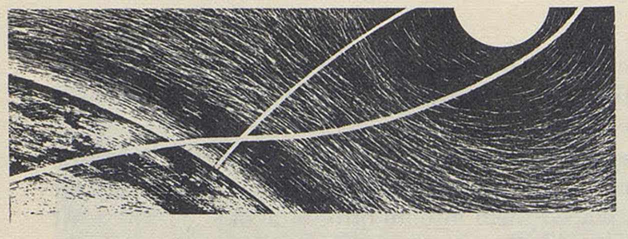


MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FACT SHEET 291-E
APRIL 1966

GEMINI VIII

RENDEZVOUS AND DOCKING MISSION

The eventful eighth flight of the Gemini program carried out by the National Aeronautics and Space Administration on March 16, 1966, resulted in a number of significant achievements:

- The first docking of two vehicles in space
- The second successful rendezvous of two spacecraft in orbital flight
- The first rendezvous of a manned spacecraft with an unmanned target vehicle
- The first successful flight of the Agena as a target vehicle
- The successful retrieval of the spacecraft and astronauts in a planned secondary landing area—required for the first time in U. S. space history
- The first successful simultaneous countdown and launch of two vehicles on the same day at the precise minute planned.

Astronauts Neil A. Armstrong and David R. Scott were the command pilot and pilot, respectively, for the Gemini VIII mission. Astronaut Charles Conrad, Jr., command pilot, and Astronaut Richard F. Gordon, Jr., pilot, served as the backup crew.

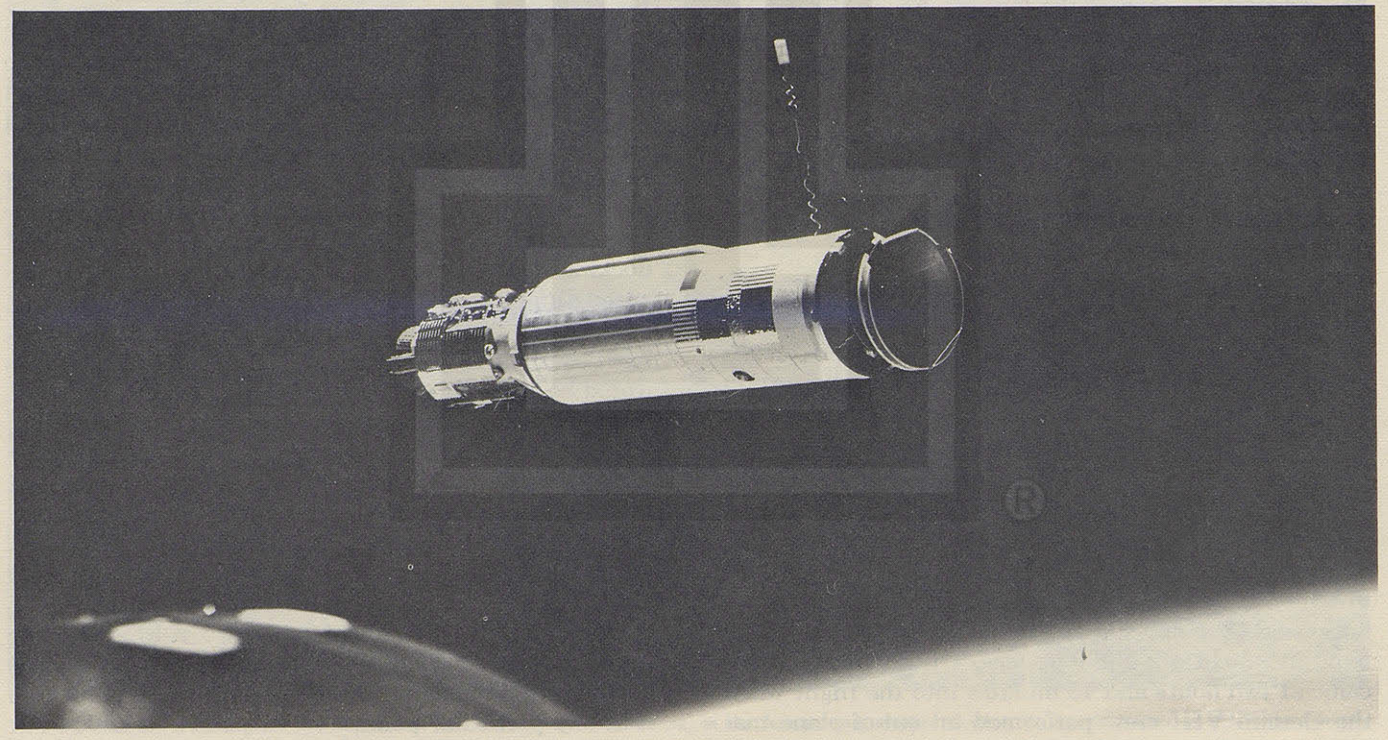
Scheduled to last approximately three days, it became necessary to terminate the Gemini VIII flight during the seventh orbit after the crew had encountered control difficulties about seven hours after liftoff.

The Gemini-Agena target vehicle was launched from Cape Kennedy at 10 a.m., EST, and the Gemini VIII spacecraft was launched precisely on time one hour and 41 minutes later. A previous simultaneous countdown for Gemini VI and its Agena target vehicle had been initiated on October 25, 1965, but the countdown terminated when the target vehicle was lost after about six minutes of flight.

The Gemini VIII flight had been planned for March 15 but was delayed one day because of minor difficulties which cropped up during the countdown in both the spacecraft and the Atlas launch vehicle.

Awakened at 7 a.m. on launch day, the flight crew shortly thereafter underwent their final physical examination and were pronounced fit. Then they had breakfast with several fellow astronauts.

Armstrong and Scott left Merritt Island crew quarters at 8:17 a.m. and proceeded to the suit trailer at launch complex 16. There they were briefed on the weather and the status of the countdown, and donned their Gemini suits. The Gemini extravehicular suit worn by Scott has seven layers. This type suit is used by each Gemini crew



THE AGENA TARGET VEHICLE, as it appeared to the Gemini VIII crew during the station keeping activity. The Agena was approximately 55 feet from the spacecraft at this time.

member to participate in extravehicular activity. It weighs 33 pounds.

Although the countdown on both the Atlas-Agena and the Gemini-Titan launch configurations was on schedule, a minor difficulty which was encountered had to be resolved. This difficulty was with a heater circuit which conditions the orbital attitude and maneuvering system in the spacecraft. A short circuit, resulting from a wire which had been cut by a spacecraft fairing, was discovered, the wire was replaced, and the heater condition was then acceptable.

Only minor difficulties presented a variety of troubles at the various Manned Space Flight Network sites. These problems were remedied to the extent that they posed no threat to proper support of the mission.

The astronauts entered their spacecraft at one hour and 55 minutes prior to liftoff and participated in the remainder of the countdown activities related to the spacecraft. Before this event the backup crew had spent about three hours in the spacecraft and had briefed Armstrong and Scott on the mission status.

Ignition of the Atlas engines occurred at 10 a.m., EST, with liftoff three seconds later as programmed. All major events of the Atlas-Agena powered flight phase were completed as planned and the waiting flight crew was kept advised. When told about the splendid performance of the Agena, Armstrong came back with an elated "very good" reply. Meanwhile the Gemini VIII countdown continued toward a "built-in" hold scheduled at ignition minus three minutes.

This hold had been scheduled in order to launch the Gemini spacecraft at the precise time for insertion into a nominal orbit for rendezvous during the fourth revolution. There was only a six-minute period during which to launch to achieve the rendezvous and docking at the desired time. Launch of the Gemini during this period would permit rendezvous during the fourth, fifth, or sixth revolution, depending upon the time of liftoff.

With the Agena in a near perfect circular orbit 161 nautical miles above the earth, Flight Director John D. Hodge ordered the countdown held for five minutes and 45 seconds at the three-minute mark. After the count was picked up, Gemini VIII was launched at 11:41:02, EST.

The initial elliptical orbit planned for the Gemini spacecraft was a perigee of 87 miles and an apogee of 146 nautical miles; actual values achieved were an 87-mile perigee and a 147-mile apogee. At orbital insertion the Gemini spacecraft was 1,050 miles behind its target.

During the first four revolutions Armstrong and Scott kept busy preparing for and performing the required maneuvers to effect the rendezvous.

One hour and 34 minutes after liftoff, several hundred miles south of New Orleans, they performed a maneuver to adjust the apogee of the spacecraft. Then, after two hours and 18 minutes, they executed a second maneuver to adjust the height of the perigee. The next adjustment came at two hours and 45 minutes into the flight when the Gemini VIII crew performed an out-of-plane maneuver to change their flight path about one-half a degree to match the flight path of the Agena. At this time they were at about a 375-mile slantrange behind and below their target.

After three hours and 47 minutes of their flight, the Gemini VIII crew performed a circularization maneuver which placed them into an orbit of about 147 miles. At this point in the mission they were an estimated 170 miles behind the Agena. Shortly afterwards the crew reported to the ground that they achieved a solid radar lock-on with the Agena at a range of 158 miles. Armstrong, in a later report to a ground station, said they sighted the Agena at a range of 76 miles when the ground elapsed time of the mission had reached four hours and 40 minutes.

Two other minor maneuvers were conducted, one at five hours and 13 minutes into the flight to initiate the terminal phase, the other at five hours and 45 minutes for the final terminal phase activity.

Six hours after liftoff Neil Armstrong informed the Hawaii tracking station that they were 150 feet from the Agena and were performing station-keeping activities. As he carefully maneuvered the spacecraft around the Agena, Armstrong described the target as "looking fine." He said the antennas were all in proper position and that the target docking adapter looked good and apparently "no worse for the wear" after its seven hours and 42 minutes in space.

Ten minutes later, over the eastern Pacific, data indicated that the two spacecraft were from 60 to 80 feet apart and that the spacecraft had matched the velocity of the Agena—25,365.9 feet per second. Armstrong cautiously closed in on the Agena and held the spacecraft steady in a docking position about two feet from the docking adapter until they were over the south Atlantic and in communication range with the Rose Knot tracking ship.

After they had compared notes, flight controller Keith K. Kundel on the Rose Knot gave Armstrong the okay to dock, and that historic event was accomplished six hours and 34 minutes after Gemini VIII had lifted off from Cape Kennedy. At the post flight news conference held in Houston, March 26, Armstrong estimated his closing speed for the docking at about three-quarter foot per second. The flight plan had called for the final docking maneuver to be accomplished with a relative speed differential of the two spacecraft of about one foot per second. The pilot had desired a closing speed of at least one-half foot per second to insure that all latches would be engaged and the link-up properly achieved.

After docking, Armstrong reported to the Rose Knot, saying, "It was a real smoothie." He then informed the flight controller that the Agena was very stable and that there were no noticeable oscillations.

Following the docking, the Gemini VIII crew performed a 90-degree yaw maneuver of the combined Gemini-Agena vehicle using the Agena control system. Later, during the news conference, Scott said that the maneuver took about 55 seconds. He added that it takes about 16 commands to yaw the Agena around and stop it at any particular point.

Approximately 27 minutes after docking, the space-

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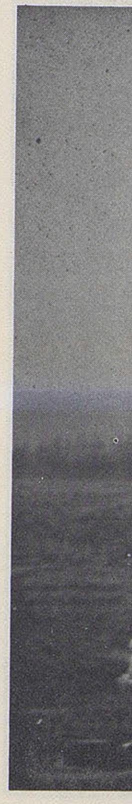
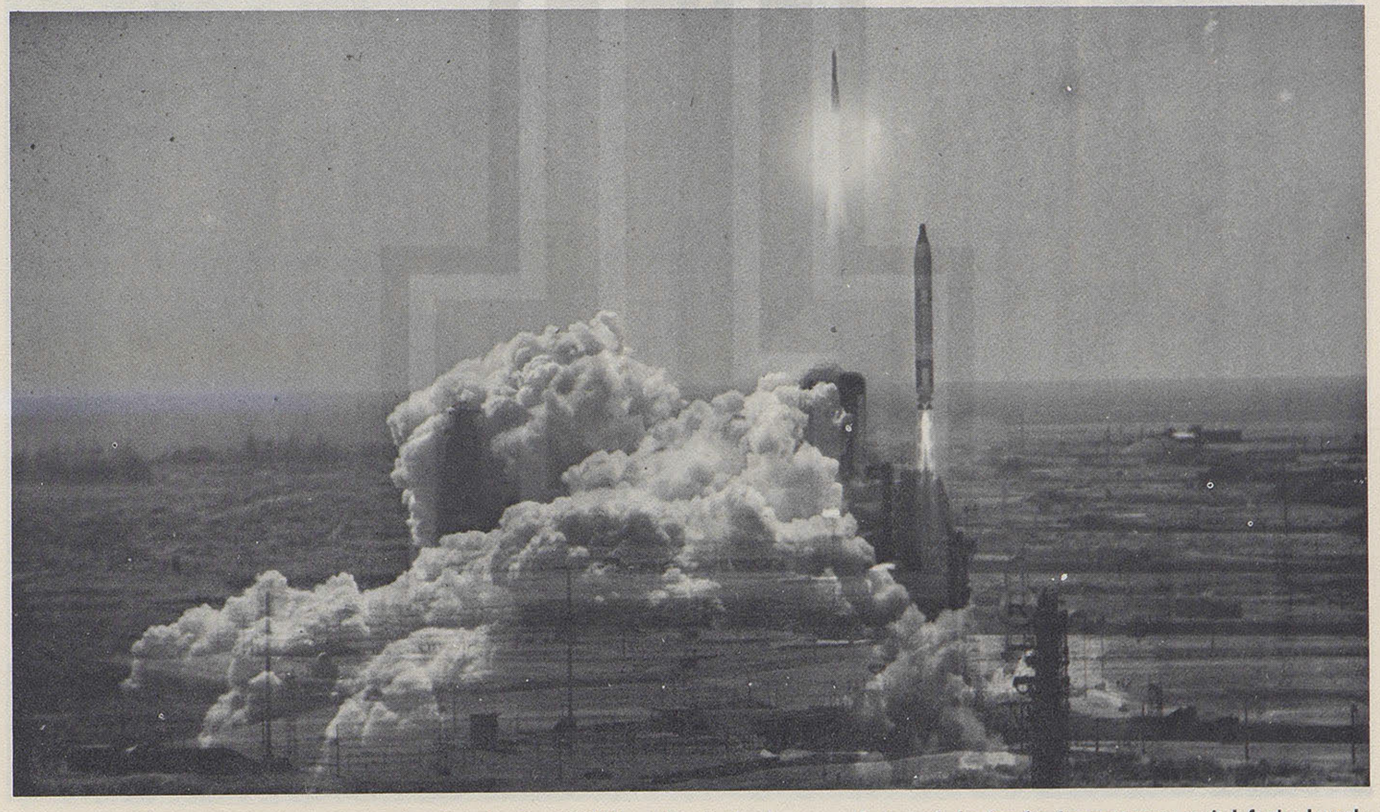


THIS DOUBLE
pad. The two

NASA OFFICIALS participated in the Mission Review Conference at Cape Kennedy prior to the Gemini VIII mission. Left to right, seated around the table, are Kenneth Nagler and Ernest Amman, U. S. Weather Bureau; Astronaut Neil Armstrong; Dr. George Mueller, Associate Administrator Office of Manned Space Flight, NASA Headquarters; Donald K. Slayton, Assistant Director of MSC for Flight Crew Operations; Dr. Charles Berry, Chief of Medical Programs, MSC; Astronaut David Scott; and George Low, Deputy Director of MSC. In the background are, left to right, Kenneth Kleinknecht, Deputy Manager, Gemini Program Office, MSC; and Leroy Day, Acting Deputy Director, Gemini Program, Office of Manned Space Flight, NASA Headquarters.



THIS DOUBLE EXPOSURE gives the impression that the Gemini VIII vehicle, in the foreground, started chasing its Agena target as it left the launch pad. The two launches occurred one hour and 41 minutes apart.

craft-target vehicle combination encountered greater than expected yaw and roll rates. The crew had not heard any thruster activity nor had they seen any reflection of thruster activity on the spacecraft. The crew assumed that some anomaly in the Agena control system had caused these rates. They activated the spacecraft orbital attitude control system and turned off the Agena control system.

They later said they spent about three minutes attempting to bring the combination under control and to reduce the rates by giving the Agena various commands. When it became obvious that this action would not be completely effective, they suspected that some part of the spacecraft control system might be involved. For about four minutes the rates were materially reduced and the crew proceeded to put the joined vehicles into the attitude they desired. Suddenly the rates increased to the point where the crew felt the structural integrity of the combination was in jeopardy.

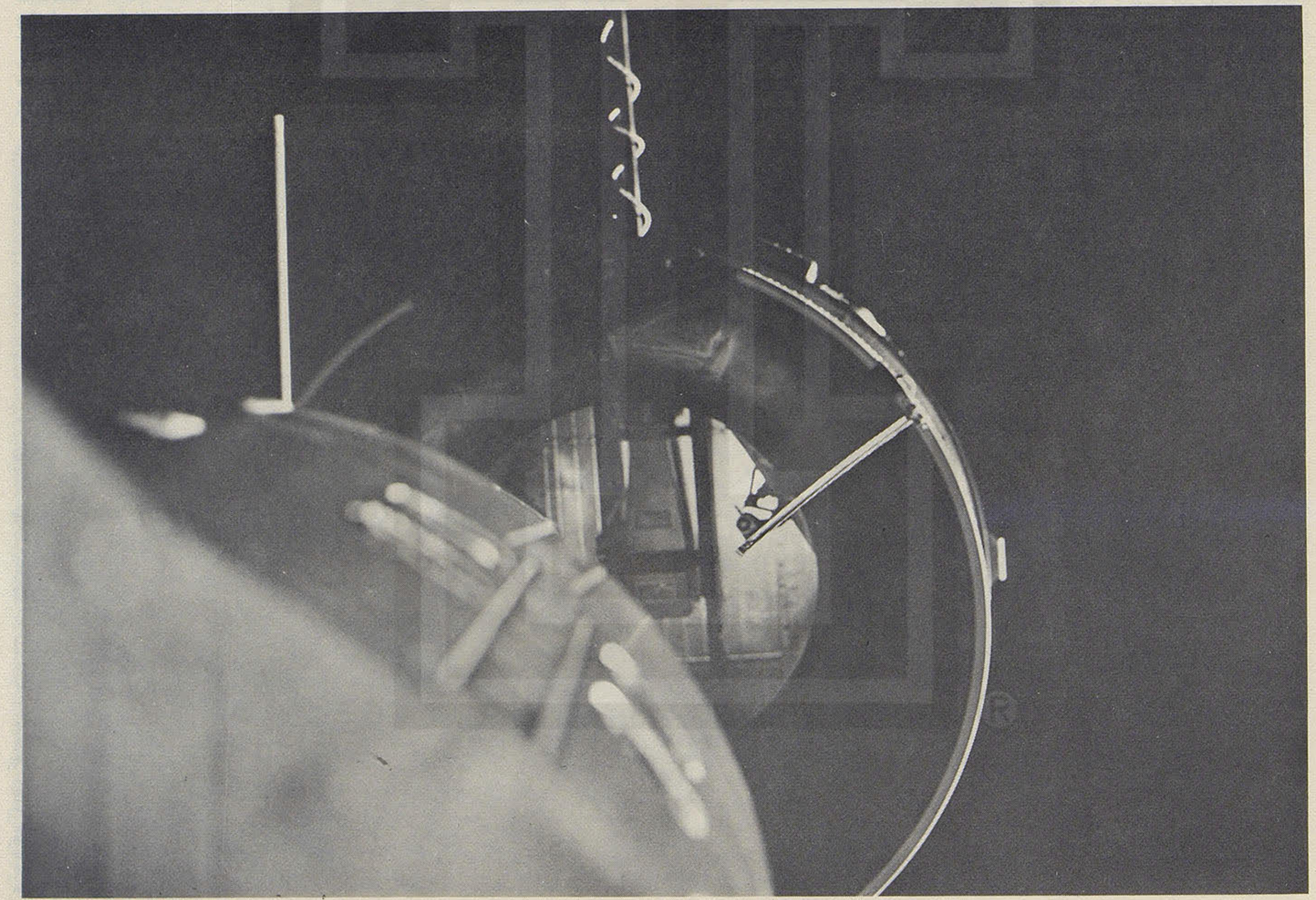
Attempting to identify the specific spacecraft control malfunction without success, the crew reduced the rates to a point where they felt they could safely undock and backed away as quickly as possible.

After completing this maneuver, it became quite evident that the spacecraft control system had caused the problem. Roll and yaw rates had now increased to such an extent that the spacecraft was making about one full revolution per second. For approximately three minutes they tried to isolate the problem, but found it necessary to activate the reentry control system to reduce the motion to acceptable rates and to regain control of the spacecraft.

NASA and McDonnell engineers immediately started an investigation to determine the cause of the anomaly. On the basis of data received from the spacecraft and the Agena, plus the pilots' report, they determined that the condition was caused by a short in the circuit to the yaw left thruster of the spacecraft orbital attitude and maneuver system which continued to thrust although this operation was not commanded.

Flight Director Hodge decided to terminate the mission during the seventh revolution when he learned that the crew had regained control of the spacecraft by using the reentry control system. This necessitated bringing the spacecraft down in a planned secondary area in the western Pacific about 500 miles east of Okinawa and about 630 miles south of Yokosuka, Japan. Weather support reported that sea conditions in this landing area were mild, with waves of three to five feet.

To implement this decision, the recovery forces commander immediately ordered the destroyer USS Mason and aircraft to converge on the area. The Mason was estimated to be about 160 miles away from the predicted landing point and would require from five to six



THE GEMINI SPACECRAFT is shown with its nose about two feet from the Agena target docking adapter just prior to accomplishing the first docking of two space vehicles in history.

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hours to arrive on the scene.

A C-54 airplane was dispatched from the Tachikawa Air Force Base in Japan and another C-54 proceeded to the area from Okinawa. In addition, the area recovery commander sent an HU16 amphibian aircraft to the scene.

Based on the flight events, retrofire was now scheduled to take place after 10 hours and four minutes into the flight, with the impact about 32 minutes later.

Retrofire took place over south central Africa and the spacecraft landed within seven miles of the target point. As the spacecraft parachuted to the ocean, an aircraft crew observed the event from a distance of about three miles. Impact occurred at 10:22 p.m., EST, and pararescuemen dropped from a plane about 13 minutes later. The flight crew was picked up by the Mason at 1:28 a.m., EST, March 17; nine minutes later the spacecraft was safely on board; and within 18 hours the destroyer docked at Okinawa.

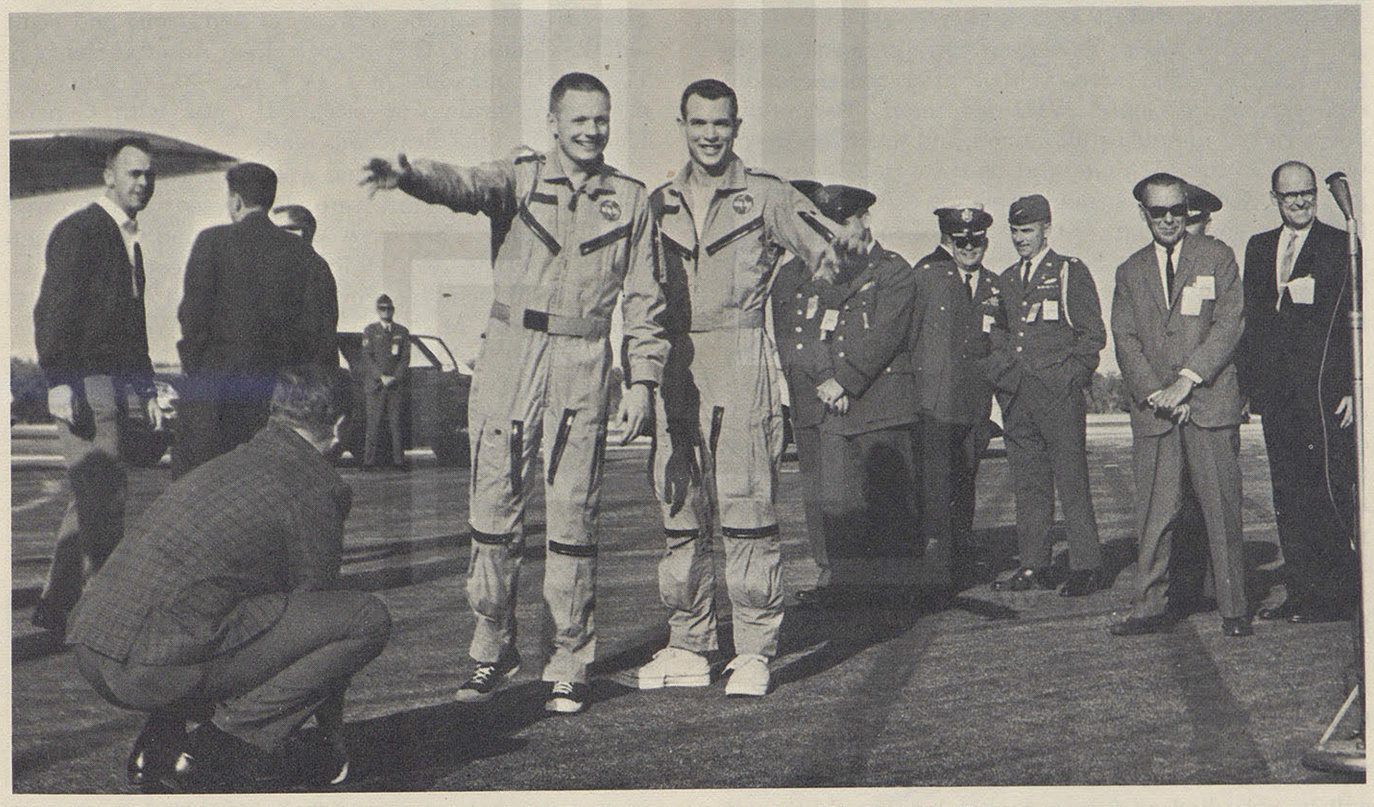
Dr. A. Duane Catterson, Astronaut Walter M. Schirra, Jr., and other NASA officials who had been on a "good will" tour of southeast Asia and Australia, met the Gemini VIII crew in Okinawa and accompanied them, after a short rest stop in Hawaii, to Cape Kennedy. Technical debriefings, typical of each manned space mission, were started.

