree elongation, counterglow, and the LaGrangian libration points of the earth-moon system.

• Reentry Communications—to determine whether injection of water into the plasma sheath during the reentry blackout would permit communications to be continued during that period.

• Two-Color Earth's Limb Photography—to photograph the earth's limb on black and white film with a hand-held camera using red and blue filters in order to determine whether the high altitude blue limb is a reliable sighting feature for use in spaceflight guidance and navigation.

• Frog Egg Growth—to determine the effect of weightlessness on the ability of the fertilized frog egg to divide normally and to differentiate and form a normal embryo.

• Astronaut Maneuvering Unit—one approach to determine the basic hardware and operational criteria required to integrate into manned space flight such activities as maintenance, repair, resupply, crew transfer, rescue, satellite inspection, and assembly in space.

• UHF/VHF Polarization Measurements—to measure the electron content of the ionosphere below the spacecraft and in particular the electron content in homogeneities which exist along the orbital path of the spacecraft.

• Agena Micrometeorite Collection—to study the micrometeorite content of the upper atmosphere and near-earth space environment.

• Ion-Sensing Attitude Control—to investigate the feasibility of an attitude control system using environmental positive ions and an electrostatic detection system to measure pitch and yaw.

• Beta Spectrometer—to determine the radiation environment external to the spacecraft.

• Bremsstrahlung Spectrometer—to determine the Bremsstrahlung flux-energy spectra inside the Gemini spacecraft while passing through the South Atlantic Magnetic Anamoly regions.

• Color Patch Photography—to determine if existing photographic materials can accurately reproduce the color of objects photographed in space.

• Landmark Contrast Measurements—to measure the visual contrast of landmarks against their surroundings in order to determine the relative visibility of terrestrial landmarks from outside the atmosphere.

• Star Occultation Navigation—to determine the usefulness of star occultation measurements for space navigation and to establish a density profile for updating atmospheric models for horizon-based measurement systems.

• Optical Communications—to evaluate an optical communications system, to evaluate the crew as a pointing element, and to probe the atmosphere using an optical coherent radiator outside the atmosphere.

• Libration Regions Photographs—to obtain photographs of libration points on the moon to investigate the possible existence of clouds of particles orbiting the earth in these regions.

• Sodium Vapor Cloud—to study the feasibility of orbital photography of a sodium vapor cloud.

• Manual Navigation Sightings—to determine the feasibility of using an onboard sextant for accurate spacecraft navigation.

• Lunar UV Spectral Reflectance—to determine the ultraviolet spectral reflectance of the lunar surface in wave lengths from 2000 to 3200 Angstroms.

REFERENCE

Ivan D. Ertel, MSC Assistant Historian, authored the MSC Fact Sheet 291 Gemini Program Series. Sources used in preparing this work included the flight mission reports, flight plans, press kits, air-ground transcripts, mission commentaries, change-of-shift briefings, prelaunch and postlaunch briefings, the post-recovery and astronaut news conferences.

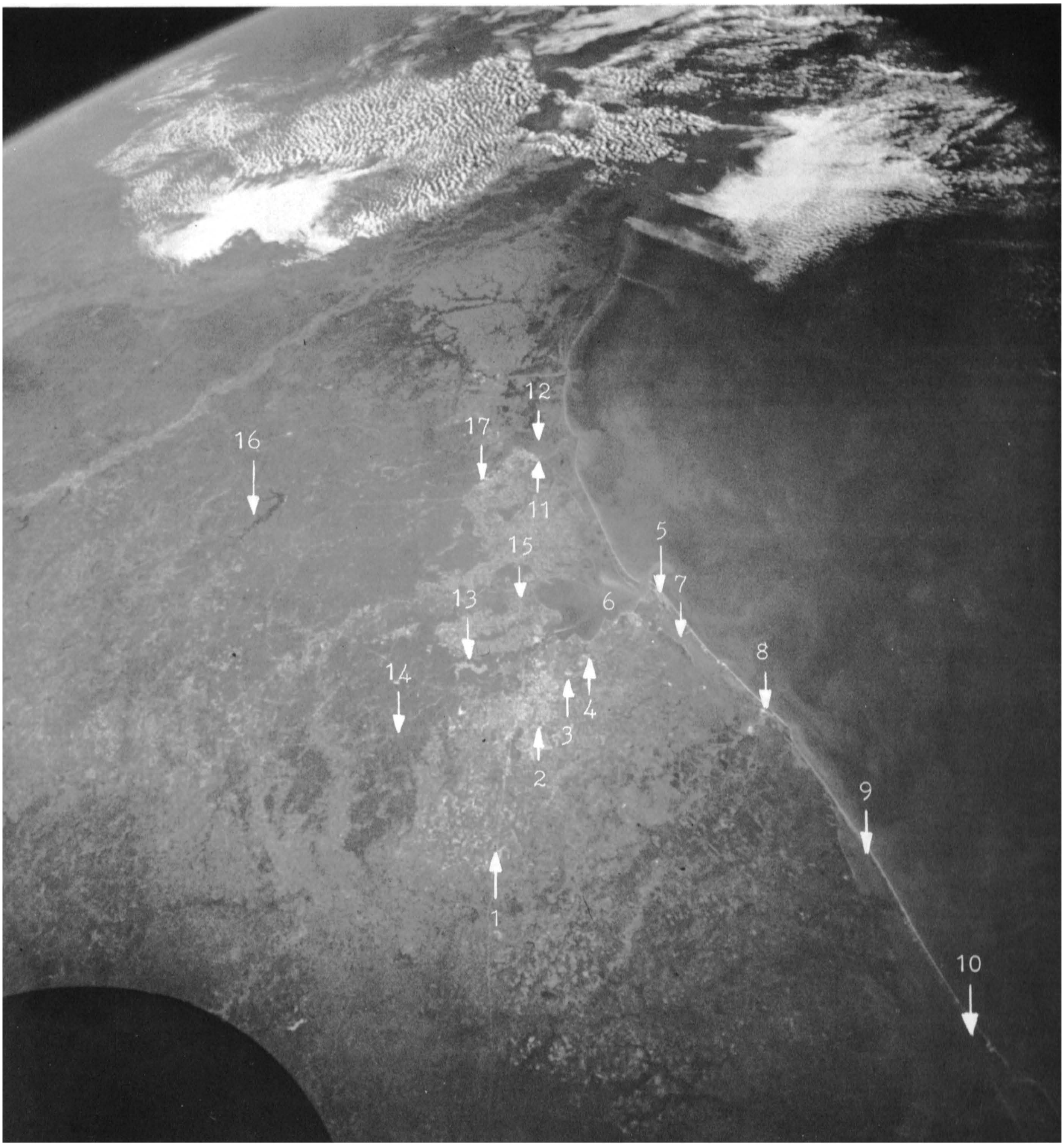
This series of fact sheets has been checked for technical accuracy by Kenneth S. Kleinknecht, Deputy Gemini Program Manager; and Scott H. Simpkinson, Manager of the Gemini Office of Test Operations and Chief of the Test Evaluation Team.