About an hour and a half after Gemini VIII landed, the Mission Control Center personnel at Houston held a news conference to provide news representatives with information available at that time. Those briefing the newsmen were Mission Director William C. Schneider, Office of Manned Space Flight; Dr. Robert R. Gilruth, Director of Manned Spacecraft Center; Flight Director Hodge, MSC; Christopher C. Kraft, Jr., Assistant Director of MSC for Flight Operations; Donald K. Slayton, Assistant Director of MSC for Flight Crew Operations; Major General Vincent G. Huston, Deputy Department of Defense Manager for Manned Space Flight Support Operations; Dr. Charles A. Berry, Chief of Center Medical Programs, MSC; and Paul P. Haney, MSC Public Affairs Officer.

Information indicated that the spacecraft had rolled at a rate of about 36 degrees per second, based on an isolated hit from data received. Later, after talking to the flight crew and observing motion picture film, the roll rate was determined to be about one complete revolution (300 to 360 degrees) per second. Participants stressed repeatedly the fact that the source of the spacecraft's problems involved many unknowns. Specific answers could not be provided to the newsmen until all data had been examined and the flight crew debriefed. Those in attendance were also told that the mission had to be terminated early since the crew had been forced to use the reentry control system (RCS) in order to stabilize the spacecraft. One of the mission rules stipulated that if the RCS squibs were blown, the operations team must consider reentering the spacecraft at the next best planned landing area.

Dr. Gilruth, at the conference, referred to a statement in which President Johnson said in part that Armstrong and Scott "have shown remarkable courage and poise under stress . . . From their skill and strength we all take heart, knowing that the personal qualities of the astronauts and their colleagues will ultimately prevail in the conquest of space. We are very proud of them."

Dr. Gilruth also pointed out that the first seven hours



ARMSTRONG AND SCOTT smiled broadly as they arrived at Patrick Air Force Base, Fla., following their flight.

of the mission had been very successful, that both launches were as near perfect as one could expect, and that the docking operation was carried out smoothly and successfully. He added, in part, "The flight crew and the ground crew, I feel, reacted extremely well and ably to an inflight emergency and we feel very fortunate to have experienced a problem like this and to have been able to overcome it and bring the craft back successfully. We missed the space walk, of course, and we missed doing some experiments, but by and large we feel that we got in a very important day's work. We have learned a lot . . . perhaps we have learned more than we set out to learn."

Kraft said that this was an operation where all the planning had paid off both in terms of onboard operations and operations with the Department of Defense, and he called on General Huston to describe the recovery operations.

General Huston stated that the Mason had started toward the aiming point immediately following the decision to use the 7-3 recovery area. In addition a total of five aircraft were deployed—three C-54's, a C-130, and the HU-16. He remarked that a C-54 from Naha, Okinawa—the first scheduled to arrive at the scene—reached the area 22 minutes prior to the spacecraft landing.

Hodge announced that the flight controllers would be going over all the data on the Agena during the night and that a scheduled operation with the vehicle covering the next several days would be worked out. Armstrong and Scott, Hodge said, had reported that at their last sighting the Agena looked stable. Data received by ground stations had verified that report.

AGENA MANEUVERS

A total of 10 major maneuvers were performed with the Gemini-Agena target vehicle after the successful recovery of the Gemini VIII spacecraft. Twenty-one hours and 42 minutes after launch, and while the Agena was still in the 161-mile orbit used for docking on the previous day, the first maneuver was executed. A 104-foot-per-second posigrade burn resulted in an orbit with a perigee of 160 miles and an apogee of 220 miles. Five hours and 21 minutes later a similar burn circularized the orbit at 220 miles.

A plane-adjusting maneuver was initiated 39 hours and 16 minutes into the Agena flight. During this plane-change maneuver, a yaw offset was noted in the velocity of the Agena. This offset introduced a dispersion into the guidance with the result that the out-of-plane burn added energy to the orbit and raised the apogee to 336 miles, although the perigee remained at 220 miles. The inclination angle desired by the flight controllers was achieved during the maneuver, and the dispersion affected only the apogee. The problem was analyzed and determined to be the result of a center of gravity offset from the vehicle center line in conjunction with a slow responding control system.

Jerome B. Hammack, acting chief of the Gemini Vehicle Development Office, said that this condition will be remedied on future Agenas by the addition of ballast weight as required. Hammack also pointed out that a slow responding control system had been intentionally designed into the Agena to insure stability of the two vehicles while docked.

Subsequent maneuvers of the Agena resulted in the following perigees and apogees at different times during the three days of operations:

Perigee	Apogee
220 miles	229 miles
258 miles	384 miles
219 miles	258 miles
221 miles	407 miles
220 miles	223 miles
220 miles	224 miles
220 miles	222 miles

At the end of the final maneuver the Gemini-Agena target vehicle was estimated to have an orbital lifetime of at least 134 days. Flight Directors John Hodge and Eugene F. Kranz said that the Agena had performed perfectly with the exception of the center of gravity problem. There were no malfunctions in the Agena command system. During the course of the mission, flight controllers gave the Agena approximately 5100 commands and the vehicle did everything it was asked to do.

POSTFLIGHT NEWS CONFERENCE

Dr. Robert C. Seamans, Jr., Deputy Administrator of the National Aeronautics and Space Administration, conducted a NASA awards ceremony at the Manned Spacecraft Center Auditorium in Houston, Texas, on March 26, 1966. NASA's Group Achievement Award was presented to General Huston on behalf of the Department of Defense's recovery forces for their outstanding performance in reacting rapidly to the emergency situation in the recovery of Armstrong and Scott and the Gemini VIII spacecraft. Rear Admiral Henry S. Persons, Commander of Task Force 130 (to which the destroyer Mason was assigned), was with General Huston when the award was made.

The three pararescuemen who attached the flotation collar to the spacecraft were also present and received special awards. They were Airman Second Class Glenn Moore of Cleveland, Ohio; Staff Sergeant Larry D. Huyett of Manchester, Pennsylvania; and Airman First Class Eldridge M. Neal of Charleston, West Virginia.

Armstrong and Scott were awarded the NASA Exceptional Service Award for "the remarkable job they did in carrying out the mission . . . and of bringing back much useful data."

At the postflight news conference, following the awards ceremony, Dr. Seamans and Dr. Gilruth made introductory statements before the Gemini VIII crew described the mission.

Dr. Seamens praised the crew for their activities and said, in part: "During the emergency period they had the presence of mind as they were undocking to leave the Agena responsive to ground command and with the tape data intact so that it could be read out to the ground. . . ."

Dr. Gilruth then introduced the astronauts. In discussing the early phases of their flight both Armstrong and Scott stressed the visual aspect of the mission.

Armstrong said, "I wish that our pictures could be sufficiently accurate to describe the magnificence. . . . Seeing your own thruster fire, . . . , seeing particles drift away from the spacecraft at extremely low rates, seeing particles from the venting of gaseous supplies on the spacecraft, watching fires on the ground in Africa, seeing storms from above, . . . , and observing the whole weather panorama from 115 miles or more above the earth is something that unfortunately can't really be described adequately."

Scott's description was tied in to other activities. He said, in part, "We knew we would be very busy toward the later part of the day, so we unstowed some food and began preparing a meal since it was just about lunchtime. And, of course, we had to get out the books and charts and flight plan to prepare for the rendezvous. In the process of doing this, I would be down in the cockpit trying to unstow or prepare something, and about every five minutes I would get a 'Hey, look at that!!', and I'll tell you what Neil says is true. It's just utterly fantastic up there. . . ."

The crew described their activities up to the completion of the docking exercises in detail. They confirmed the report of the pilots of the Gemini VII/VI mission that station keeping with another vehicle in space is not at all difficult. Armstrong also said that he found that it was relatively easy to dock. There had been some conjecture as to whether there would be any electrical discharge when two space vehicles were joined. Armstrong and Scott reported that there was no such discharge and that they did not see any sparks when the spacecraft touched the target.

Both crew members said that even after encountering the control problem and undocking they were extremely reluctant to give up the flight, since there were a lot of other things they had hoped to work on. However, the decision to terminate the mission under such circumstances had been made prior to the flight by the established mission rules.

They praised the spacecraft communicators on the Rose Knot and Coastal Sentry (the only people the crew had contact with from the time of the control problem until after reentry) for the effort expended in getting them the information required for the reentry phase.

The crew said they heard an aircraft fly over shortly after the landing. They saw a plane about 15 minutes later, then a few minutes after that it flew by again and they saw the pararescuemen deploy. Scott said one of them landed about 15 feet in front of the spacecraft. He added that he and Armstrong both commented on the amount of gear the man carried as he came down. They learned later that the load was about 140 pounds.

During the question and answer period which followed, the VIII crew was asked about their physical condition during the peak rolling period. Armstrong said they did have a little bit of difficulty with particular head positions and with identifying proper circuit breakers and switches on the overhead panel. He compared the situation to one that test pilots encounter in spinning airplanes.

When asked whether they had begun to "grey out," the crew said they had not and felt they were perhaps some distance from that sort of physiological problem.

THE PILOTS

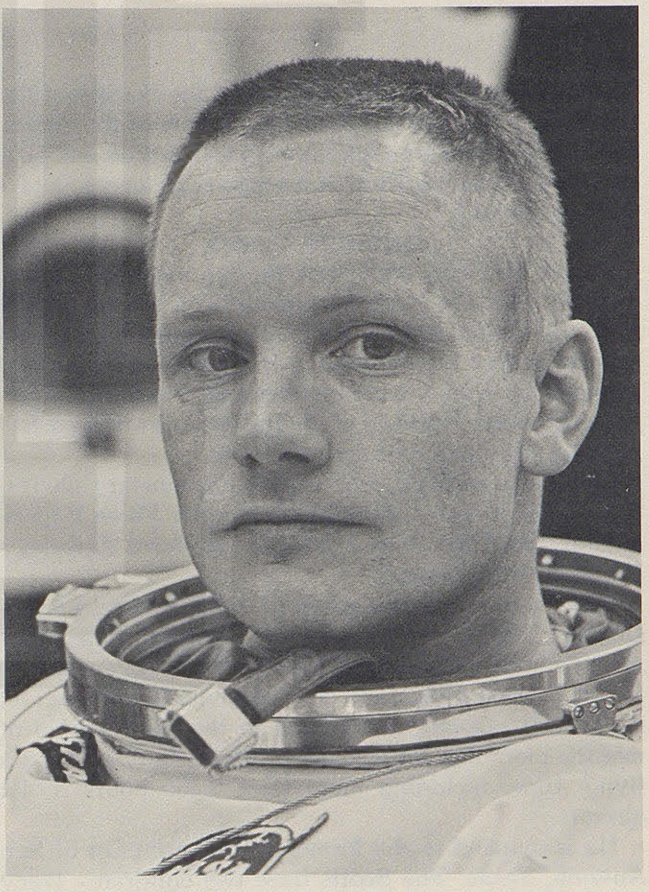
Neil A. Armstrong

Born in Wapakoneta, Ohio, August 5, 1930, Armstrong was graduated from Purdue University with a bachelor of science degree in aeronautical engineering. He is five feet, 11 inches tall, and has blue eyes and blond hair.

Armstrong was a naval aviator from 1949 to 1952 and flew 78 combat missions during the Korean action. He joined NASA's Lewis Research Center in 1955 (then NACA Lewis Flight Propulsion Laboratory) and later transferred to the NASA High Speed Flight Station at Edwards Air Force Base, California, as an aeronautical research pilot. He was an X-15 project pilot, flying the aircraft to more than 200,000 feet at a speed of about 4,000 miles per hour.

He has logged more than 3,400 hours flight time, including more than 1,900 hours in jet aircraft. Armstrong was selected as an astronaut in September 1962. In addition to normal training duties, his responsibilities include the readiness of Operations and Training in the Astronaut Office. Armstrong also served as command pilot of the backup crew for the Gemini V mission.

Armstrong is married to the former Janet Shearon of Evanston, Illinois. They have two sons—Eric, born June 30, 1957, and Mark, born April 8, 1963.



COMMAND PILOT NEIL A. ARMSTRONG

UNITED STATES SPACE FLIGHT LOG

MISSION	PILOT(S)	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	Schirra-Stafford	Dec. 15-16, '65	26:01:40	1354:38:39
Gemini-Titan VIII	Armstrong-Scott	Mar. 16, '66	10:41:26	1376:01:31

Armstrong is a charter member of the Society of Experimental Test Pilots, Associate Fellow of the American Institute of Aeronautics and Astronautics, and 1962 recipient of the Institute of Aerospace Sciences Octave Chanute Award.

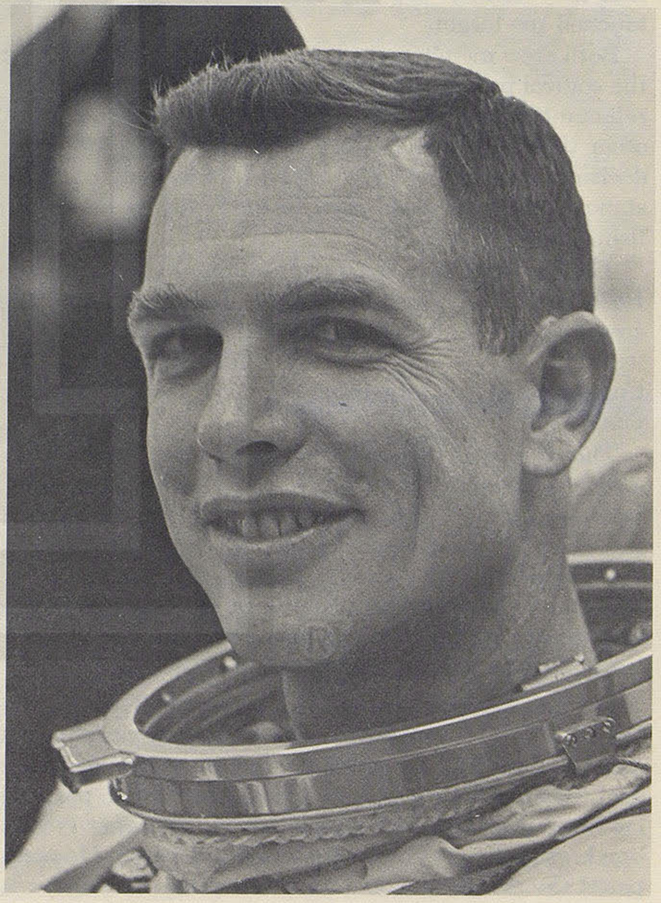
David R. Scott

David R. Scott was born in San Antonio, Texas, June 6, 1932. He received a bachelor of science degree from the United States Military Academy, a master of science degree in aeronautics and astronautics and an engineering degree in aeronautics and astronautics from Massachusetts Institute of Technology. Scott is six feet tall and has blond hair and blue eyes.

His thesis at MIT concerned interplanetary navigation. Scott is also a graduate of the Air Force Experimental Test Pilot School and the Air Force Aerospace Research Pilot School.

Scott was among the group of astronauts selected in October 1963. In addition to participation in the astronaut training program, he has specific responsibilities for monitoring design and development of guidance and navigation systems, and aiding in the coordination of mission planning. He has logged more than 2,600 hours flying time, including more than 2,400 hours in jet aircraft.

He is married to the former Ann Lurton Ott of San Antonio, Texas. The Scotts have two children—Tracy L., born March 25, 1961, and Douglas W., born October 8, 1963.



PILOT DAVID R. SCOTT

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEMINI X

Fact Sheet 291-G
September 1966

MULTIPLE RENDEZVOUS, EVA MISSION

Gemini X was described prior to its scheduled lift-off as the most ambitious manned space flight ever attempted by the United States. Results of the flight indicate just how appropriate this description was.

The prime crew consisted of Astronauts John W. Young and Michael Collins who served as command pilot and pilot, respectively; the backup command pilot was Alan L. Bean and Clifton C. Williams, Jr., was the backup pilot.

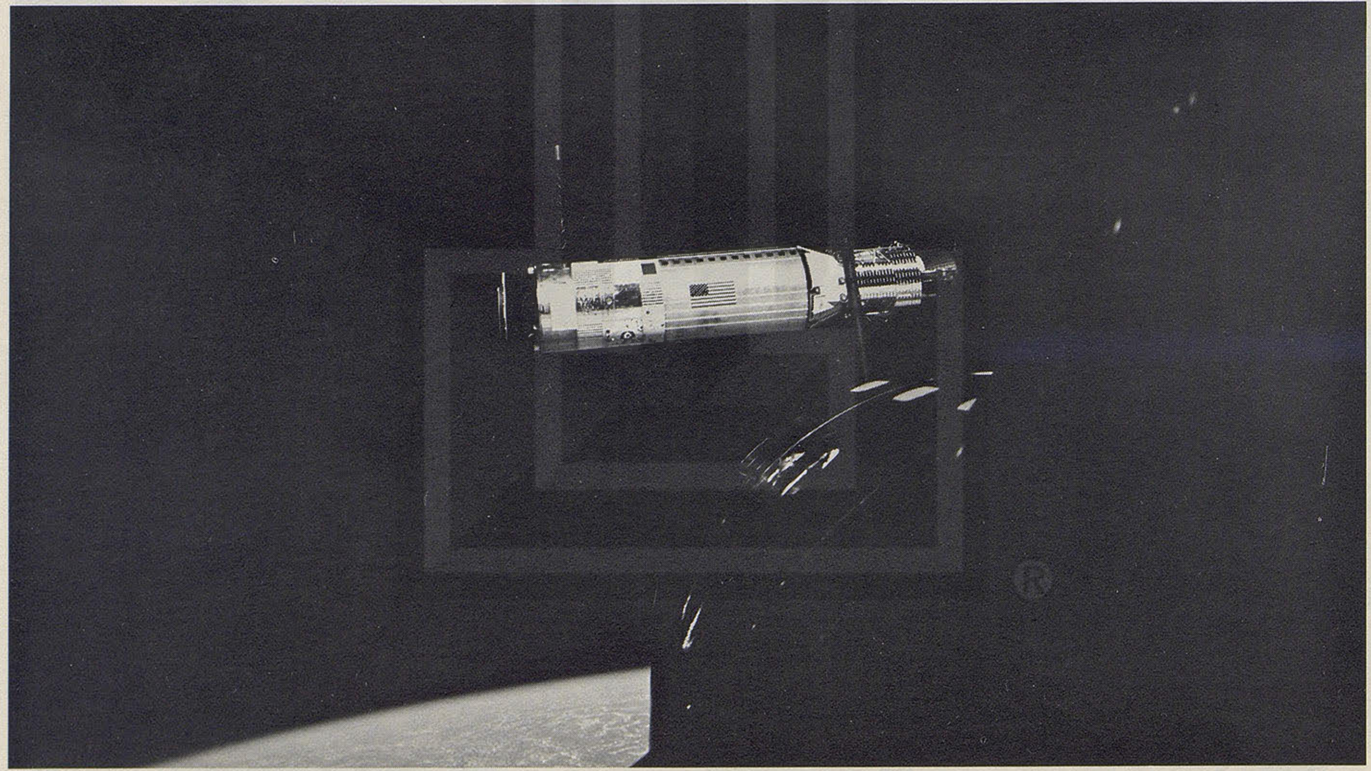
Speaking of the flight activities during the post-flight news conference, John Young said in part, ". . . . It was an ambitious flight plan and we knew that. I've always thought that the probability, statistically speaking, of doing everything we had in the mission plan was low . . . . But on the 18th of July the boosters, the Agena, the Gemini, the launch crews, the flight operations division, and even the one thing we couldn't do anything about — the weather — were all on our side."

Most of the goals of the mission were successfully accomplished.

- The primary mission objective was to rendezvous and dock (achieved).

Six secondary objectives were also assigned to the Gemini X mission. They were:

- To rendezvous and dock during the fourth revolution (achieved).



THE GEMINI X AGENA TARGET as seen from the command pilot's window after the rendezvous was accomplished. This was the first target on which the American flag was painted.

- To use large propulsion systems in space by attempting dual rendezvous maneuvers using the Gemini Agena target vehicle's primary and secondary propulsion systems (achieved).
- To conduct extravehicular activity operations (achieved).
- To conduct docking practice (not achieved).
- To conduct experiments (partly achieved).
- To conduct the following systems evaluations: bending mode, docked spacecraft — Gemini Agena target vehicle maneuvers, static discharge monitoring, post-docked spacecraft-Agena target vehicle maneuvers, and parking the Agena target vehicle (all achieved).

LAUNCH DAY ACTIVITIES

The prime crew went to bed about 2 a.m., EST (all times used in this fact sheet are Eastern Standard Time) July 18, 1966, and slept until shortly after noon. At 1:15 p.m., the final physical examination had been completed and Young and Collins had brunch with Astronauts Eugene A. Cernan, James A. Lovell, and Donald K. Slayton.

The multiple countdown (conducted simultaneously on the Agena and its Atlas standardized launch vehicle at Launch Complex 14 and on the Gemini spacecraft and its launch vehicle at Launch Complex 19) continued smoothly during the late morning and early afternoon of that day.

At about two hours and 50 minutes before the scheduled launch of the Atlas-Agena (3:39:44 p.m.) Young and Collins arrived at the Ready Room on Pad 16 at Cape Kennedy and started donning their spacesuits. The crew continued suiting-up and was briefed on the status of the countdown, the mission and the weather. At about 3:20 p.m., they arrived at the White Room at the 100-foot level at Pad 19. This was two hours before their scheduled lift-off at 5:20:30 p.m. Prior to being inserted into their spacecraft, they were brought up to date on the spacecraft countdown status by the backup crew which had been in the spacecraft and participating in the countdown activities about five hours.

The Atlas-Agena lift-off occurred at 3:39:46 p.m., just two seconds later than planned. The Gemini X flight crew, already in place and with their hatches closed, followed the progress of the early phases of the Agena flight closely, and expressed their happiness when told that the Agena had achieved its prescribed orbit.

The countdown on the Gemini X spacecraft and its launch vehicle continued on schedule and at the

THE GEMINI X astronauts—John W. Young, left, and Michael Collins—are pictured as they study the flight plan several days prior to the mission.

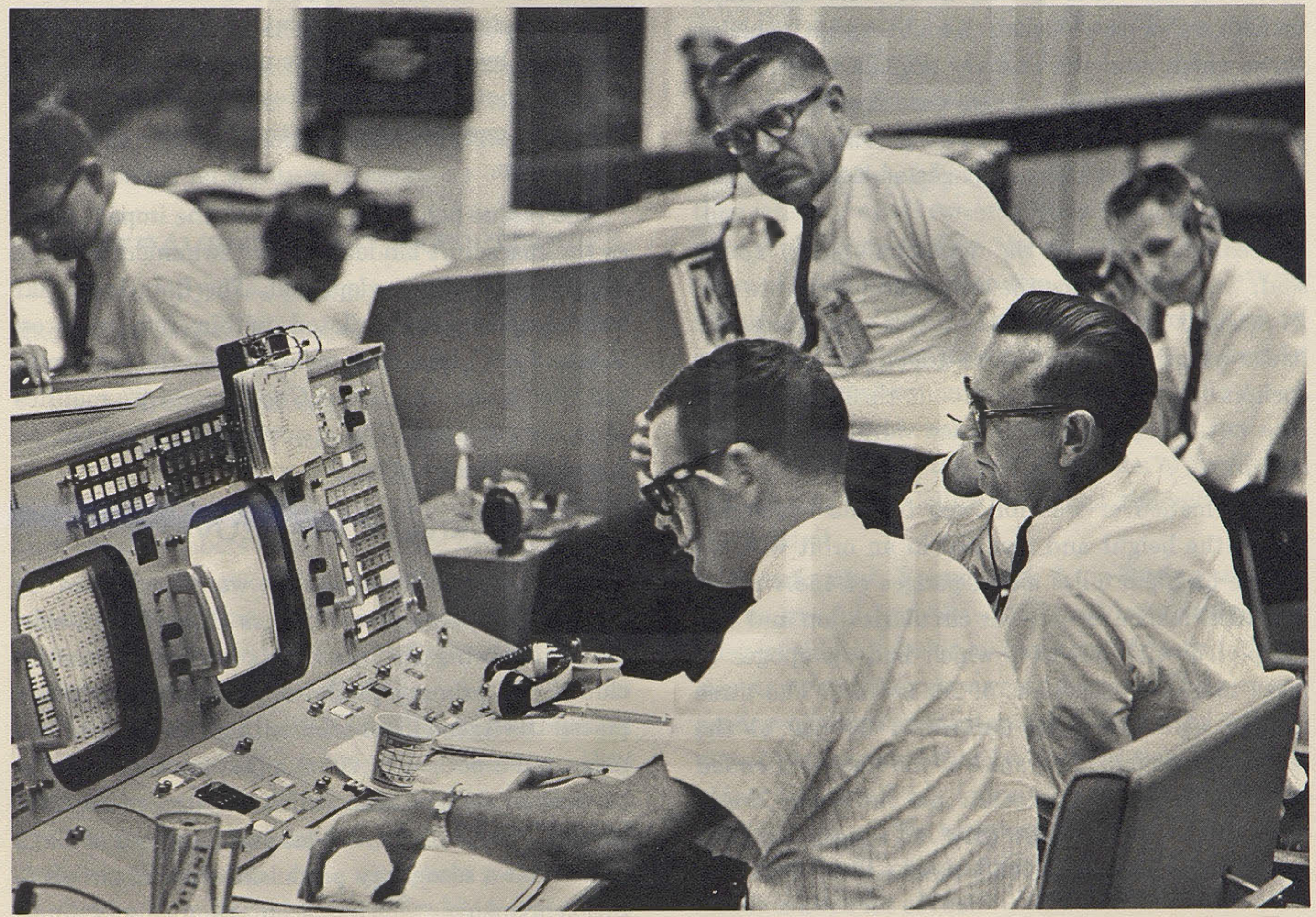
T minus three-minute mark, a built-in hold was entered. This hold has been programmed into all Gemini rendezvous flights to allow the flight controllers to set up the precise launch conditions of time and launch azimuth. In the case of the Gemini X, the hold was scheduled to last five minutes and 34 seconds, aiming for an ignition time of 5:20:23 p.m., and a lift-off slightly less than four seconds later. Ignition had to be effected within a 37-second launch window period to attain the desired objectives of the mission.

Gemini X lifted off exactly as planned at 5:20:27 p.m., EST and was inserted into orbit with a perigee of 87 miles and an apogee of 146 miles. (All mileage figures quoted in this fact sheet are nautical miles. A nautical mile is equal to 1.15 statute miles.) A half-hour after lift-off the Gemini X spacecraft trailed the Agena X by 850 miles and the Agena VIII trailed the Gemini X spacecraft by 500 miles.

MANEUVERS FOR RENDEZVOUS

A series of five major maneuvers were performed by the Gemini X crew in preparation for the rendezvous with the Agena X target scheduled for the fourth revolution. Those maneuvers were completed and, after five hours and 21 minutes of flight the crew reported through the Tananarive, Malagasy, tracking station that they were 40 feet from the Agena X. Later, while the spacecraft was over the *Coastal Sentry* tracking ship, Young and Collins were given a "go" for docking and that phase of the mission was completed after five hours and 53 minutes of elapsed flight time.

During the early phases of the flight, before ren-



A SCENE AT THE FLIGHT DIRECTOR'S CONSOLE during the second day of the Gemini X flight—Flight Director Glynn Lunney, left, monitors the progress of the mission while Christopher C. Kraft Jr., Assistant Director of Manned Spacecraft Center for Flight Operations, seated at Lunney's right, and William C. Schneider, Deputy Director for Mission Operations, Office of Manned Space Flight, NASA Headquarters, observe the activities.

dezvous, the crew accomplished sextant readings and performed other activities to attempt rendezvous without using ground-computed data. Although the computations were made, the crew decided to use the ground-computed data to accomplish the rendezvous. Fuel usage was high during the terminal phase of the first rendezvous.

The resultant shortage of fuel placed an additional constraint on most phases of the planned flight activities from that point. The flight controllers did, however, greatly alleviate the situation by determining that the Gemini X spacecraft should stay docked with the Agena X for almost 39 hours in order to get the maximum benefit out of the propulsion system of the target vehicle. By using the spacecraft-target vehicle combination, most of the mission objectives were able to be recorded as "achieved."

DOCKED MANEUVERS

During this time period there were six major maneuvers of the docked Gemini-Agena vehicles, three which used the primary propulsion system of the Agena X and three which used the Agena's secondary propulsion system. The first maneuver resulted in an orbit with an apogee of 412.2 miles and a perigee of 158.5 miles.

Speaking of this at the news conference, Young said, ". . . Mike threw the switch and a minute and 24 seconds later . . . it was really something. We had a negative 1-g and were driven forward in the cockpit . . . we got a tremendous thrill . . . on our way out to apogee and a new world's record for altitude . . ."

This maneuver was followed by one which adjusted the height and resulted in an orbit with an apogee of 205.8 miles and a perigee of 158.4 miles. The next maneuver was for circularization and was completed with an orbit which had an apogee of 208.7 miles and a perigee of 203.9 miles. The three smaller maneuvers, all performed by use of the secondary propulsion system of the Agena X, ended with the Gemini X spacecraft and the Agena X still docked and in an orbit with an apogee of 208.5 miles and a perigee of 205.5 miles.

RENDEZVOUS WITH THE AGENA VIII

The crew undocked the spacecraft from the Agena X after 44 hours and 40 minutes of flight. The undocking was uneventful and a maneuver shortly thereafter was performed to permit the spacecraft to rendezvous with the Gemini VIII Agena which has been in orbit since March 16.

About three hours later Young and Collins reported they were closing in on the Gemini VIII target vehicle. After station-keeping for more than three hours, the crew performed a maneuver which separated them from their passive target at a rate of about one and one-half feet per second. An orbit shaping maneuver was performed shortly after that.

Retrofire was initiated after 70 hours, 10 minutes, and 27 seconds of the mission had elapsed, in order to bring the spacecraft down in the primary landing area during the 44th revolution.

The spacecraft landed at the beginning of that revolution in the west Atlantic landing zone. The landing occurred at 4:07:06 p.m., EST, July 21, 1966. The landing point was 3.4 miles east-northeast of the planned landing point, and the spacecraft retrieval by the prime recovery ship, the USS *Guadalcanal,* some 54 minutes later, was at a point 3.2 miles east-northeast of the planned spacecraft touchdown.

The rescue helicopter arrived at the impact point as the spacecraft landed and the swimmers and the flotation collar were deployed. The flotation collar was attached and inflated within five minutes. Young and Collins were picked up by the helicopter and arrived on board the *Guadalcanal* 27 minutes after their landing. The spacecraft was brought on board 27 minutes after the crew.

AGENA X MANEUVERS

Three Agena X maneuvers were performed by command of ground controllers during a 12-hour period following the spacecraft landing. These included one primary propulsion system burn which placed the Agena in an orbit with an apogee of 750.0 miles and a perigee of 208.2 miles; another primary propulsion system burn which resulted in an orbit with an apogee of 208.7 miles and a perigee of 190.2 miles; and a secondary propulsion system circularization maneuver which placed the Agena X in an orbit with an apogee of 190.3 miles and a perigee of 187.6 miles.

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A STORM CENTER near the Straits of Gibraltar as viewed by the flight crew of the Gemini X spacecraft.

Following this last maneuver, control was turned over to the Hawaii tracking station. This station monitored the vehicle until its power was depleted about seven days after lift-off. The Agena X vehicle was permitted to remain in this orbit and may be a passive target on a future mission.

EXTRAVEHICULAR ACTIVITIES

The Gemini X crew established another record as they depressurized their spacecraft and opened the hatch on three different occasions during the flight.

The standup Extravehicular Activity (EVA) started after about 23 hours and 23 minutes of the flight had elapsed. Approximately 50 minutes later this phase of the activity was terminated because both crew members experienced eye irritation. Collins said the irritation was accompanied by an odor which reminded him of lithium hydroxide, a substance which is used in the environmental control system to remove carbon dioxide.

The umbilical or tethered EVA period started after 48 hours and 41 minutes of elapsed flight time and continued about 39 minutes. During this period Collins accomplished the majority of the planned activities. Evaluation of the hand-held maneuvering unit was not completed because the EVA period was terminated early to conserve fuel for maneuvers in preparation for their return to earth. The maneuvering unit was used successfully, however, to conduct Collins' transfer in both directions between the spacecraft and the Agena VIII target vehicle, a distance of about 15 feet. Also, during this EVA, Collins retrieved an experiment package which had been attached to the Agena VIII since March 16.

The crew opened the spacecraft for a third time after approximately 50 hours and 32 minutes of the flight had been completed. This time they jettisoned the EVA equipment.

AWARDS CEREMONY

An Awards Ceremony and the Pilots' Postflight News Conference was held at Manned Spacecraft Center, Houston, Texas, August 1, 1966. The MSC Director, Dr. Robert R. Gilruth made a brief opening statement, then introduced Dr. Robert C. Seamans, Jr., Deputy Administrator of NASA.

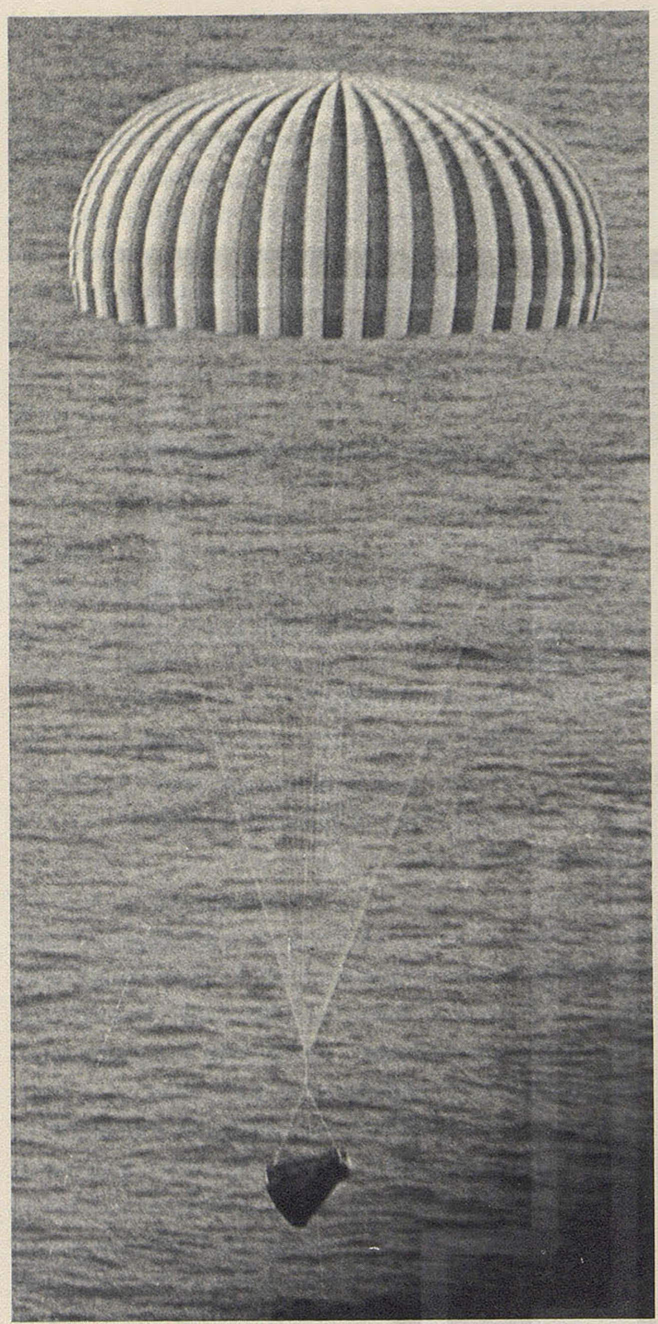
Dr. Seamans briefly discussed the results of the Gemini X mission and the total Gemini Program to date, then presented the NASA Exceptional Service Medal to both Young and Collins.

During the discussion, Dr. Seamans said, ". . . We've done a great deal more with Gemini than originally intended. We've made Gemini much more than an improved two-man Mercury. Gemini has done much more to open the way to the moon than we could have hoped for five years ago . . . With Gemini, we've developed our ability to maneuver in space, to change orbits, to inspect other objects in space, to rendezvous and dock, and to use the power of an orbiting rocket as a switch engine in space . . ."

In talking about the various phases of the flight, both Young and Collins described the activities in great detail.

At one point, Young said, ". . . During the first five hours of the mission, Mike and I were extremely busy evaluating orbit navigation and orbit determination, and the primary rendezvous. The primary rendezvous was characterized, I think, by a large out-of-plane error. When we realized this was taking place, we could no longer let orbital mechanics work for us . . . We were working for it. We had to use what I call a brute force method of rendezvous, and it takes a lot of fuel."

Later Young said, "It was on this Agena that we painted the United States flag for the first time. I



THE GEMINI X SPACECRAFT near the end of its journey as it approached the landing point about 460 miles southeast of Cape Canaveral, Florida, on the third day of the flight. The photo was taken from a helicopter.

was very pleased to see it when we got there. That is a beautiful vehicle. It took tremendous engineering skill . . . to get those two vehicles up there at the same time."

In discussing the docking, Collins said, "This docking is an extremely precise maneuver. The alignment must be nearly perfect, in order to bring the two vehicles together successfully. John really made it look easy — as a matter of fact, he lined right up on the first try, we glided right into the center of the docking cone and at that point the Agena took over and literally engaged the forward nose of the Gemini and pulled it in until the Gemini was tight against the front end of the Agena. We were really glad to be there . . ."

Young said, "We burned the Agena main engine three times — the first time, 14 seconds; the second time, 11 seconds; and finally a short burn of four seconds, and in all cases the Agena performed magnificently, a flawless performance."

Pilot Collins talked about his standup extravehicular activity. He said, ". . . I opened up the right hatch with John's help and it opened very easily. I stood up part of the way and turned to the left and actually got my legs up under the instrument panel which . . . was a very comfortable position . . . during the standup EVA it's almost like standing with your head up through the roof of a car going sideways across the world. It was a very pleasant sensation."

EXPERIMENTS

A total of 14 experiments were scheduled as activities of the Gemini X crew. Following is a brief description of those experiments and results.

- The star occulation navigation experiment is designed to determine the feasibility and operational value of star occulting measurements in the development of a simple, accurate, and self-contained orbital navigational capability. On Gemini X, this experiment was accomplished with the Gemini Agena target vehicle control system because of the constraint to remain docked. This experiment was terminated early because of concern over excessive use of propellant but the crew obtained good data.
- The flight crew performed the ion-sensing attitude control experiment in an excellent manner, and, in addition to performing required operations, they obtained photographs of the attitude indicators while maneuvering. The purpose of this experiment is to develop a navigation system which can sense vehicle attitude by using flow variations on a specially designed system.
- The color patch photography experiment was terminated before completion when the eye irritation problem caused termination of the standup

EVA; however, one of the three planned series of exposures was obtained. The purpose of this experiment was to determine if existing photographic materials could accurately reproduce the color of objects photographed under the environmental conditions which exist in space.

• The fact that any data were obtained on the zodiacal light photography experiment is attributed to the crew's decision to combine this experiment with the ion-sensing attitude control experiment.

• No fuel was allocated for the synoptic terrain and synoptic weather photography experiments, but the crew obtained good photographic data while in drifting flight.

• The micrometeorite collection package was retrieved from the Gemini VIII Agena target vehicle, but the new micrometeorite collection package was not in place as planned because of hand-hold problems encountered by the pilot.

The crew performed the micrometeorite collection experiment later than originally planned because of the early termination of the first EVA. The package was retrieved during the second EVA and handed into the spacecraft, but subsequently floated out of the spacecraft and was lost in orbit.

• The decision to remain docked to the Agena target vehicle after the initial rendezvous placed a major constraint on the experiment concerning the ultraviolet astronomical camera. However, several exposures more than planned were obtained.

• The quantity of ion-wake measurement was decreased because of the deletion of docking practice. The crew performed all required operations for the completion of this experiment.

Three other experiments were conducted according to the flight plan. They concerned a Tri-Axis Magnetometer, a Beta Spectrometer, and a Bermsstrahlung Spectrometer.

THE PILOTS

John W. Young

Astronaut John W. Young was named the command pilot of the Gemini X spacecraft. He was born in San Francisco, Calif., September 24, 1930, and was one of the nine astronauts selected by NASA in September 1962. Young was pilot of the first manned Gemini flight on March 23, 1965, a three-orbit mission on which Virgil I. Grissom was the command pilot.

He attended Georgia Institute of Technology and was graduated in 1952 with a bachelor of science degree in aeronautical engineering. He joined the Navy after graduation and completed flight training. From 1959 until 1962 he served as a test pilot and as program manager of the F4H weapons system project.

In 1962, Young set world time-to-climb records in the 3,000-meter and 25,000-meter altitude events in the F4B Navy fighter plane.

In addition to the two space flights made by Young, he was also pilot on the backup crew for the Gemini VI mission. Prior to his selection as an astronaut, he served as maintenance officer for All-Weather Fighter Squadron 143, at the Naval Air Station, Miramar, Calif. He has logged more than 3,400 hours flying time, including more than 2,900 hours in jet aircraft. Young was awarded the NASA Exceptional Service Medal in 1965 and in 1966.

He is married to the former Barbara V. White of Savannah, Georgia. They have two children: Sandy, born April 30, 1957; and John, born January 17, 1959.

Michael Collins

Michael Collins, pilot of Gemini X was born in Rome, Italy, October 31, 1930. He was selected as a NASA astronaut in October 1963.

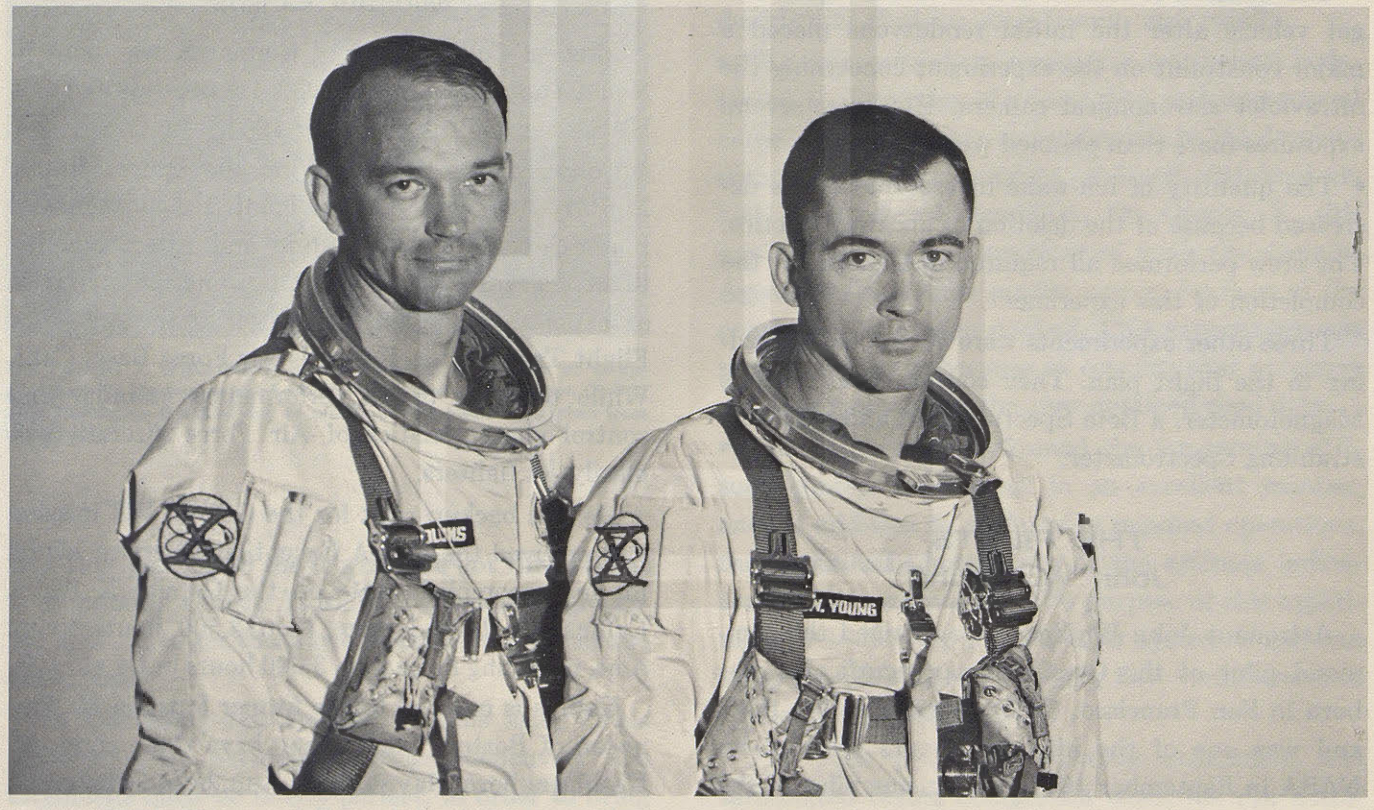
Collins was graduated from the United States Military Academy at West Point. He chose an Air Force career upon graduation and, after receiving flight training and test pilot training, he served as an experimental flight test officer at the Air Force Flight Test Center, Edwards Air Force Base, Calif. While there he tested performance, stability and control characteristics of Air Force aircraft, primarily jet fighters.

He was backup pilot for the Gemini VII mission and received the NASA Exceptional Service Medal for his accomplishments on the Gemini X flight. Collins has logged more than 3,500 hours flying time, including more than 3,000 hours in jet aircraft.

Collins is married to the former Patricia M. Finnegan of Boston, Mass. They have three children: Kathleen, born May 6, 1959; Ann, born October 31, 1961; and Michael, born February 23, 1963.

UNITED STATES SPACE FLIGHT LOG

MISSION	PILOTS	DATE(S)	MISSION 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



THE GEMINI X FLIGHT CREW: Pilot Michael Collins, left, and command pilot John W. Young.

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEMINI IX-A

RENDEZVOUS MISSION

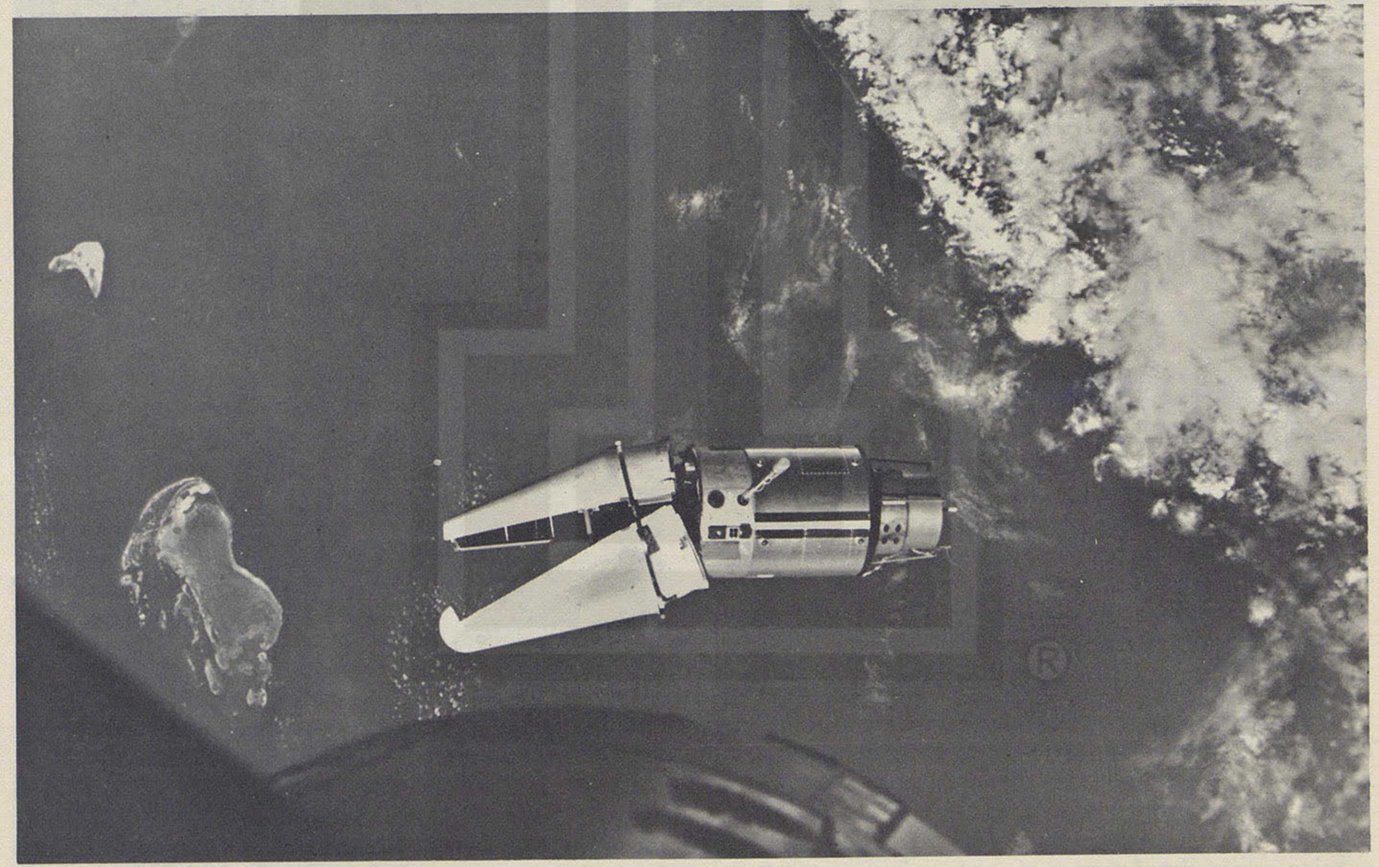
Fact Sheet 291-F
August 1966

Gemini IX-A, the seventh manned flight in the Gemini program, was conducted on June 3-6, 1966, following launch of Atlas-Agena on June 1, 1966. Two scheduled launch dates — May 17 and June 1 — were to pass before Astronauts Thomas P. Stafford, command pilot, and Eugene A. Cernan, pilot, and their Gemini IX spacecraft would attain orbital flight.