GEMINI EXPERIMENT RECORD

Experiment Flight	III	IV	V	VI-A	VII	VIII	IX-A	X	XI	XII
Cardiovascular Conditioning			X		X					
In-Flight Exerciser		X	X		X					
In-Flight Phonocardiogram		X	X		X					
Bioassays Body Fluids					X	X	X			
Bone Demineralization		X	X		X					
Calcium Balance Study					X					
In-Flight Sleep Analysis					X					
Human Otolith Function			X		X					
Electrostatic Charge		X	X							
Proton Electron Spectrometer		X			X					
Tri-Axis Magnetometer		X			X			X		X
Beta Spectrometer								X		X
Bremsstrahlung Spectrometer								X		X
Color Patch Photography									X	
Two-Color Earth's Limb Photography		X								
Reentry Communication	X									
Basic Object Photography			X							
Celestial Radiometry			X		X					
Star Occultation Navigation					X			X		
Surface Photography			X							
Space Object Radiometry			X		X					
Radiation in Spacecraft		X		X						
Simple Navigation		X			X					
Ion-Sensing Attitude Control								X		X
Astronaut Visibility			X		X					
UHF-VHF Polarization							X			
Zodiacal Light Photography			X				X	X		
Frog Egg Growth						X				X
Radiation and Zero-G on Blood	X								X	
Synoptic Terrain Photography		X	X	X	X			X	X	X
Synoptic Weather Photography		X	X	X	X			X	X	X
Cloud Top Spectrometer			X							
Visual Acuity			X		X					
Agena Micrometeorite Collection							X	X		
Airglow Horizon Photography							X		X	X
Micrometeorite Collection							X	X		X
UV Astronomical Camera								X	X	X
Ion Wake Measurement								X	X	
Sea Urchin Egg Growth	X									
Nearby Object Photography			X							
Optical Communications (Laser)					X					
Landmark Contrast Measurement					X			X		
Mass Determination									X	
Nuclear Emulsion									X	
Night Image Intensification									X	
Dim Light Photography/Orthicon									X	
Lunar UV Spectral Reflectance										X
Astronaut Maneuvering Unit							X			
Libration Regions Photography										X
Sodium Vapor Cloud										X
Manual Navigation Sightings										X

ONE OF THE MAJOR ACCOMPLISHMENTS OF THE Gemini Program was rendezvous. The photo above shows the enthusiasm generated in Mission Control Center at Houston following the first successful rendezvous in history — that of Gemini VI-A and Gemini VII. Small American flags were "raised" above all the Control Center consoles to mark the historic achievement.

GEMINI FLIGHTS WERE first specifically identified by name, later by distinctive patches. Gemini III had a code name, "Molly Brown," and Gemini IV was unofficially referred to as "Little EVA," because of the extravehicular activity. From that point in the program forward, each crew had a patch. Those patches are shown above, including the Gemini XII patch as it is sewn on a suit.



IT SEEMS APROPOS THAT excellent photography of the Houston area should have been obtained on the final Gemini flight since mission control of all flights was exercised from that location starting with Gemini IV. Points of interest in the photo above are: (1) Interstate Highway 10, (2) the Astrodome, (3) Gulf Freeway, (4) Manned Spacecraft Center, (5) Galveston, (6) Galveston Bay, (7) West Bay, (8) Freeport, (9) Matagorda Bay, (10) West Matagorda Bay, (11) Port Arthur, (12) Sabine Lake, (13) Lake Houston, (14) Interstate Highway 45, (15) Interstate Highway 10, (16) Sam Rayburn Reservoir, and (17) Beaumont.