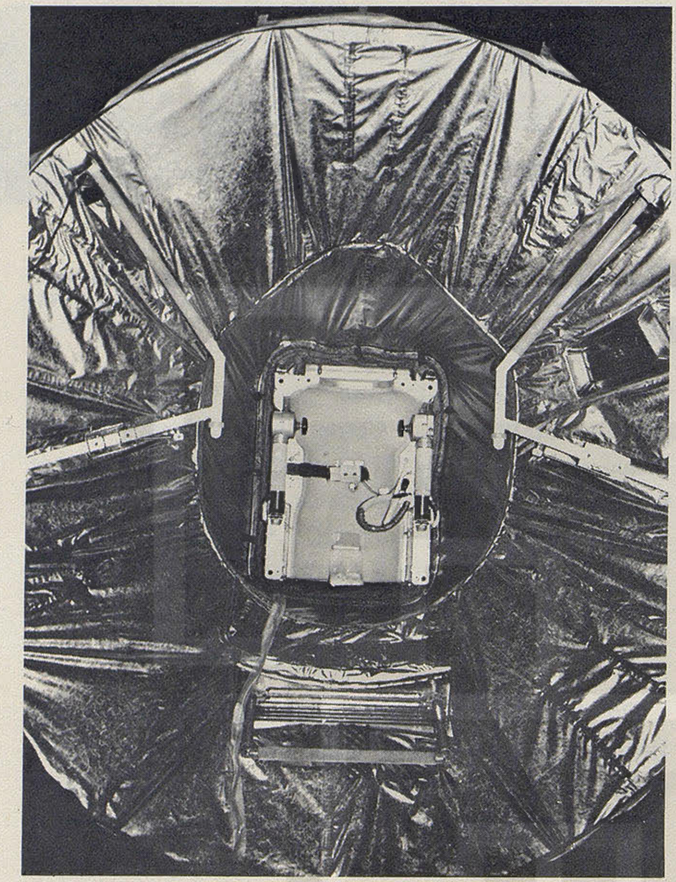
Astronauts Elliott M. See, Jr., and Charles A. Bassett, II, originally had been named as command pilot and pilot, respectively, with Stafford and Cernan as their backup crew. See and Bassett died when their airplane crashed at St. Louis, Missouri, February 28, 1966, while en route to the McDonnell Aircraft Corporation plant for specialized mission training. Subsequently, Stafford and Cernan were selected as the prime crew (the first time that a backup team, or backup astronaut, had been so utilized in America's manned space flight program). Astronauts James A. Lovell, Jr., and Edwin E. Aldrin, Jr., were chosen as the new Gemini IX backup crew.

MAY 17 ATTEMPT

On the May 17 mission attempt, the Atlas-Agena lift-off occurred at 10:15 a.m., EST, following a short delay during the countdown caused by a slight problem in loading the Agena to capacity. During this time,



THE AUGMENTED TARGET DOCKING ADAPTER as seen by the Gemini IX spacecraft after the rendezvous in space. Command pilot Tom Stafford referred to the ATDA and its still attached shroud as an "angry alligator."



THE ADAPTER EQUIPMENT SECTION of the Gemini IX spacecraft shows the installation of the Astronaut Manuevering Unit back pack in place prior to the mission.

a simultaneous countdown of the Gemini IX spacecraft and its launch vehicle had proceeded without incident. After the Atlas-Agena launch only two minutes and ten seconds elapsed before all contact with the target vehicle ceased, causing Mission Director William C. Schneider to "scrub" the mission. Stafford and Cernan egressed from the spacecraft and descended on the elevator to wait for another try on another day.

Dr. George E. Mueller, Associate Administrator of NASA Manned Space Flight, announced at a news conference shortly thereafter that work was proceeding at the pad to complete launch preparations as quickly as possible and that an Augmented Target Docking Adapter (ATDA) would be used as the target vehicle for the Gemini IX mission.

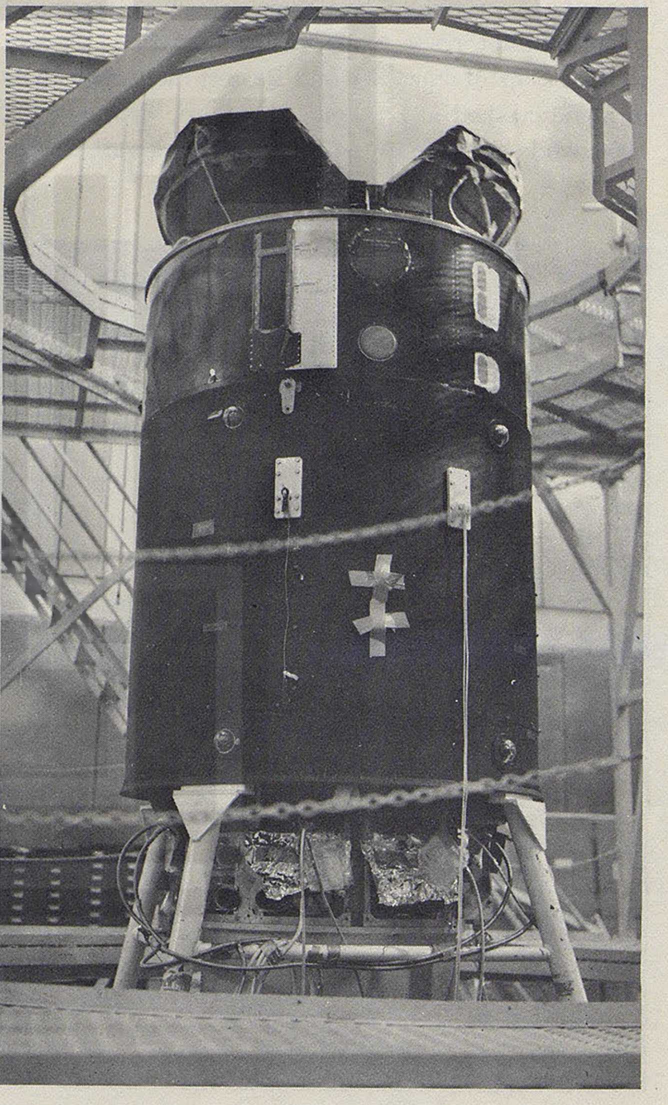
THE ATDA

The Augmented Target Docking Adapter is a rendezvous target vehicle designed for launch by an Atlas should an Agena target vehicle fail to achieve orbit or should one not be available for other reasons. The ATDA used on the Gemini mission had also been designated as a backup target for the Gemini VIII mission while the Agena was undergoing a reevaluation of its propulsion system.

The ATDA is 12 feet long (28.33 feet long with the nose shroud and Atlas adapter), is five feet in diameter, and weighs 2400 pounds at launch and 1748 pounds in orbit. It has no propulsion system for translation maneuvers and is fabricated mainly from Gemini off-the-shelf items.

Docking equipment installed is a Gemini Target Docking Adapter (TDA) The C-band beacons and antennas, the digital command system, the L-band radar transponder, telemetry system, stabilization system, shaped charge separators, batteries, wire bundles, relays, and connectors which make up the ATDA systems are all standard Gemini parts.

Lighting on the ATDA is identical to that of the Agena. There are two acquisition lights on the outer edge of the adapter structure that produce a flashing light reference of 55 pulses per minute and that can be seen for several miles.



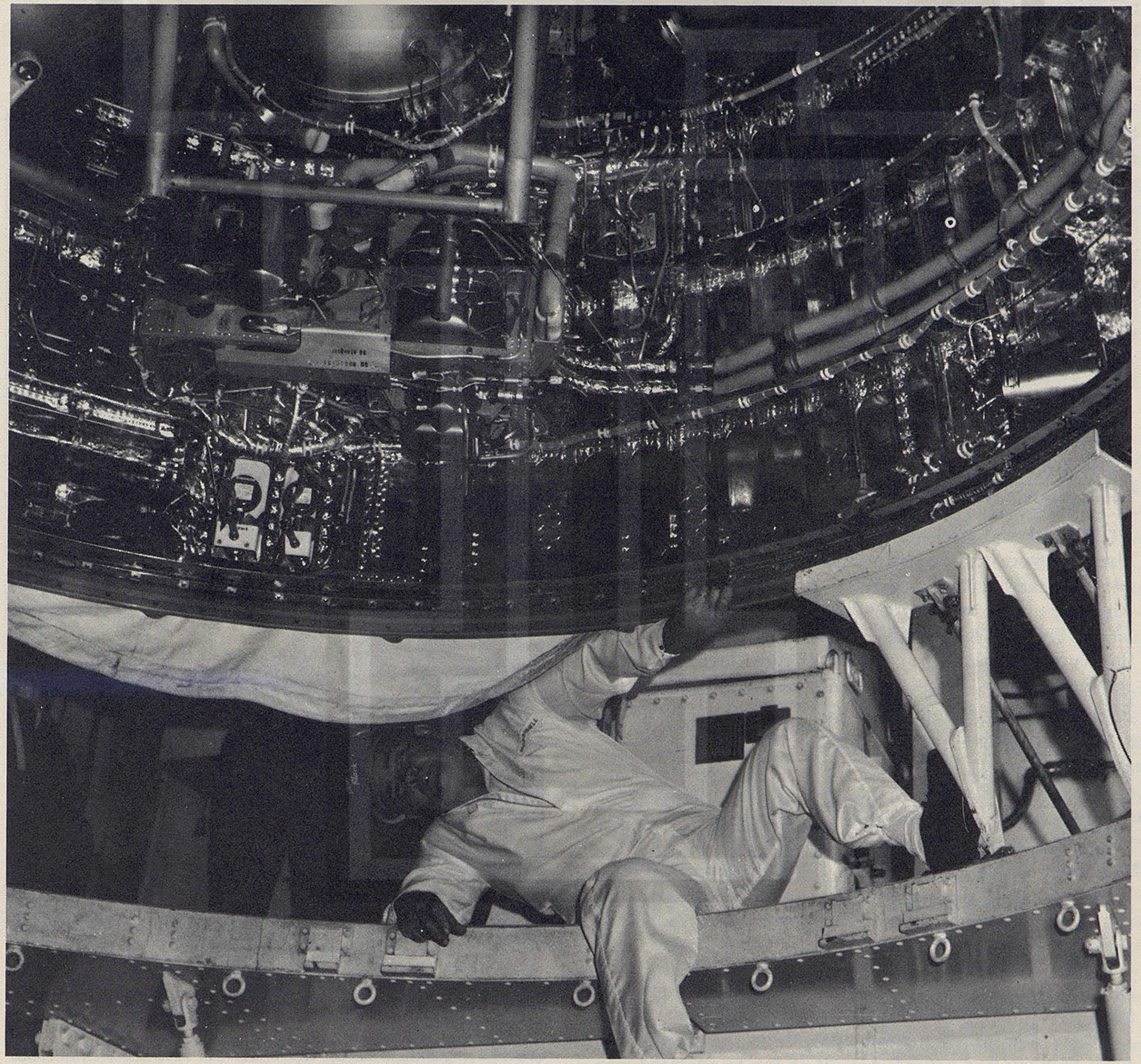
A CLOSE-UP of the Gemini Augmented Target Docking Adapter (ATDA) as it underwent a pre-flight checkout at Cape Kennedy, Fla.

JUNE 1 ATTEMPT

The Gemini IX mission was redesignated Gemini IX-A and on the morning of June 1, 1966, countdowns proceeded simultaneously for the Atlas-ATDA and for the Gemini spacecraft and its launch vehicle. Following an uneventful countdown, the Atlas-ATDA lifted off from the Cape Kennedy Pad 14 at four seconds after 10:00 a.m., EST, with the Gemini spacecraft expected to be launched about 98 minutes later.

After launch, the Atlas-ATDA followed a nominal trajectory and attained a near circular orbit with an apogee of 161 nautical miles and a perigee of 159 nautical miles. The shroud housing the ATDA was commanded to separate 10 seconds after the launch vehicle's vernier engine cutoff, but telemetry signals did not confirm this.

The usual planned hold of four minutes duration was instituted in the Gemini countdown at Pad 19 at the T minus 3-minute mark. The count then resumed and continued until T minus one minute and 40 seconds. At this point the count was recycled to T minus three minutes and holding. From Launch Control the announcement came that the MOD III guidance system update of the spacecraft computer could not be transferred through the ground equipment to the spacecraft.



MC DONNELL AIRCRAFT CORPORATION technician Don Black inspects the Gemini IX spacecraft in the white room atop Pad 19 prior to positioning it over the Gemini launch vehicle and cabling up.

Shortly thereafter the countdown was resumed but a second update attempt also could not be transferred. Later, a third failure of the ground equipment to transfer the launch-azimuth update to the command transmitter for transmission to the spacecraft was recorded.

By this time the launch window had been violated and Mission Director Schneider called for the launch attempt to be rescheduled for the third of June — a day on which two panes in the launch window would be available.

LAUNCH AT LAST

On June 3, Stafford and Cernan were awakened at 3:11 a.m. They underwent the usual preflight physical examination, and then ate the traditional astronaut breakfast consisting of fruit juice, filet mignon, scrambled eggs, toast and coffee. One guest joined them for breakfast — Donald K. Slayton, MSC's Director for Flight Crew Operations.

At 4:21 a.m., the flight crew left the crew quarters at Merritt Island and proceeded to the ready room at Pad 16 to don their suits and make final preparations for the mission.

Over at Pad 19, the countdown of the spacecraft and its launch vehicle proceeded smoothly. Because of the difficulty encountered two days earlier, the computer at the Mission Control Center, Houston, was programmed to transmit the update information directly to the Gemini IX spacecraft computer at the T minus 60-minute, the T minus 30-minute, and the T minus 15-minute marks. This would permit the launch to go on time using the latest data entered into the computer, if the T minus 3-minute update information could not be transferred by the ground equipment to the command transmitter.

Stafford and Cernan completed preparations, made the trip from the ready room to Pad 19, entered the elevator, and went up to the launch pad white room, arriving about two hours before the scheduled launch time. They were briefed by the backup crew on the status of the countdown, as Lovell and Aldrin had been participating in these activities since about 2:00 a.m.

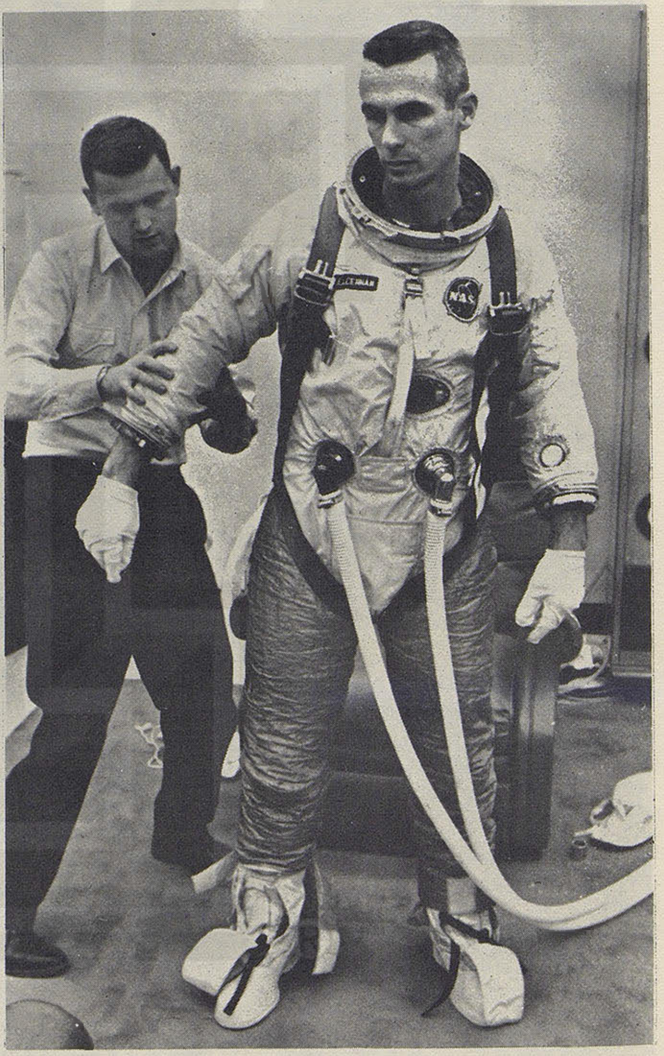
Technicians closed Stafford's hatch at T minus 105 minutes and Cernan's about 10 seconds later. The count continued on schedule. As launch time approached, following a planned hold at T minus three minutes, the ground equipment again failed to transfer update information; however, satisfactory information had been transmitted at T minus 15 minutes from MCC-Houston, and lift-off occurred precisely on schedule at 8:39:33 a.m., EST.

With the final minutes of countdown ticking by, and during a communications check, Command Pilot Stafford used the term Walter M. Schirra, Jr., his command pilot on Gemini VI-A, had used, "For the third time, Go." History had repeated itself as far as Stafford was concerned. On his first space trip, he was launched on the third try and it had taken three efforts for his second space mission.

The primary objectives of the Gemini IX-A mission were rendezvous and docking of the Gemini spacecraft with the ATDA, and the extravehicular activity of Pilot Eugene Cernan.

The Gemini IX spacecraft was inserted into an initial orbit with an apogee of 144 miles and a perigee of 86 miles (all mileage quoted in this report is in terms of nautical miles, and each nautical mile is 1.15 statute miles). According to the mission plan, the spacecraft would rendezvous with the ATDA during the third revolution; to accomplish this event, seven maneuvers were scheduled.

The first maneuver involved a phase adjustment initiated at 49 minutes and three seconds after lift-off



ASTRONAUT EUGENE A. CERNAN, Gemini IX pilot, has his suit adjusted by suit technician Al Rochford in preparation for a test. The Gemini IX extravehicular suit weighed 35 pounds and the leg cover layer was qualified to withstand surface temperatures of 1200 degrees Fahrenheit while maintaining the suit internal temperature to no more than 110 degrees Fahrenheit.

...suit adjusted ...The Gemini IX ...er layer was ...es Fahrenheit ...ore than 110

to attain the correct orbital catch-up rate for rendezvous with the ATDA in the third revolution of the spacecraft. Following the completion of this maneuver, the Gemini IX spacecraft now orbited the earth with an apogee of 147 miles and a perigee of 124 miles.

Stafford executed a corrective combination maneuver beginning one hour and 55 minutes, 17 seconds into the mission. This action adjusted the catch-up rate and the plane of the spacecraft orbit to bring it closer to the ATDA's orbital plane.

An additional maneuver was performed as the Gemini spacecraft neared its apogee on the second revolution. Termed a coelliptic maneuver, the objective was to place the spacecraft in a circular orbit. Initiated two hours, 24 minutes, and 51 seconds into the flight, this action resulted in the spacecraft being within 109 miles of the target with a closure rate of about 126 feet per second and about 12 miles below the target orbit. Pilot Cernan related that the spacecraft was about one mile from the target as they passed over New Guinea during the third revolution, at about four hours and 11 minutes of mission elapsed time.

As the spacecraft moved across the Pacific Ocean, the tracking station at Hawaii picked up the voice communication, and at this time Stafford revealed that the shroud on the nose of the ATDA had not separated. In describing the situation, Stafford said, "We have a weird looking machine here . . . both the clam shells of the nose cone are still on but they are open wide. The front release has let go and the back explosive bolts attached to the ATDA have both fired. . . . The jaws are like an alligator's jaw that's open at about 25 to 30 degrees and both the piston springs look like they are fully extended. . . . It looks like an angry alligator out here rotating around."

During the rest of that pass over Hawaii and continuing across the United States, flight controllers studied the situation and considered several possible means of breaking the shroud loose from the target. They determined that one possibility would be to have the ground transmit several commands to the target, first to "rigidize," the second to "unrigidize" the docking cone. These actions were carried out after the crew had backed away to a safe distance to observe the activity. The commands resulted in the shroud moving, and the "alligator's jaw" partially closing.

After it was suspected that the shroud had not jettisoned an alternate plan was worked out in Houston. At a time when docking had been planned, the Mission Control Center, Houston, gave Stafford instructions to align his spacecraft and to perform a maneuver which would place the spacecraft into an orbit about two and a half miles above and 11 miles behind the target. About an hour and 30 minutes later, Stafford completed the equi-period rendezvous which had originally been programmed for the 28th hour of the flight. This maneuver, a completely onboard operation, used the computer and a handheld sextant to obtain a guidance.

Stafford executed a separation maneuver at an elapsed flight time of seven hours and 14 minutes. He later reported satisfaction with the results after tracking the ATDA on radar. Following this maneuver, the Gemini IX spacecraft orbited the earth at an apogee of 160 miles and a perigee of 156 miles; the ATDA remained in an orbit with an apogee of 161 miles and a perigee of 159 miles. Mission Control Center, Houston, predicted that during the sleep period scheduled for the crew before the final rendezvous attempt, the spacecraft would move about 60 miles ahead of the target.

The third rendezvous, designed to simulate a lunar module rendezvous (rendezvous from above), would undertake to investigate possible conditions of a lunar rendezvous which might take place if the lunar excursion module had descended to the 50,000-foot level above the moon's surface. With the spacecraft about 80 miles ahead of the target, the first maneuver toward affecting the rendezvous was initiated at 18 hours, 23 minutes into the flight to adjust the spacecraft altitude. About two hours and 39 minutes later, the crew was preparing for the terminal phase initiate maneuver of this rendezvous. Stafford and Cernan then reported difficulty in visually acquiring the target using this mode of rendezvous but stated they had a solid radar lock-on. This difficulty resulted when they attempted to visually sight the target against the background of the Atlantic Ocean and the sand dunes of the Sahara Desert. The crew was not able to see the ATDA until they were within three miles of it. They said during a debriefing later that even after they had visual acquisition it would be intermittently lost to sight against various terrain features.

During this final rendezvous with the ATDA, the crew maneuvered to about three inches from the shroud to take closeup pictures of the shroud wires. Speaking of this activity, Stafford graphically described it by saying, "We kept clear of the dipole antenna, rolled the Gemini on its side, and rolled right up to where the X axis of the Gemini was 90 degrees to the X axis of the ATDA, and rolled right into it, and snapped the pictures. Making sure the alligator wouldn't bite us that way."

Stafford and Cernan reviewed the situation after the rendezvous. Stafford requested that any extravehicular activity be postponed until the following day due to crew fatigue. They had completed three rendezvous events in less than a day, all being by different modes, and the crew was quite fatigued by the close attention demanded. Permission was granted and the flight controllers on the ground started immediately to revise the flight plan.

After completing their station-keeping operation with the ATDA, Stafford and Cernan performed a separation maneuver high above the African continent. Several hours later after another scheduled rest period, the crew began work to accomplish several experiments. These consisted of zodiacal light photography, airglow horizon photography, and a communications system experiment to check operations through the ionosphere.

GEMINI IX-A EXTRAVEHICULAR PHOTOGRAPH — Astronaut Eugene A. Cernan during the time he was outside his spacecraft during the long period of extravehicular activity. The photo was taken by command pilot Thomas P. Stafford.

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EVA

About 5:30 a.m., EST, the following day, some 45 hours into the flight, Stafford and Cernan began precise preparations for the EVA activity. According to the plan, this operation would commence at the 49-hour, 26-minute point, just as the Gemini IX spacecraft entered the daylight portion of an orbital circuit. During the "making ready" period, ground stations held their communications with the spacecraft to a minimum, collecting only the essentials of information, and the crew advised on the status of the preparations. Stafford said, near the 47-hour point, ". . . we've got the big snake out of the black box," meaning thay had removed the 25-foot umbilical from its stowage place. A few minutes later, Stafford reported a problem with the number three thruster which was causing the spacecraft to build up a roll. During this same time period, the command pilot also reported that the needles indicating attitude of the spacecraft appeared to be in reverse logic. James Walker of McDonnell suggested that perhaps the crew had inadvertently knocked the scanner heater circuit breaker to the off position during their EVA preparations. Stafford checked; Walker was right. The command pilot switched the circuit breaker to the on position, the needles again indicated proper spacecraft attitude. At the same time the roll control problem with the number three thruster cleared up.

As the 49th hour drew near, Stafford told the ground stations that they were slightly ahead of schedule in their EVA preparations and that they were in the process of drinking a lot of water as the flight surgeon in the Houston Control Center had advised. Shortly thereafter, Flight Director Eugene F. Kranz told the Carnarvon station to relay the word to them that they were "Go" for cabin depressurization; this activity took place between Canton Island and Hawaii. Stafford reported depressurization complete at 49 hours and 19 minutes, and three minutes later the crew started opening the hatch. With the hatch opened Cernan stood in the seat, retrieved the S-12 micrometeorite impact package, deployed the handrails, attached the docking bar mirror, and set up his EVA 16mm camera. All the while he seemed enthralled with the space view. He also noted that the tasks were somewhat difficult to accomplish in this weightless, suit-pressurized environment where the objects he worked with all tried to float away.

At the 49-hour, 43-minute elapsed-time point, Cernan moved outside the Gemini IX spacecraft. He saw Los Angeles, he thought, and mentioned seeing Edwards Air Force Base. Cernan remarked about the difficulty in getting to desired vantage positions with the "snake" seemingly all over him, but he gradually worked his way toward the spacecraft's adapter section. He then returned to the hatch area so that he and Stafford could change the film in the EVA camera and illuminate the EVA lights for the night orbital period. After this, Cernan returned to the adapter vicinity and reported there were no streamers or hanging straps as there had been in the case of the VI and VII spacecraft.

As IX came into the sunlight over Africa, Cernan moved into the adapter area where the Astronaut Maneuvering Unit (AMU) was stowed. As he began to plug into the AMU circuits, Cernan noted that the exertion caused some fogging of his helmet visor. He also encountered difficulty in deploying the attitude control arms on the AMU, which ". . . presented far more difficulty to us in zero g than they did in the simulation," Stafford said. In addition to problems in connecting the oxygen hoses and electrical circuits, Stafford described Cernan's communications through the AMU transreceiver as having a "log of garble." The command pilot stated that Cernan's tasks seemed to be about four or five times harder to accomplish than had been anticipated, and they were about ready to give a "no go" on the AMU if the visor continued in its fogged condition. Although Cernan rested, the fogging condition did not improve significantly. Stafford and Cernan evaluated the situation after sunrise. They felt continued fogging constituted a flight safety hazard and, after ground concurrence, the AMU experiment was scrubbed. Cernan continued to rest and gradually gained about 25 percent vision through the visor. After he had switched to the umbilical communications lead, voice contact immediately improved between the command pilot and pilot. Looking through a clear spot near the point of his nose, Cernan facetiously remarked to Stafford, "Hey, Tom, what's that guy doing with the Texas driver's license out there on the California highway?" After more rest the fogging reduced to about 40 percent, but as he began to retrieve the docking bar mirror the fogging grew worse. Cernan also became quite warm. According to the flight plan he was scheduled to take photographs of the sunset but Stafford decided that Cernan should get back in the spacecraft before then.

At 51 hours and nine minutes Stafford helped Cernan back into the seat and they spent the next 17 minutes stowing the umbilical. They secured the hatch at 51 hours and 30 minutes elapsed time. The crew had been in extravehicular conditions for two hours and five minutes and had accomplished cabin repressurization without incident.

LANDING AND RECOVERY

Following the rather strenuous EVA operation the crew stowed equipment and settled down to rest and eat. At 53 hours and 10 minutes Houston Control Center passed data for Stafford to use in bringing IX's apogee down about 10 to 12 miles. This would make retrofire less sensitive to dispersions and allow better control during reentry. Stafford effected the maneuver and also tracked the ATDA at a distance of 165 miles behind the spacecraft. Over Hawaii during IX's 35th revolution, Cernan loaded the computer with the reentry equations and math flow. In the 36th revolution they received information on the 46-1 landing area from the *Coastal Sentry* in the western Pacific. With much of the preparatory work completed, they had their evening meal and began a sleep period. At the 67-hour point, Stafford responded to the Carnarvon communicator's call. The crew received flight update information, attended to the flight-plan checklist, and stowed equipment in preparation for reentry. Shortly after the 70-hour mark, Stafford armed the Reentry Control System (RCS); the dual set of rings checked out well. Then he asked the Houston communicator if the captain of the prime recovery ship in the Atlantic would "guarantee that the big boat's going to be on the spot?"

Retrofire was initiated at 71 hours, 46 minutes, and 44 seconds. In less than a minute Cernan confirmed "4 good Retros" to the Canton station. Splashdown occurred at 72 hours, 20 minutes, and 50 seconds less than two miles from the U.S.S. *Wasp* and in full view of television cameras. In four minutes, recovery personnel had the spacecraft flotation collar attached. The crew asked to be hoisted aboard ship in the spacecraft —a precedent set by Schirra in Mercury-Atlas 8 in October 1962, and also followed by Schirra and Stafford in Gemini VI on December 16, 1965.

POSTRECOVERY BRIEFING

Dr. Mueller opened the conference by expressing his satisfaction with the development of controlled reentry. He pointed out that this had been the longest EVA period and that this experience had taught us "a great deal more about man's ability to work in space. . . ." Dr. Robert R. Gilruth, Director of the Manned Spacecraft Center in Houston, said that although this was the thirteenth manned flight in Mercury and Gemini, he had observed that "even though we get a lot more proficient, the flights don't get any easier." The reason for this is because we try to do more on each flight, he said. As an example, he recalled that just a year ago we had trouble stationkeeping with the launch vehicle's second stage; the IX had not only performed this task using the ATDA but had been able to rendezvous successfully three times. Since docking had not been accomplished and the AMU had not been used, Dr. Mueller was asked if these had become "secondary in the scheme of things?" Mueller replied, "Of course not. Literally we did not meet all of the objectives we had established for the mission. I think we had a quite ambitious set of objectives to meet. Our posture is one where we will try to do as much as we can on each of our Gemini flights. We won't always succeed in meeting all of the objectives."

PILOTS' REPORT CONFERENCE

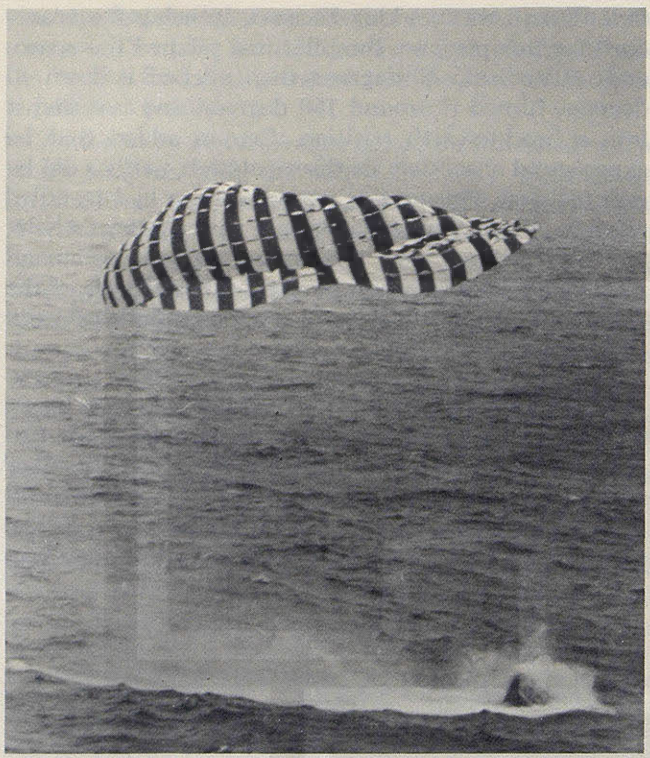
On June 17, after almost two weeks of technical debriefings, the pilots appeared before the news media to present a firsthand report of their mission experiences. NASA's Deputy Administrator, Dr. Robert C. Seamans, Jr., opened the conference by announcing that both astronauts and Colonel Richard C. Dineen of the Air Force's Space Systems Division had been awarded the NASA Exceptional Service Medal. Colonel Dineen had been responsible for the Gemini launch vehicle. Seamans then remarked that the Gemini IX spacecraft had been launched almost flawlessly and had landed with almost pinpoint precision. He added that some unforeseen difficulties had cropped up; some were procedural such as the shroud that failed to clear the ATDA docking adapter, and some were operational and could only be learned in space such as Cernan's saturated suit environment. These problem areas pointed up a factor quite often forgotten. ". . . . the Gemini program is experimental," Seamans said, and "As an experimental program, we try on each flight to advance to a maximum extent our understanding of space and how to operate in it." He added, ". . . there is still a good deal to learn in some . . . areas, as for example operation in docked mode and in manned operation outside the spacecraft." Much experience was still needed, he continued, in preparation for the Apollo missions.

Dr. Gilruth then introduced the Gemini IX-A crew, and Stafford led off the discussion with several allusions to his "elevator time" during VI and IX, facetiously remarking that he believed he had been jinxed by Schirra and Cernan. Then Stafford talked seriously of what had been gained from the May 17 failure of the Atlas to put the Agena into orbit. The crew had returned to Houston and met with Christopher C. Kraft, Jr., MSC's Director of Flight Operations, and his flight planning group to outline a Gemini IX-A mission which might achieve all the major objectives of the original flight plan. This included three rendezvous, which they believed to be important "to feed over into the latter Gemini flights and also the Apollo flights." Within about two days, he said, they had completed the analysis and had come up with the trajectories. On June 1 the computer update could not be transferred by ground equipment and the mission was again postponed. Stafford explained that these data were very sensitive to accomplishing rendezvous at the apogee of the third orbit.

Following the orbital insertion of the ATDA and another trip by the crew from the spacecraft to the now quite familiar elevator, there were suspicions that the ATDA shroud had not jettisoned. On the following day they went over to the hangar to study Gemini X's shroud in minute detail until they knew every piece and what to expect once they were in flight.

On June 3 the Gemini launch vehicle put them in orbit about 570 miles behind the target, and they began their catching maneuvers. When the target became visible they could see its docking adapter in reflected sunlight; in darkness they could see its flashing light. Stafford and Cernan thought ". . . . we were home free because we couldn't see a flashing blue [light] if the shroud was on." Even at a half-mile distance they had the same impression, Stafford said. At about 1,000 feet, however, they saw the shroud in its "open-jawed-alligator" position.

Stafford pointed out that their second rendezvous with the ATDA was the first pure optical space rendezvous that had ever been performed. Cernan made all of the computations; they did not use the computer and employed the radar only as a monitor. He added that whereas the shroud had been a curse to docking with the ATDA, it was a blessing to the visual sighting of



THE GEMINI IX spacecraft is seen as it touches down in the Atlantic Ocean on June 6, 1966, at the conclusion of its three-day space voyage.

the target due to its reflectivity in the sunlight, ". . . . in fact we might have missed it completely if we hadn't had the shroud on it." The command pilot stated that optical rendezvous from short distances was feasible but costly in fuel expenditure; radar was best and more economical in fuel usage.

The third rendezvous, which simulated a lunar module positioned in front of and below the Apollo command module, forcefully made the crew realize the value of their radar. To the command pilot the docking adapter against the background of the Sahara Desert ". . . looked like a period on a piece of typing paper." Without radar they would never have found the target and would have completely missed the rendezvous.

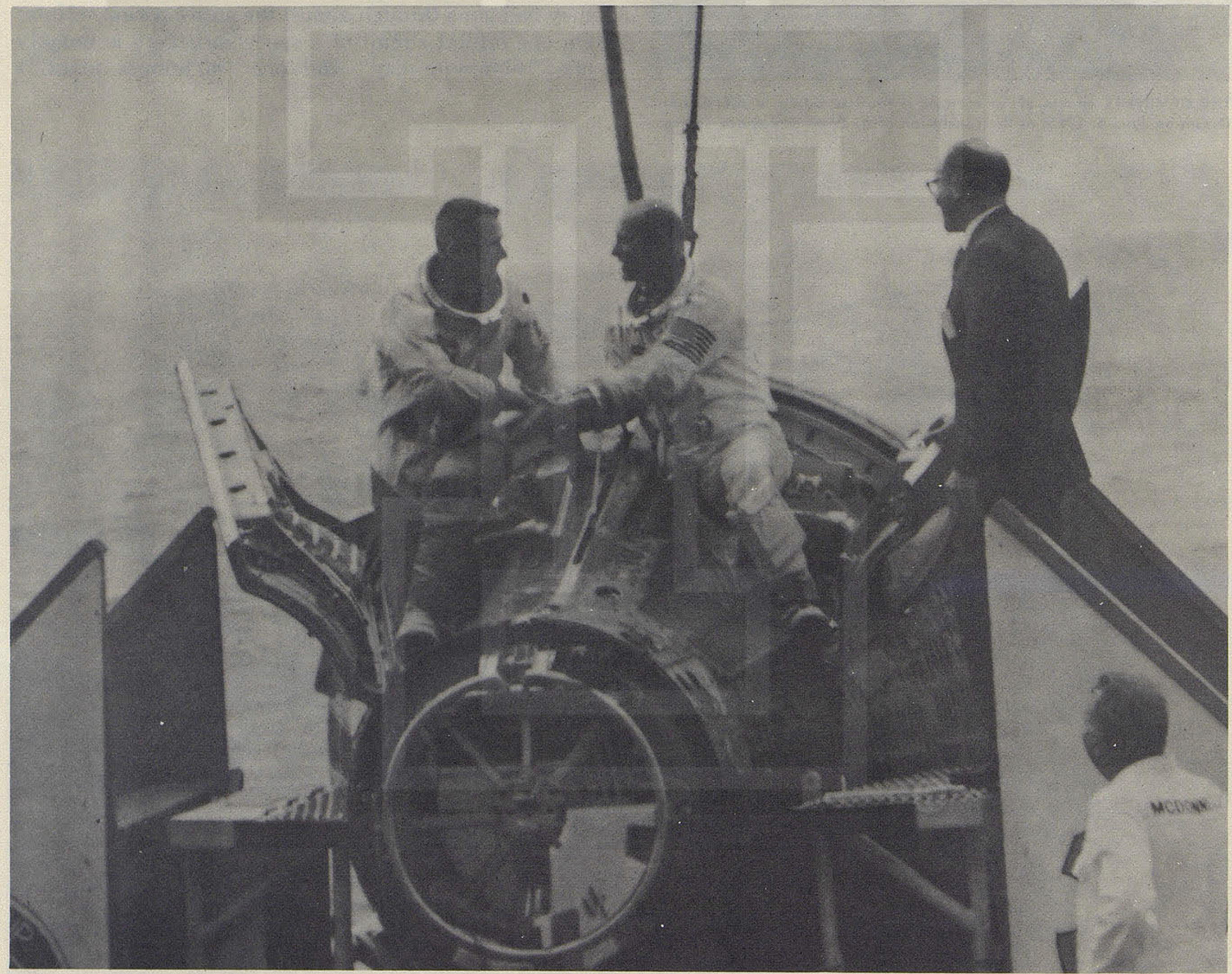
Speaking of EVA activities, Cernan said he had ". . . . been over it about 30 times in the technical debriefings . . . .," and he intended only to summarize the problem areas encountered in the actual flight situation. He opened the discussion by saying that a two-day and one-night EVA had been planned, and they had gone through almost the entire period. (Note: On one orbital circuit of a spacecraft there is roughly one "45-minute day" and one "45-minute night.")

GEMINI IX CREWMEN Eugene A. Cernan, left, and Thomas P. Stafford relax aboard their spacecraft as they await the arrival of the aircraft carrier USS Wasp and recovery helicopters hover nearby.

Cernan said that at the outset of EVA he sought to evaluate the tether dynamics control and with the 25-foot umbilical, test the use of handholds and Velcro or sticky type pads to assist in "walking around the spacecraft, and investigating the operation of the new Extravehicular Life Support System (the chest pack or ELSS)". Cernan said the ELSS operated satisfactorily on its medium flow providing comfort in terms of temperature control, total oxgen supply, and suit integrity. His suit pressure, he added, never varied from the chamber runs he had seen in Houston during the flight-training period.

While "walking" around the spacecraft, Cernan met with some difficulty in attaining the exact position he desired — a means of bracing himself against the drift encountered in zero gravity was needed in order to free his hands to accomplish the scheduled tasks. At this point Stafford injected that he could easily tell that Cernan was working because, in using the spacecraft for this purpose, the pilot had pitched the spacecraft attitude up 30 degrees, then pitched it down 40 degrees, turned it around 150 degrees, and inverted it into a head-to-earth position. Cernan added that he experienced absolutely no disorientation, neither did he ever feel lost. During this period Cernan had installed cameras, made film pack changes with Stafford's help, and attached rearview mirrors so that the command pilot could see him while he was in the aft area of the spacecraft. All of these tasks were accomplished with little physical exertion.

Near the 50-hour point, as scheduled, the crew began to partially close the hatch, leaving it open about two inches. Cernan said, "We didn't lock it for a number of reasons, not that I didn't trust Tom, but we did have an umbilical coming out of the hatch . . ." The main reason for this action was thermal control to pro-



SPACE BUDDIES Cernan, left, and Stafford exchange congratulations on completing their mission shortly after the spacecraft with the crew inside was picked up by the carrier USS WASP. On hand to greet them was John C. Stonesifer of Manned Spacecraft Center's Landing and Recovery Division.

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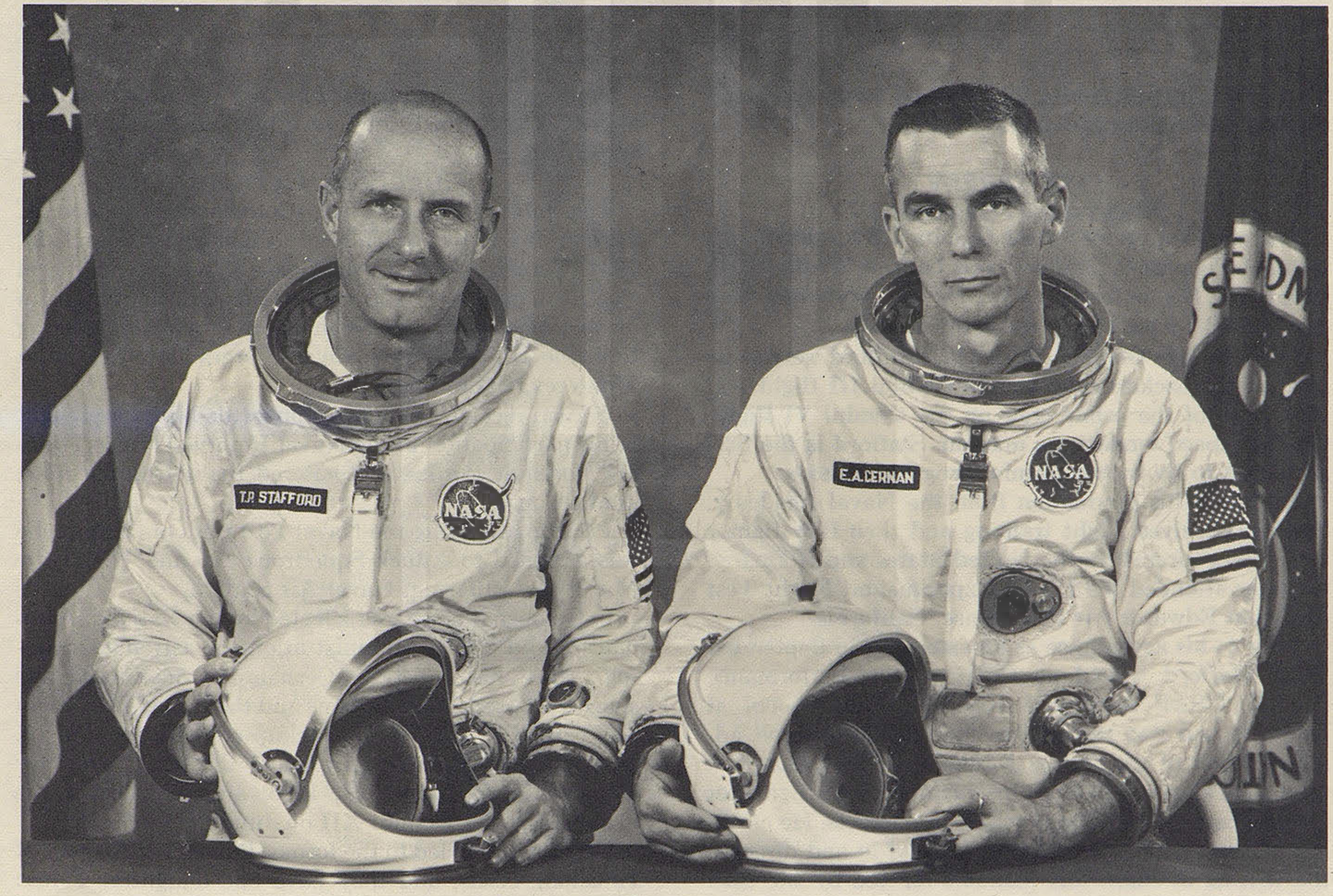
tect the hatch seals from the day-night temperature extremes. The pilot stated that the hatch closing proved to be the first real physical task he had encountered up to that point.

At the June 17 conference he used a full-sized spacecraft adapter with the AMU properly installed to demonstrate the second phase of his EVA experiences. He showed that the first objectives were to get his feet in the stirrups to prevent him from floating away; the stirrups allowed him the use of both hands to accomplish the electrical and oxygen connections. As it turned out, he said, his feet tended to float out of the stirrups and it became a problem to maintain his position. Thus, he was involved in an expenditure of effort that had not been anticipated in preparing the AMU for operation. Since he was in total sunlight at this time, he began to feel warm at a point in the small of his back. Postflight analysis showed that part of the superinsulation had ripped away from the stitching and allowed the radiation to penetrate the suit at that point. So he stopped and rested until sunset. When he resumed the tasks of donning the AMU, he noted that his visor began to fog with moisture collecting on both the visor and the suit pressure gauge. When he had felt the heat from the sun, he had increased the oxygen flow rate to maximum for better cooling and then left it in the increased flow position to try to eliminate fogging (in a similar manner to a defroster on an automobile).

Even after his vision became obscured Cernan continued to work for as Stafford said ". . . . he had been through it so many times he could do it blindfolded. Actually Cernan reached the point where he had only to connect the restraint harness (similar to an automobile safety belt) and the oxygen hose and for Stafford to throw the switch to cut the AMU loose. The question now was how long the fogging would continue; the crew decided to hold up on the terminal action to see. Since little improvement in vision resulted during the wait, they decided they were "no go" for the AMU. Cernan said that he rated the condition of the AMU "... in top notch shape . . ." when he left it. ". . . I'm convinced it was a flyable machine, "the pilot reported.

The crew learned several lessons during the EVA experience. They determined that work was possible in daylight and darkness; work could be accomplished in temperature extremes; there were absolutely no problems in disorientation in the two-hour period and no feeling of vertigo. Cernan stated that he had to expend an estimated 50 percent of his effort just to maintain the desired position while he was in the adapter area.



GEMINI IX FLIGHT CREW — Command Pilot Thomas P. Stafford and Pilot Eugene A. Cernan.

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	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	Stafford-Cernan	June 3-6, '66	72:21:00	1520:22:59

This effort, in addition to the required work, overtaxed the suit environmental circuit.

THE CREW

Thomas P. Stafford

The command pilot for the Gemini IX-A mission, Lt. Colonel Thomas P. Stafford, was born in Weatherford, Oklahoma, September 17, 1930. He was graduated from the United States Naval Academy in 1952.

Prior to the Gemini IX flight, Stafford served as pilot of the backup crew for the Gemini III flight and was pilot of the prime crew on the Gemini VI flight, the first space rendezvous mission. Stafford is the first astronaut to fly in two Gemini program missions.

Following his graduation from the Naval Academy, Stafford received flight training and then flew fighter interceptor aircraft in the United States and Germany. He later attended the USAF Experimental Flight Test School at Edwards Air Force Base, California.

Prior to his acceptance as an astronaut in September 1962, Stafford served as Chief of the Performance Branch, USAF Aerospace Research Pilot School at Edwards and was responsible for supervision and administration of the flying curriculum for student test pilots. He also served as an instructor in both flight test training and in specialized academic subjects. He established basic textbooks and participated in and directed the writing of flight test manuals for use by the staff and students.

Stafford is married to the former Faye L. Shoemaker, also of Weatherford; they have two daughters, Dianne and Karin.

Eugene A. Cernan

The pilot of Gemini IX, Commander Eugene A. Cernan, is a native of Chicago, Illinois, born March 14, 1934. Cernan received a bachelor of science degree in electrical engineering from Purdue University and a master of science degree in aeronautical engineering from the United States Naval Postgraduate School at Monterey, California.

Cernan received a commission in the Navy as a result of his participation in the Naval Reserve Officer Training Corps at Purdue and entered flight training upon graduation.

Prior to attending the Naval Postgraduate School, he was assigned to Attack Squadrons 126 and 113 at the Miramar, California, Naval Air Station.

In October 1963 he was selected by the National Aeronautics and Space Administration for astronaut training. Since his selection, Cernan has monitored the spacecraft propulsion systems and the Agena D. Cernan was named as pilot of the backup crew for Gemini IX on November 8, 1965; as pilot of the prime crew for Gemini IX on March 21, 1966; and as pilot of the backup crew for Gemini XII on June 17, 1966.

Cernan is married to the former Barbara J. Atchley of Houston, Texas, and they have one daughter, Teresa Dawn.

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEMINI XI MISSION

High Altitude, Tethered Flight

Fact Sheet 291-H
October 1966

Gemini XI, the ninth manned space flight of the Gemini program, was launched September 12, 1966. The mission was ended September 15. Primary objective of the mission—to rendezvous and dock with the target vehicle during the first revolution—was accomplished.

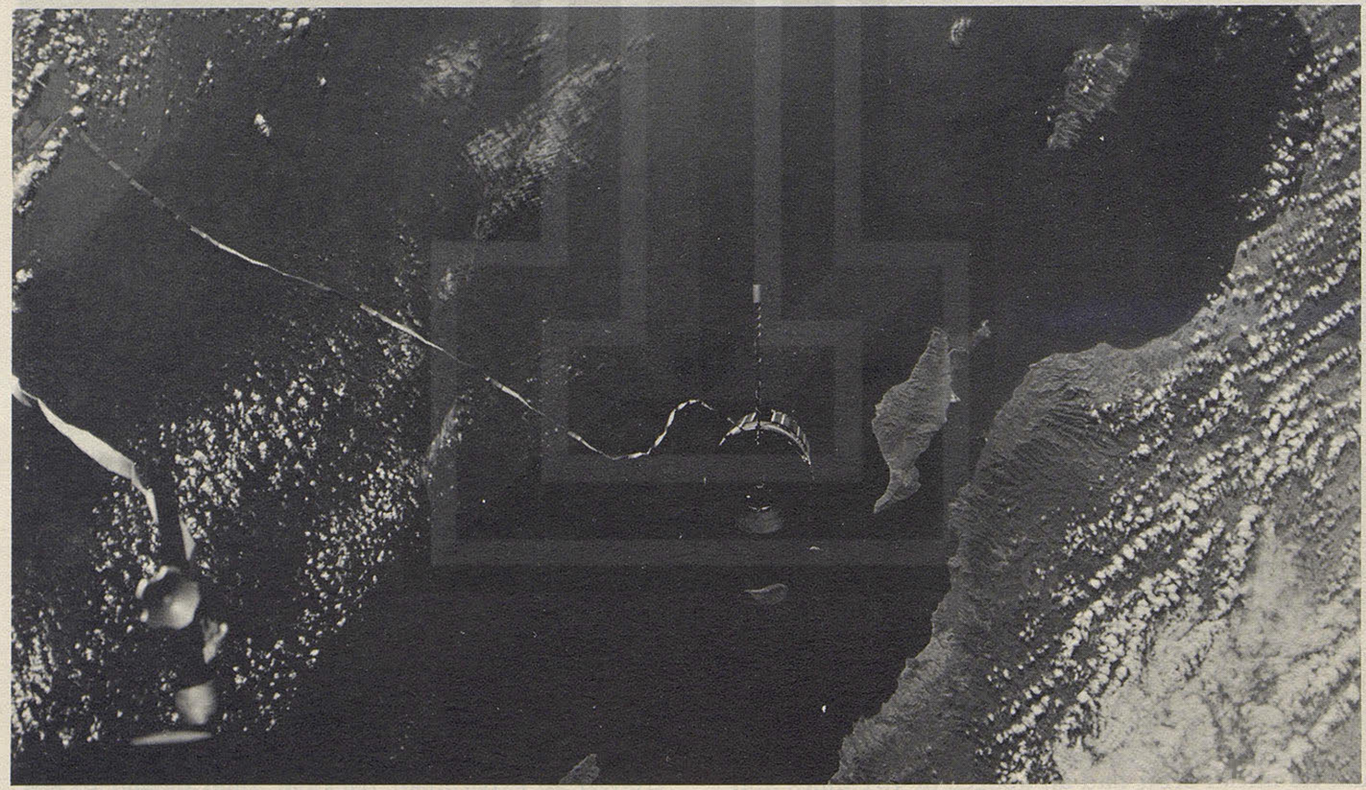
There were seven secondary objectives assigned to the flight:

- To conduct docking practice
- To conduct extravehicular activity
- To conduct 11 experiments
- To conduct docked maneuvers which included a high-apogee excursion
- To conduct a tethered vehicle test
- To demonstrate an automatic reentry, and
- To park the Agena target vehicle.

Gemini XI had been scheduled by the National Aeronautics and Space Administration for launch September 9, 1966. During the early stages of the countdown on that day, a small leak was discovered in the first stage oxidizer tank of the Gemini launch vehicle following completion of the propellant loading. The twin launches for the Gemini XI mission were later re-scheduled for the following day.

On September 10, Astronauts Charles Conrad, Jr. and Richard F. Gordon, Jr., command pilot and pilot of Gemini XI, respectively, were awakened early and after a physical examination, they had breakfast, suited up, and arrived at the White Room at the launch pad about 6:23 a.m., EST.

On arriving there, they were advised that the count was being held and were asked to hold up on being inserted into the spacecraft. This hold had become effective during the few minutes it took them



THE GEMINI XI SPACECRAFT, lower left, and target vehicle, center, are shown during tethered flight. This photo was taken as the spacecraft passed above the Gulf of California and Baja California.

to travel from the Ready Room to the launch pad and ascend to the 100-foot level on the elevator. Some 35 minutes later Conrad and Gordon were advised to return to the Ready Room. At 7:19 a.m., almost an hour after the hold had gone into effect, Mission Director William C. Schneider of NASA Headquarters announced that the flight had been scrubbed and would be recycled to occur 48 hours later. This hold was caused by a suspected malfunction of the autopilot on the launch vehicle for the Agena target.

Launch Day

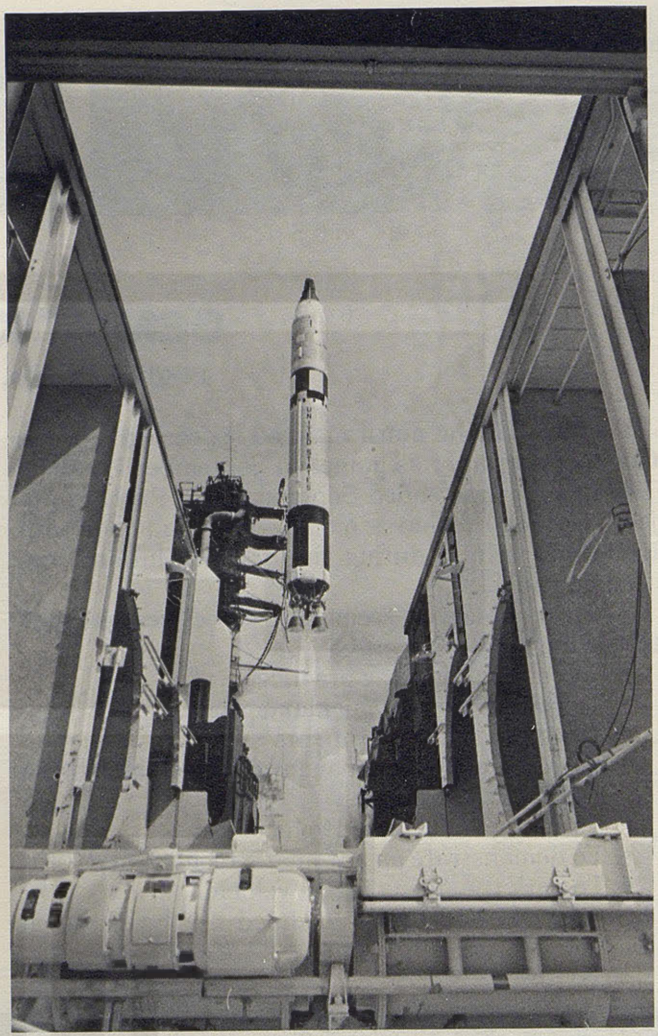
Finally, on September 12, the third time proved the charm for Gemini XI crew. They again went through the familiar preflight preparations including the physical examination, breakfast, suiting up, final briefings, and the trip to the White Room atop the gantry. On this morning they had Astronaut Alan B. Shepard Jr., as a breakfast guest and the menu varied from that which has come to be considered the normal preflight breakfast by substituting sirloin strip steaks for filets. The rest of the breakfast consisted of juice, scrambled eggs, toast, and coffee.

Conrad and Gordon arrived at the White Room at 7:25 a.m., EST, and "checked signals" with the backup crew before being inserted into the spacecraft. That crew, with Neil Armstrong and William Anders serving as command pilot and pilot, respectively, had been participating in the countdown activities for about five and a half hours.

A hold was initiated at T minus 97 minutes and five seconds due to suspected leakage around the command pilot's hatch. The hatch was reopened, the sealant checked, and the hatch closed again. The countdown was then recycled to T minus 103 minutes. This hold lasted about 10 minutes plus a 6-minute recycle for a total of 16 minutes delay.

The countdown was resumed and the Atlas-Agena target vehicle liftoff occurred at 8:05:02 a.m., EST. Shortly after liftoff preliminary orbital figures for the Agena indicated that it would be in an orbit with an apogee of 165 miles and a perigee of 156.6 miles (all mileage figures quoted in this Fact Sheet are in nautical miles—one nautical mile is equal to 1.15 statute miles).

A postflight examination of data determined that the Agena was in an orbit with an apogee of 163 miles and a perigee of 153 miles. During the remainder of the Gemini countdown, Conrad asked for an estimated launch time, the length of the launch window and the length of the T minus three-minute hold. He was told that the estimated ignition time was 9:42:23 a.m. with liftoff to occur at 9:42:26 a.m., the launch window would be two seconds in duration, and that the hold was anticipated to last two minutes 21 seconds. This information was accurate. Gemini XI liftoff was clocked at 9:42:26.5, and its initial orbit had an apogee of 151 miles and a perigee of 87 miles.



AN UNUSUAL ANGLE shows Gemini XI scant seconds after lift-off.

In achieving the first-orbit rendezvous, Gemini XI performed a minor plane change to the left shortly after 29 minutes of the flight had elapsed, then made a terminal phase burn maneuver after 49 minutes and 58 seconds of the mission had been flown. The latter maneuver with minor midcourse corrections placed the spacecraft in position to initiate the braking maneuver after about one hour and 18 minutes of the flight had elapsed.

During the next several hours the crew performed various sequences of the Ion-Wake Measurement experiment, including one undocking and redocking. After four hours and 28 minutes of flight the first docked maneuver was initiated using the Agena's primary propulsion system. Each crewman performed an additional docking practice before entering the first sleep period which was scheduled to start about eight hours after liftoff.

At 24 hours and two minutes after liftoff, Gordon opened his hatch and began the umbilical extravehicular (EVA) activity. He set up a camera, retrieved an experiment package, then moved to the nose of the spacecraft and attached a tether from the Gemini Agena Target Vehicle to the docking bar. This operation proved very difficult and tiring. As a result, Conrad and Gordon decided to terminate this phase of EVA because of pilot fatigue. The hatch was open 33 minutes.

After 25 hours and 37 minutes, ground elapsed time, the pilot opened the hatch and jettisoned the equipment no longer needed for the mission. The other major activity during the second day of the flight was spent performing various sequences of the Airglow Horizon Photography experiment, and the second sleep period started after 31 hours and 30 minutes of flight. That period terminated at 39 hours.

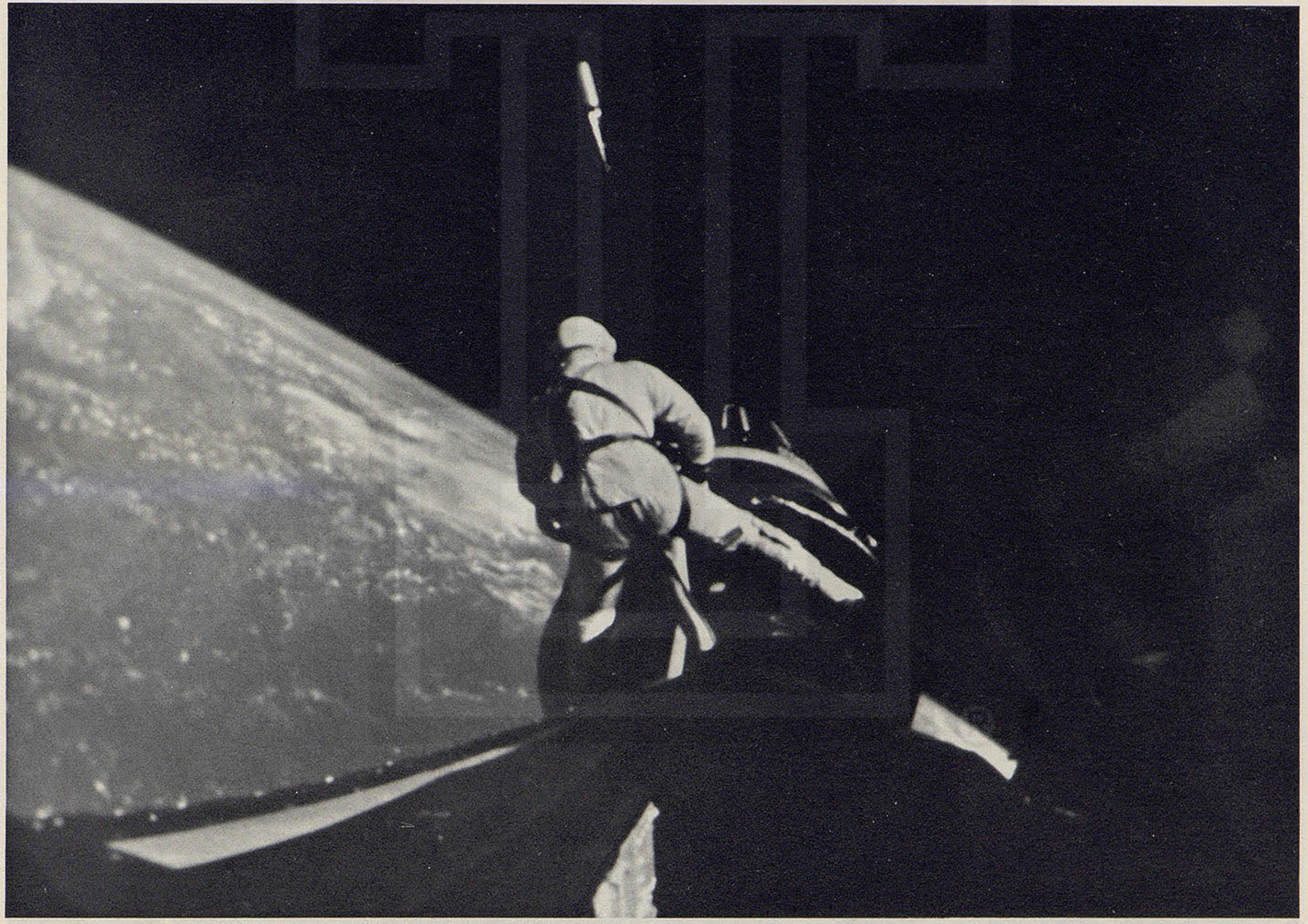
High Altitude

The following day the Agena primary propulsion system was used to place the docked Gemini-Agena configuration into an elliptical orbit which had an apogee of 741.5 miles and a perigee of 156.3 miles. This maneuver was initiated after 40 hours, 30 minutes and 15 seconds of flight. During the ensuing two revolutions the crew was busy taking photographs required for the Synoptic Terrain Photography, Synoptic Weather Photography, and the Airglow Horizon Photography experiments. After 43 hours, 52 minutes, and 55 seconds of flight, a retrograde maneuver was performed which lowered the apogee of the docked vehicles to 164.2 miles while the perigee remained at 156.0 miles.

Conrad and Gordon then started preparation for the standup EVA activity and the pilot opened his hatch after an elapsed flight time of 46 hours and seven minutes. During the two hours and eight minutes of standup EVA both night passes were spent taking photographs for the Astronomical Camera experiment.

Tethered Operation

The spacecraft was undocked about 49 hours and 55 minutes after liftoff and the successful tether operation began at that time. About 17 minutes later the crew initiated a rotational rate to the tethered vehicles. The initial rate achieved was 38 degrees per minute. Later the Gemini XI crew increased the rotational rate to about 55 degrees per minute and again encountered oscillations. Oscillations were reduced more rapidly by maneuvering the spacecraft and after about 20 minutes the rotating combination became very stable.



THIS EVA ACTIVITY of Astronout Richord Gordon prompted command pilot Charles Conrad to yell "Ride 'em Cowboy!" The oction took place 160 miles above the Atlantic Ocean.

As a result of this operational experiment the tethered system appears to be an economical and feasible method of unattended station keeping. This activity was ended after about 53 hours of flight.

The next day, a series of maneuvers was initiated, starting at 65 hours and 27 minutes of flight, to achieve a re-rendezvous with the target vehicle. Conrad and Gordon were station keeping with that target one hour and 13 minutes later.

Retrofire occurred over the Canton Island tracking station at an elapsed time of 70 hours, 41 minutes and 36 seconds. The crew performed all manual functions to prepare the spacecraft for reentry. At 400,000 feet Conrad rolled the spacecraft to a backup bank angle of 44 degrees, and the computer commanded a bank angle for full lift and a right roll to recover from the backup bank angle. At this time the crew agreed that the computer was operating properly and switched control to the automatic mode. Conrad followed all commands for control of the spacecraft with the attitude hand controller deactivated so that, if a problem occurred, manual control of the reentry could have been initiated in a minimum time.

The landing point achieved by the automatic reentry was about one and a half miles from the prime recovery ship, the USS *Guam*, after 71 hours, 17 minutes and eight seconds of flight. After landing, Conrad and Gordon decided to be retrieved by helicopter and they were on the deck of the *Guam* 24 minutes after landing. The spacecraft was picked up by the *Guam* 35 minutes later.

George E. Mueller, Associate Administrator of NASA for Manned Space Flight, listed the major accomplishments of the Gemini XI flight at the post recovery news conference, conducted in Houston September 15. They were:

- The first-orbit rendezvous and docking—probably the most difficult to achieve of all rendezvous attempted to date.
- A perfect re-rendezvous from a standoff position of about 25 miles.
- Achieving an orbit with a 741.5 mile apogee and verification of the radiation levels at that altitude—a new altitude record for manned flight.
- Docking practice successfully carried out—two dockings performed by the command pilot, two by the pilot.
- Gemini XI achieved the greatest total time engaged in extravehicular activity for a single flight—a total of 161 minutes.
- Gemini XI carried out the tethered vehicle exer-

THIS UNUSUAL PHOTO shows Gemini XI pilot Richard Gordon preparing for the umbilical extravehicular activity. Conrad took the picture.

cises. It reached a spin rate of 55 degrees per minute, thus providing the first, although very small, artificial gravity field in space.

- Maneuvers with the Agena and Gemini spacecraft in a docked configuration and using the Agena propulsion unit for power were conducted. This activity resulted in attaining an elliptical orbit with an apogee of 741.5 miles.
- Ten out of 11 scheduled experiments for the mission were accomplished.
- The automatic reentry—attempted for the first time in the Gemini program—was successful and the spacecraft landed within several miles of the primary recovery ship.

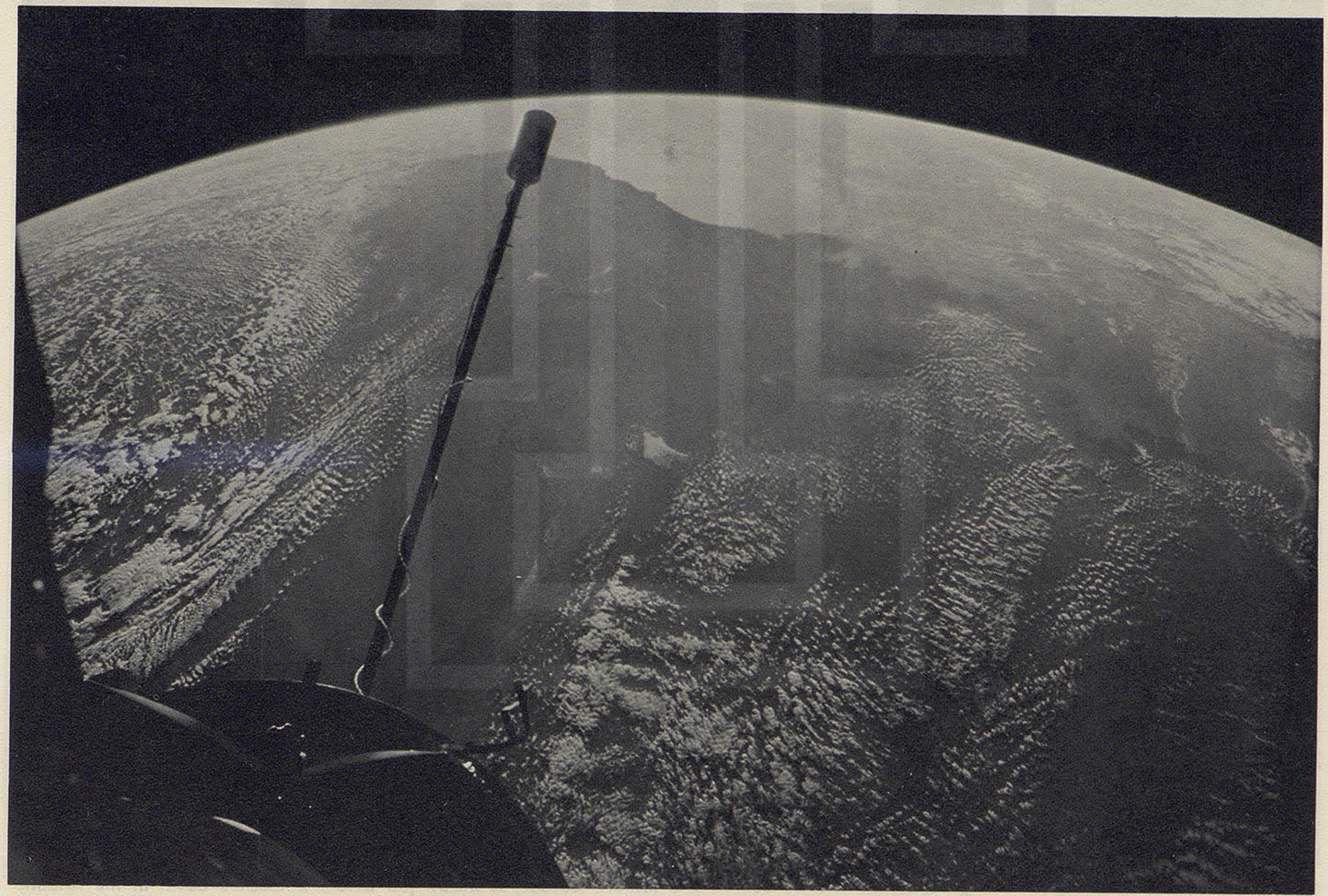
In addition to Mueller, those participating in the post recovery news conference included: MSC Director Robert R. Gilruth, Lt. Gen. Leighton I. Davis, DOD Manager of Manned Space Flight Support Operations; Charles W. Mathews, Gemini Program Manager, MSC; and Flight Surgeon Charles A. Berry.

In his remarks, Gilruth pointed out that he found the results of the tether experiment to be most fascinating and said that the resultant stability and the low rotation rates achieved was probably an indication that a number of vehicles can be fastened together in space in this or similar ways. He also pointed up the fact that there is still much to be learned about extravehicular activity. Gilruth said we have worked hard on this phase of activity and each time felt we have learned from the preceding flight and still the problems of EVA have not yielded to solution as have other technical problems.

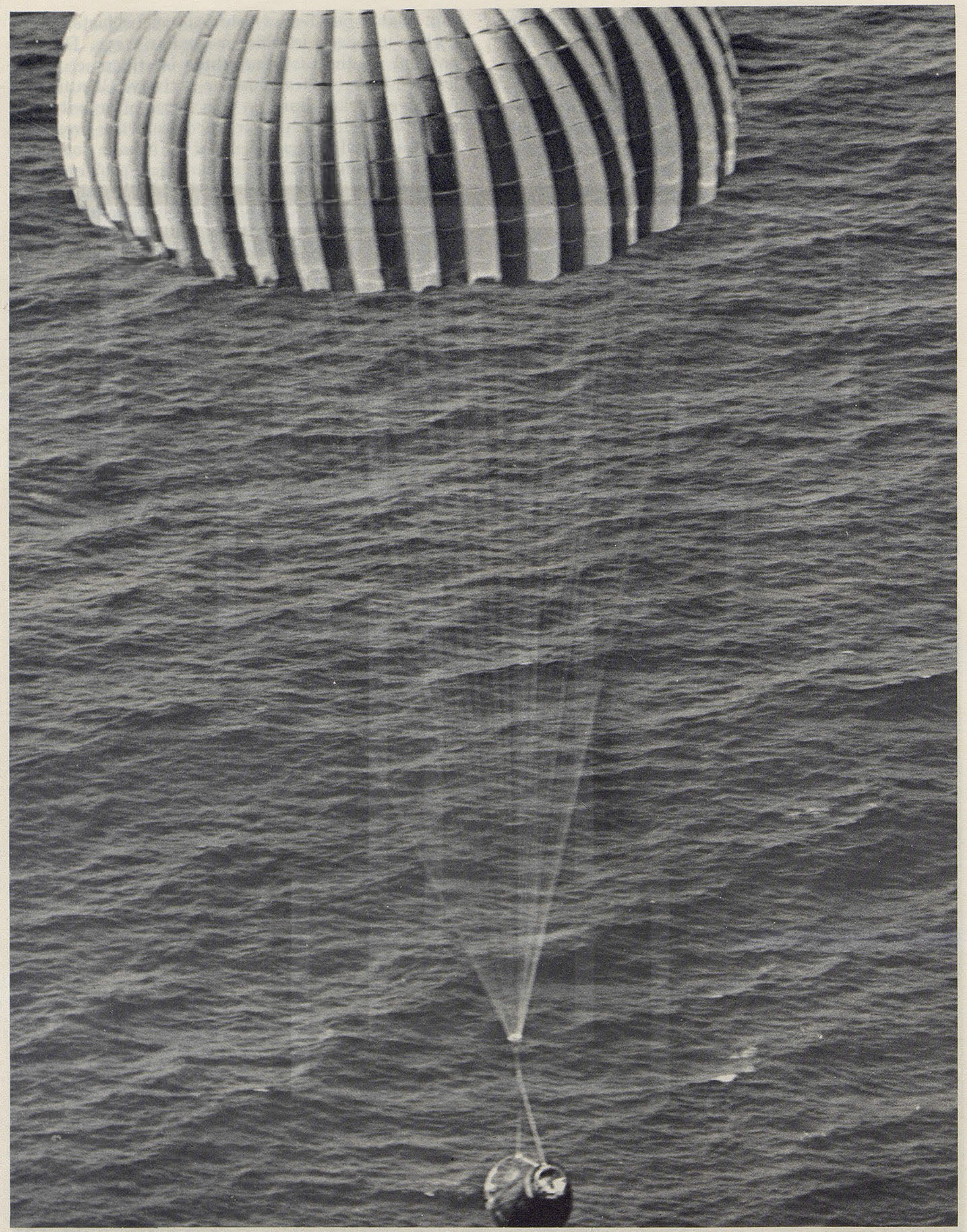
In answer to a question as to whether the workload encountered during EVA on Gemini XI had come as a surprise, Mathews said the design of the equipment was based on a reasonable workload one might expect a man to do. He added that one of the major difficulties is the fact that it is impossible to simulate weightlessness for extended periods of time on earth, and that up to this time no technique for this training has been developed which does not have great limitations.

General Davis said the recovery force had a very easy job due to the fact that the people responsible had developed the equipment and techniques which led to such a precise operation.

Dr. Berry, in response to a question as to whether Gordon had any reaction of any kind after his extreme exertion, said that there was no reaction other than the fact he was tired.



THE NORTHWEST COAST OF AUSTRALIA as seen from the Gemini XI spacecraft at an altitude of 740 miles. This is the most impressive view of the curvature of the earth yet taken by man.



THE GEMINI XI SPACECRAFT, containing Astronauts Charles Conrad and Richard Gordon, is shown just before it touched down in the Atlantic Ocean about 700 miles east of Cape Kennedy, Florida. This photo was taken from a helicopter which was hovering in the vicinity of the impact point.

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PILOT'S REPORT

The postflight Pilots' Report was conducted at Houston, September 26. Following brief introductory remarks by George Low, Deputy Director of Manned Spacecraft Center, Conrad and Gordon described their experiences at length.

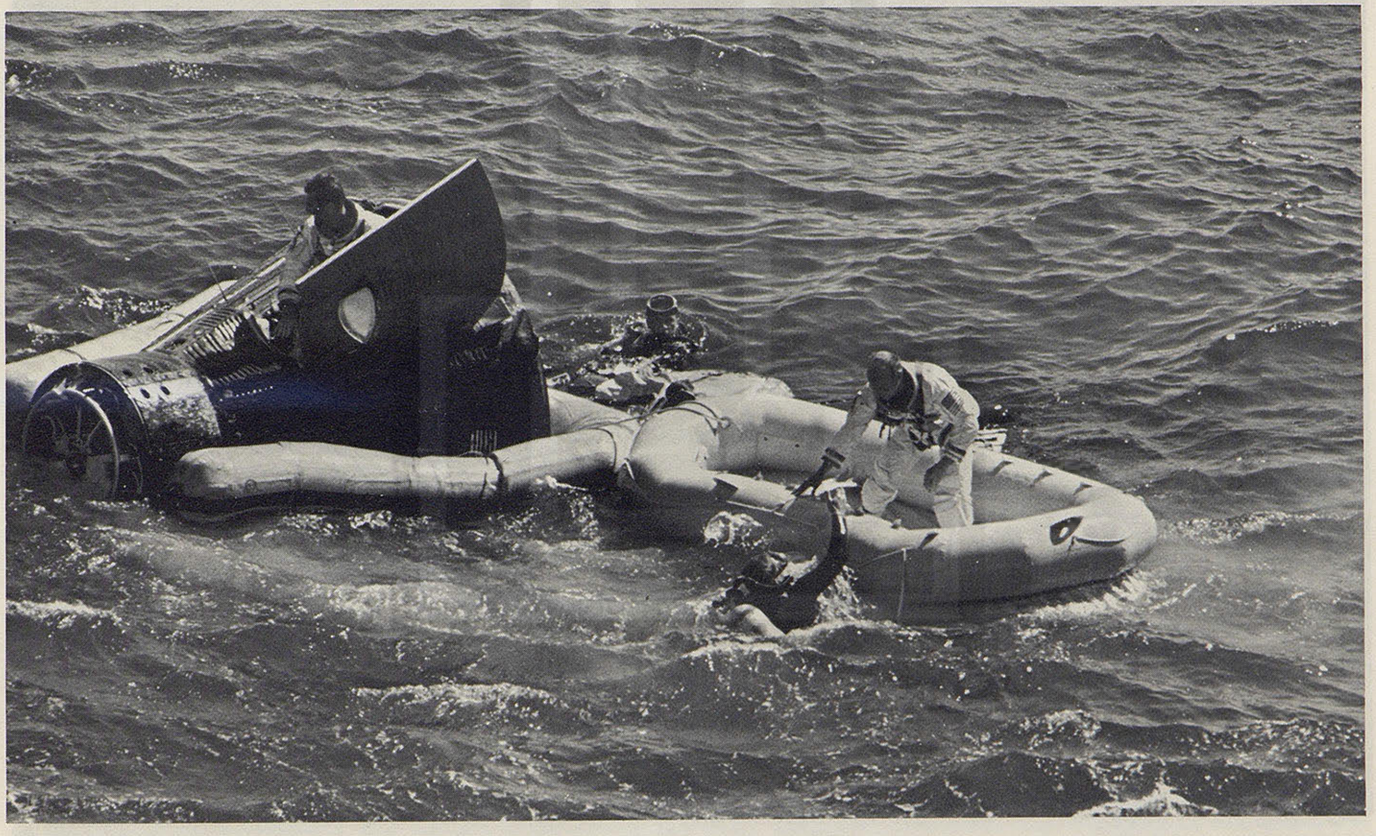
In talking about the first orbit rendezvous, Conrad said, "I think probably the most significant factor of the rendezvous is that although we had good information from the ground we accomplished the rendezvous totally with information contained within the spacecraft."

A little later Conrad added, "Due to our late liftoff time we came upon the Agena in daylight a little bit sooner than we expected. I think I shot two or three per cent of the fuel fussing around getting used to seeing the bright Agena when I couldn't see the instruments. I fumbled for my sunglasses and didn't get them. On the re-rendezvous I was ready for it and got the sunglasses on in time and I could both read the instruments and track the Agena."

Gordon threw a little sidelight into the report at that time. He said, "I want to mention something about insertion that Pete and I had talked about a great deal. This was our own ability to shut out the outside world and confine our activities to the vicinity of the spacecraft . . . [in my case] to the manual data insertion unit, the computer and the readouts. We had sustainer engine cutoff at about five minutes and 40 seconds with spacecraft separation at six minutes. Well, when Pete separated from that booster I couldn't help myself. I really had to look outside and I got the biggest shock of my life because floating all around the spacecraft was all kind of garbage. I said, 'Hey, look at all that junk out there.' And the next words I got from him were 'Hey, get to work.' . . . but I couldn't resist. I must admit that I had talked to myself for days, but I just couldn't resist that first quick look."

In discussing the umbilical EVA problems, Gordon said he felt that he and Conrad had practiced this phase of activity so frequently that they got into trouble. The flight plan allowed about four hours for the EVA preparation and the Gemini XI crew was ready approximately two hours before they were scheduled to be. This resulted in Gordon becoming overheated and the crew decided to go back to the spacecraft's environmental control system. About a half hour before start of EVA Gordon again pressurized his suit, then had difficulty putting on the gold-plated EVA visor. This task was so difficult that Gordon became extremely tired and developed a high heart rate.

Gordon said, "The hatch was opened on time, I stood up in the seat, or rather flew out of the spacecraft, because as soon as we opened the hatch all the debris and junk that we found in the spacecraft went floating out the window—or out the door



POST-LANDING RECOVERY ACTIVITY—Command pilot Conrad stands in the life raft and talks to a Navy pararescueman while pilot Gordon emerges from the Gemini XI spacecraft. This action took place only several minutes after the landing.

really. And I was right along with the rest of the debris."

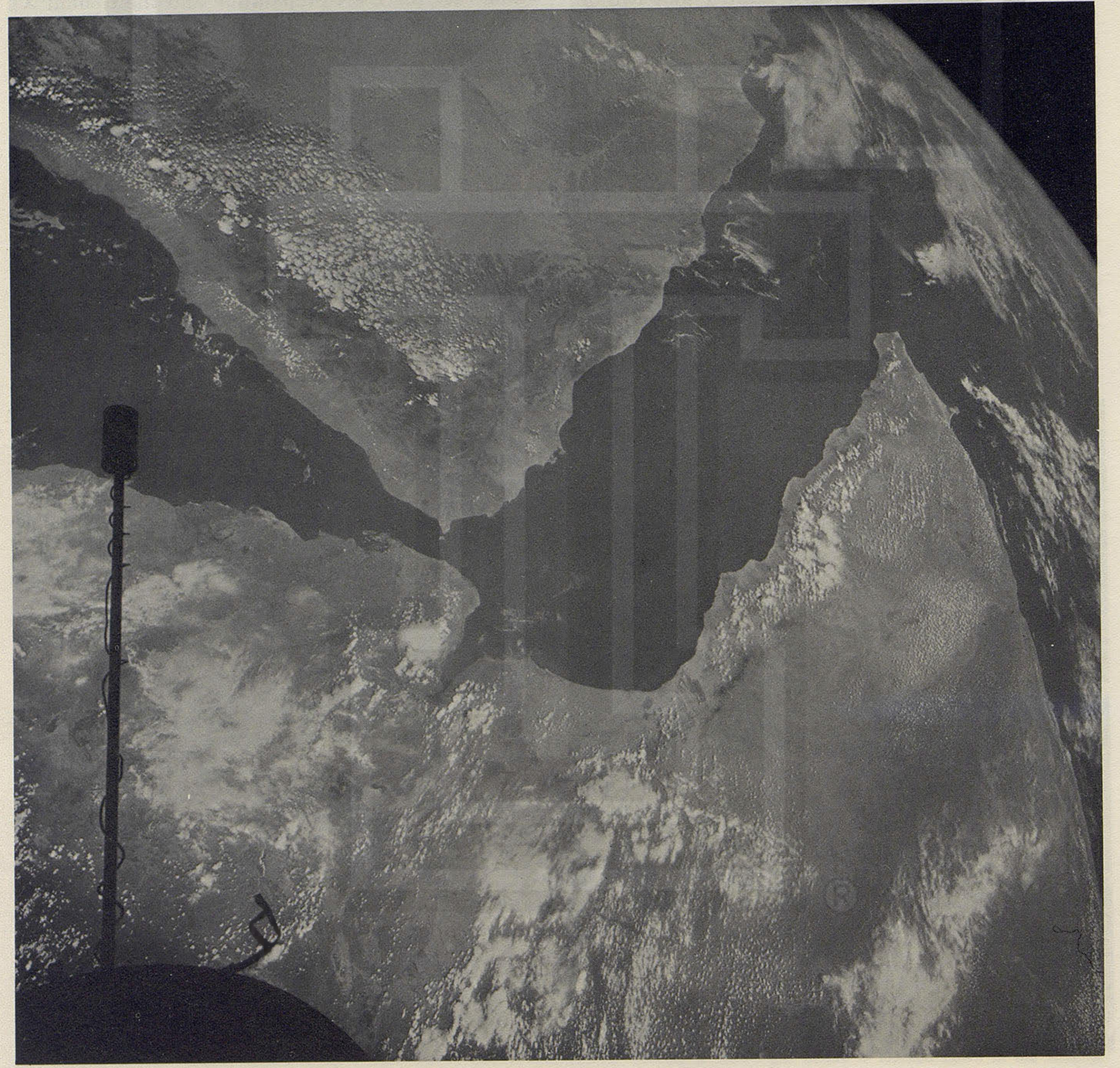
Conrad interjected, "I remember that. The only thing I saw was his feet going out of the hatch."

Gordon continued, "The only thing I could say to Pete was 'Hey, grab me, I'm leaving you.' So Pete actually had to hold me in the craft."

The crew continued the description of the EVA and told of the difficult nature of the activities which led to their decision to terminate the EVA after 33 minutes because of the exhaustion of the pilot and the fact that perspiration was gathering in Gordon's right eye and impairing his eyesight.

At a later point in the discussion Conrad was talking about activities during the standup EVA. He said after their experience with the umbilical EVA they knew they had an excellent hatch. When they jettisoned the umbilical equipment it was apparent that the right hand hatch was like your front door. He said, "We could open and close it any time we wanted to."

Conrad added, "Houston advised us that the weather there was going to be clear and suggested that we might get some pictures out of the hatch. We hadn't been able to do this before. So, Dick was going to hang out of the hatch and grab some pic-



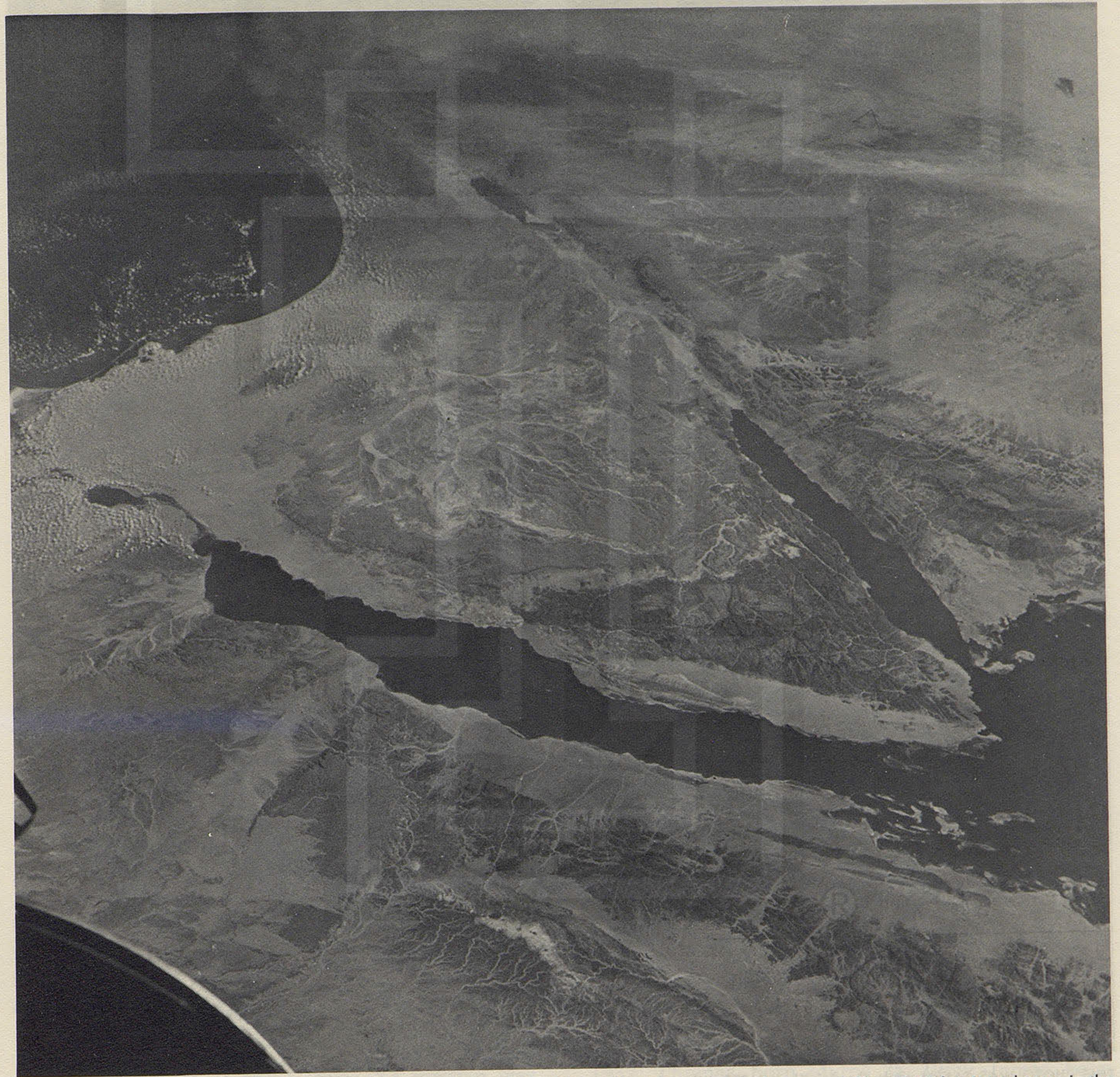
THIS VIEW FROM ABOUT 400 miles high presents a view of Ethiopia and Somali in northeast Africa. Also seen in this photo are the Red Sea and the Gulf of Aden.

tures of Houston with the Hasselblad . . . we came out of the night side and it was 7:00 a.m. in Houston, local time. It only took us about four minutes to go from Houston to Florida and we had the whole rest of the Atlantic to go with nothing to do. So, lo and behold, I fell sound asleep in my hard suit with my arms extended and all of a sudden I woke up and realized that not only was I asleep on the job but I was asleep while we were depressurized. I said, 'Hey, Dick, would you believe I fell asleep?' And all I got out of him was, 'Huh, what?' So there we were out over the Atlantic. He was asleep hanging out of the hatch on his tether and I was sitting asleep inside the spacecraft. So I think you can see that standup EVA was an entirely different operation than umbilical EVA."

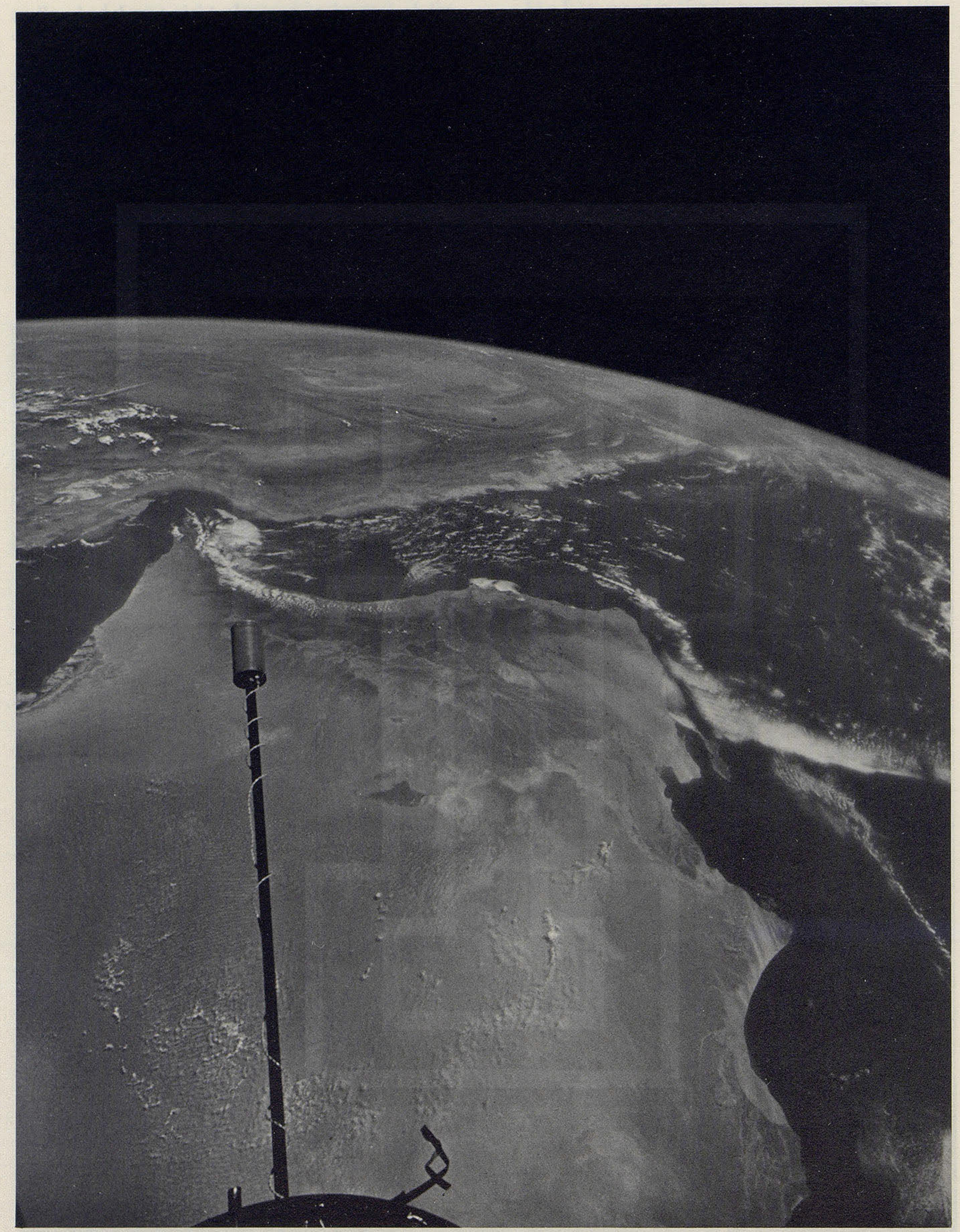
The crew talked at length about their experience during the high-altitude orbits. Conrad said, "Passing India it became apparent to us that we were climbing at a fantastic rate. I don't know what the exact numbers were but they were extremely high . . . we just had the impression that we were looking down at the ground going straight up."

At this point, Gordon interrupted, "We were wondering if we were going to stop."

"We were worried about the orbital mechanics,"



THE NEAR EAST as seen from the Gemini XI spacecraft. The United Arab Republic is seen in the foreground. The triangular-shaped area is the Sinai Peninsula. The Gulf of Aqaba, right center, separates the Sinai Peninsula and the Arabian Peninsula.



THIS PHOTO WAS TAKEN while Gemini XI was 270 miles above the earth. On the Peninsula are Trucial Oman, Muscat and Oman, and Saudi Arabia. Pakistan and India are in the top center background. The body of water at the right is the Arabian Sea.

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Conrad continued. "We did this for two revolutions and we saw some of the most amazing sights that man has ever seen . . . the photographs, I think, do some justice to what we saw, but you can't do justice to what you actually see with your eyes."

The crew spent considerable time in describing the tethered maneuvers with the Agena target vehicle. Conrad said that it took longer to get the tether deployed than they had expected. They had placed the tether on several strips of Velcro before they stowed it. When they deployed it and reached the point where the tether was attached to the Velcro the spacecraft was pulled toward the target vehicle a bit.

Conrad stated, "We somehow got a little rotation velocity in the tether . . . and I can't tell you how I got it stopped spinning to where we finally had the tether completely straightened out . . . We went to the end of the tether and it became obvious to us that we actually had the whole system rotating, so we watched it about 20 minutes and the attitude excursions damped down to about 30 degrees per minute . . . We told the ground we would go ahead and ride it into the night side . . . as we went into the night side we had our docking light on the tether and we could see that it stayed taut. We had the running lights on the Agena and could tell that it was still oscillating . . . our biggest surprise as we came out into the daylight was when we discovered that the rotation of both vehicles was down to less than 10 degrees per minute."

Twelve scientific and technological experiments were originally planned for the Gemini XI. The three-day delay from the September 9th launch date resulted in cancellation of the Libration Regions Photography experiment because the earth-moon libration regions became obscured by the Milky Way, thereby preventing the experiment from meeting its basic objectives.

Only one of the eleven experiments scheduled during the mission was not attempted. This concerned the evaluation of a special power tool for use in space. That experiment was cancelled because of the premature termination of the umbilical extravehicular activity.

Another experiment—one concerning Dim Sky Photography/Orthicon—was only partially completed.

The following experiments were completed although a complete analysis of the results is not available: Mass Determination, Night Image Intensification, Radiation and Zero-G on Blood, Synoptic Terrain Photography, Synoptic Weather Photography, Nuclear Emulsion, Airglow Horizon, Ultraviolet Astronomical Camera, and Ion-Wake Measurement.

THE CREW

Charles Conrad, Jr.

Command pilot of the Gemini XI mission was Astronaut Charles Conrad, Jr. Conrad, born in Philadelphia, Pennsylvania, June 2, 1930, was graduated from Princeton University with a bachelor of science degree in aeronautical engineering.

Conrad entered the Navy following his graduation and received flight training. He attended the Navy Test Pilot School at Patuxent River, Maryland, and upon completion of that training was a project test pilot in the Armaments Test Division there. He also served as a flight instructor and performance engineer at Patuxent.

Conrad was selected for the astronaut program by NASA in September 1962. He has logged more than 3,200 hours flying time, including more than 2,400 hours in jet aircraft.

He was pilot of the Gemini V mission which lasted 190 hours and 56 minutes, during the period August 21-29, 1965. Command pilot on that mission was L. Gordon Cooper, Jr. Later, Conrad served as command pilot of the backup crew for the Gemini VIII flight. He was awarded the NASA Exceptional Service Medal in September 1965. Conrad is a member of the American Institute of Aeronautics and Astronautics, and an associate member of the Society of Experimental Test Pilots.

He is married to the former Jane DuBose of Uvalde, Texas. The Conrads have four sons: Peter, born December 25, 1954; Thomas, born May 3, 1957; Andrew, born April 30, 1959; and Christopher, born November 26, 1960.

Richard F. Gordon, Jr.

The Gemini XI pilot, Astronaut Richard F. Gordon, Jr., was born in Seattle, Washington, October 5, 1929. He was graduated from the University of Washington with a bachelor of science degree in chemistry.

Gordon joined the Navy and entered aviation training in 1951. He received his wings in 1953. Gordon attended the Navy Test Pilot School at Patuxent River, Maryland, in 1957, and served at that station until 1960. While there he performed flight test work on the F8U Crusader, F11F Tigercat, FJ Fury, A4D Skyhawk, and was the first project test pilot for the F4H Phantom II.

In May 1961, Gordon won the Bendix Trophy Race from Los Angeles, California, to New York City while establishing a new speed record of 869.74 miles per hour and a transcontinental speed record of two hours and 47 minutes.

At the time of his selection as a NASA astronaut in October 1963, Gordon was a student at the U.S. Naval Postgraduate School, Monterey, California. He has logged more than 3,000 hours flying time, including more than 2,500 hours in jet aircraft.

He is married to the former Barbara J. Field of Freeland, Washington. The Gordons have six children: Carleen, born July 8, 1954; Richard, born October 6, 1955; Lawrence, born December 18, 1957; Thomas, born March 25, 1959; James, born April 26, 1960; and Diane, born April 23, 1961.

UNITED STATES SPACE FLIGHT LOG

TIME	ELAPSED	DATE(S)	MISSION PILOTS	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	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	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

THE GEMINI XI CREW—pilot Richard F. Gordon, Jr., left, and command pilot Charles Canrad, Jr.

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:

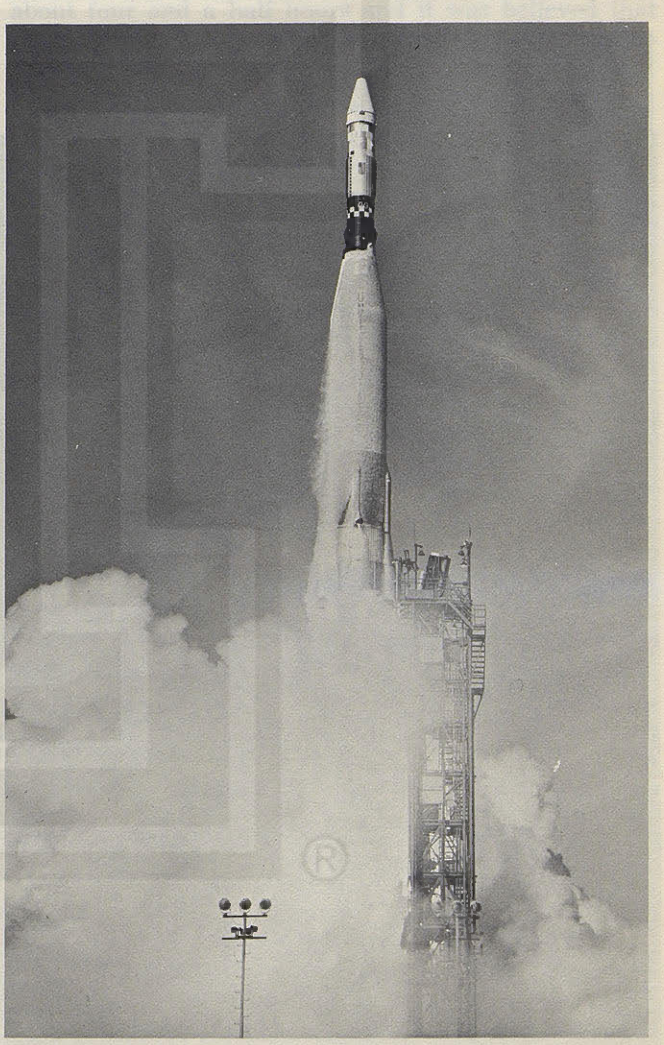
- To practice docking. (Achieved)
- To accomplish a tethered-vehicle station-keeping exercise by the gravity gradient technique. (Achieved)
- To conduct experiments. (Achieved)
- To perform maneuvers, using the Agena primary propulsion system to change the orbit.
- To use a controlled reentry technique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



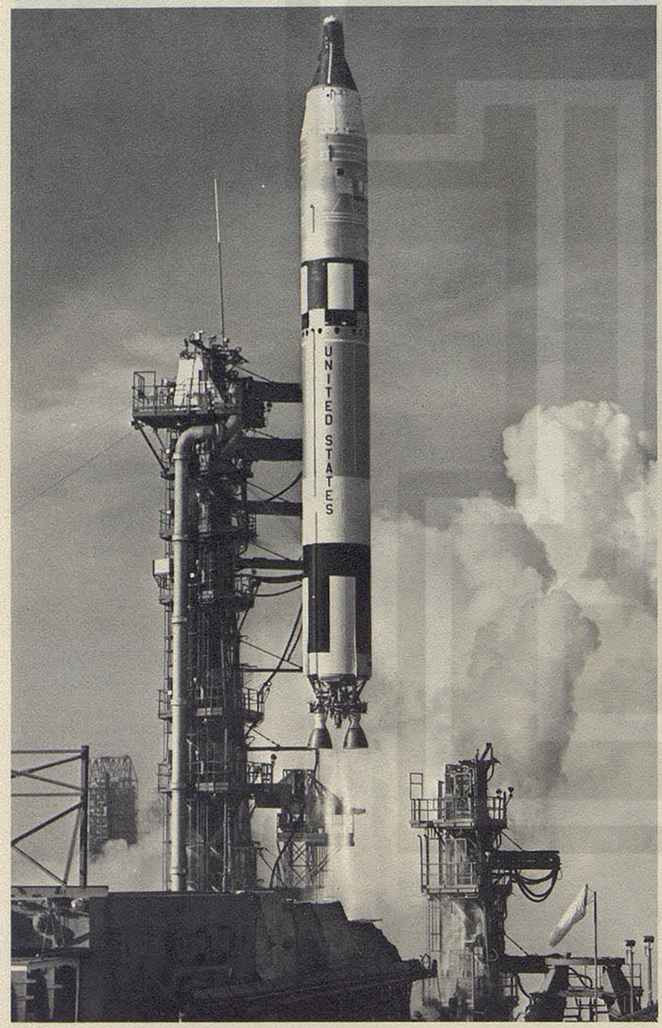
THE GEMINI XII target vehicle and its Agena D payload as it lifted off from Launch Complex 14 at Cape Canaveral, Fla., November 11, 1966.

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



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.

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.

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

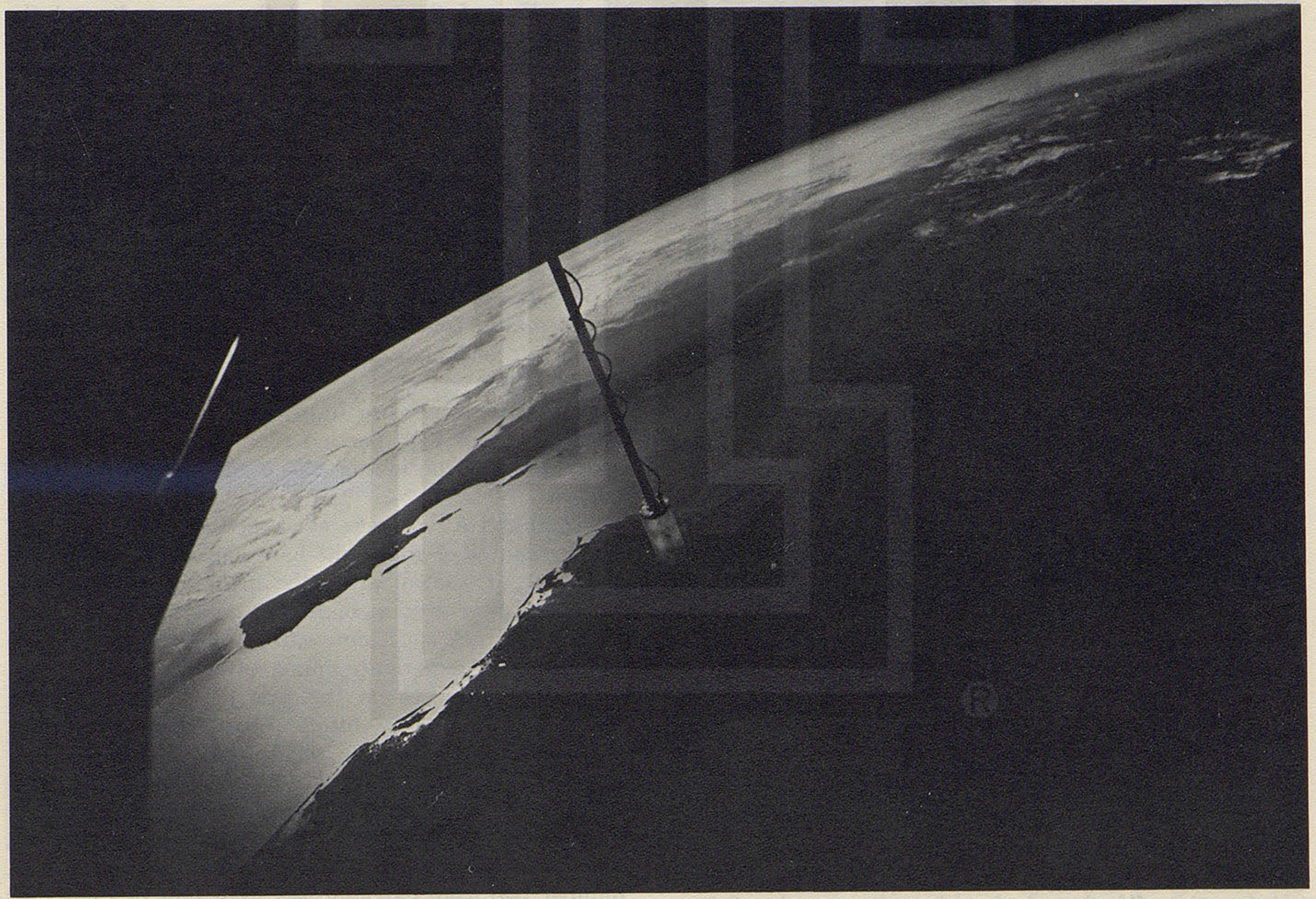
During the second day of the Gemini XII mission, the major accomplishments included umbilical extravehicular activity and the start of the spacecraft/Agena target vehicle tether evaluation.

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.



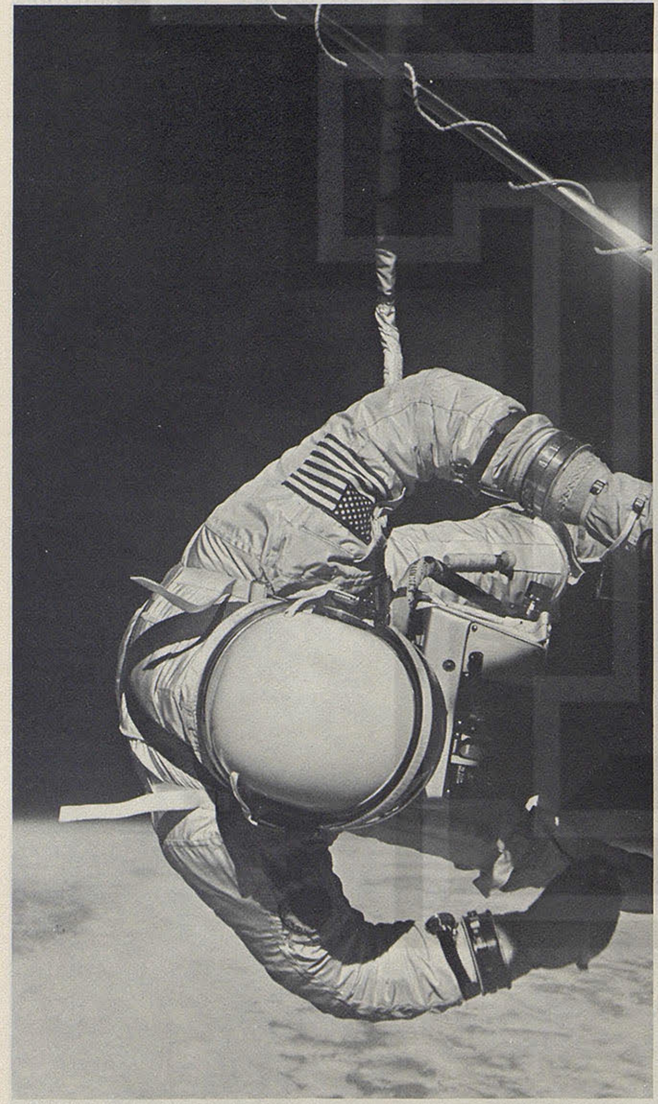
THE GEMINI XII crew obtained this unusual photo during their 16th revolution. Looking from the spacecraft to the northwest are the coast of Mexico, the Gulf of California, and Baja California.

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

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.

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.

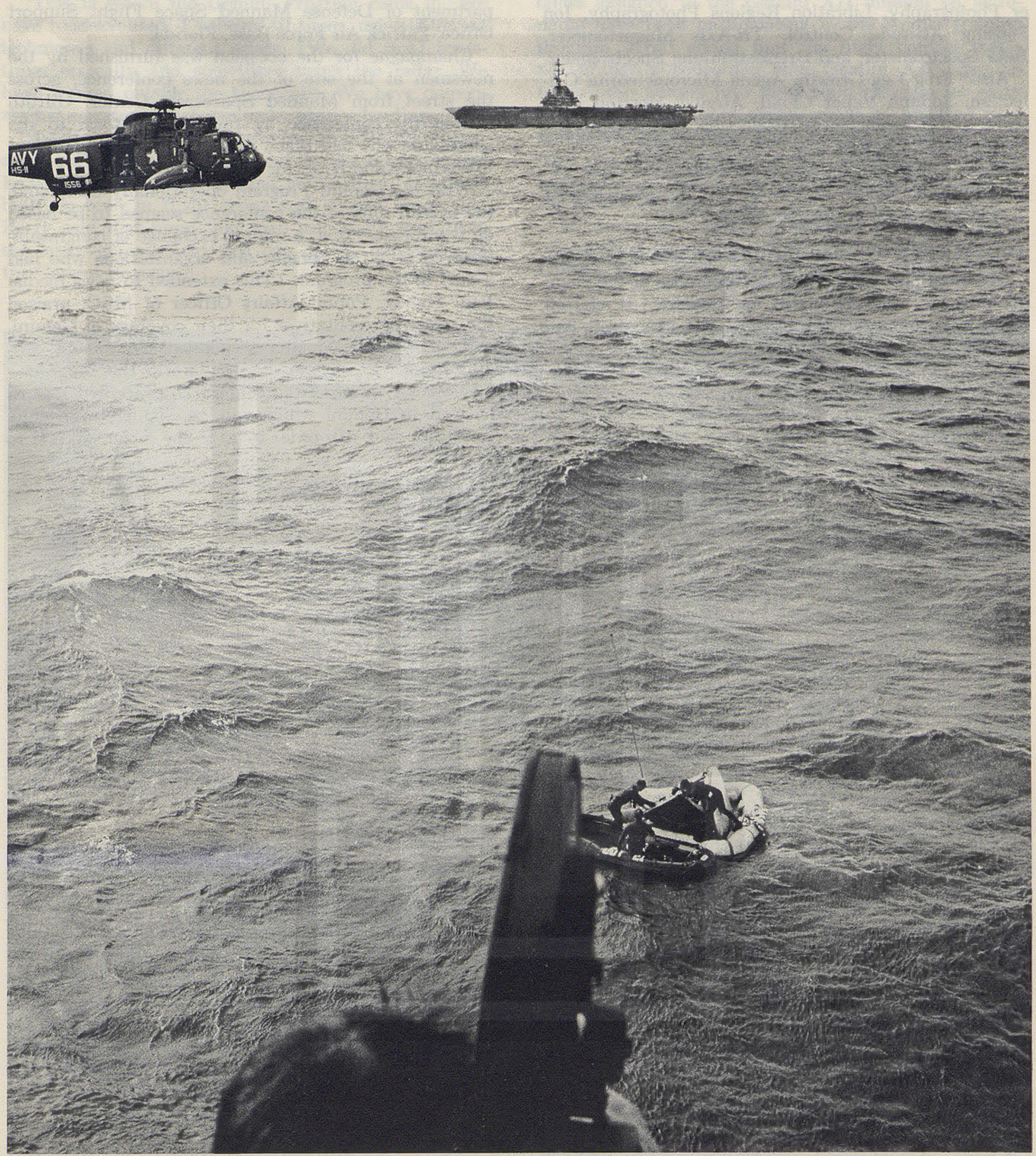
Until that time, the fourth day of the flight had been taken up with participation in experiments and in keeping a continuing check on operational difficulties.

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 padium 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.

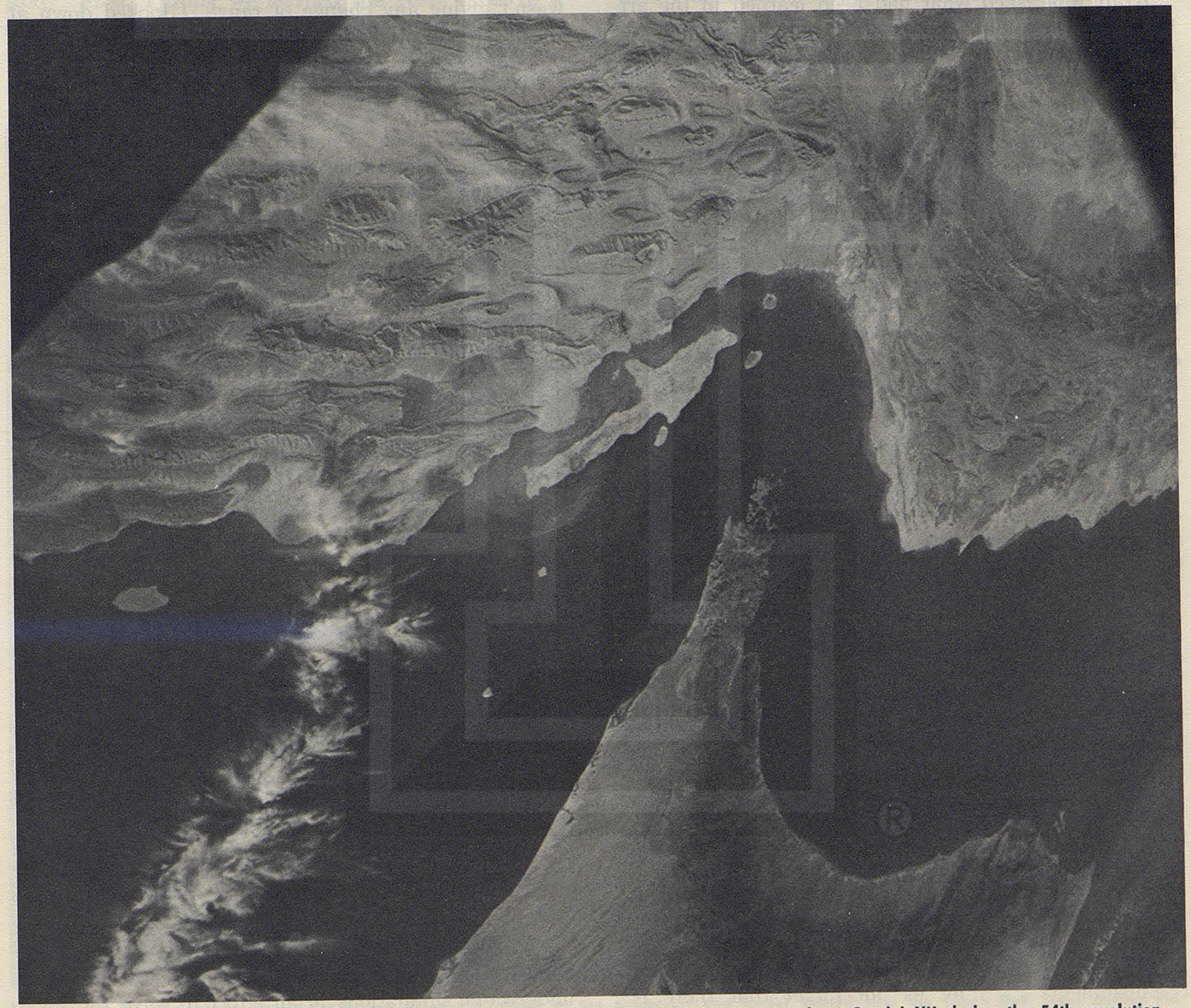
"This is where the Gemini Program came in. We have rendezvoused, I believe, 10 times, using different techniques and different orbits. [We did this] sometimes optically and sometimes using the radar. We have worked outside the spacecraft. We have demonstrated a system which can make precise landings."

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 boresighted 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.

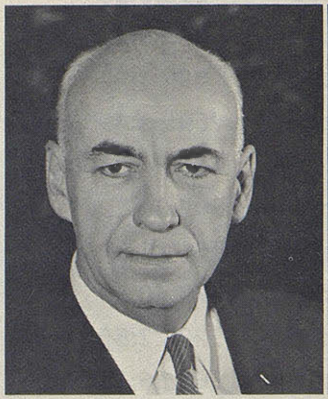
Aldrin has logged more than 2800 hours flying time, including more than 2400 hours in jet aircraft. He is married to the former Joan A. Archer of Ho-Ho-Kus, New Jersey. They have three children: James M., born September 2, 1955; Janice R., born August 16, 1957; and Andrew J., born June 17, 1958.

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.

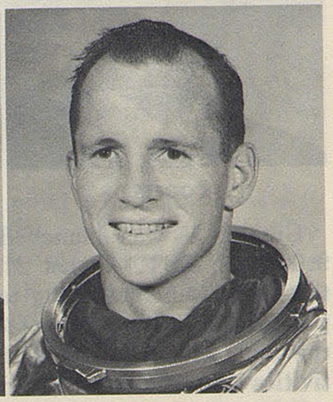
The maximum apogee during the flight was 121 miles, the lowest perigee, 87.5 miles. The spacecraft landed about 50 miles up-range from the predicted landing point at 2:16:31 p.m., EST. The crew was recovered at 3:28 p.m., and the spacecraft was picked up at 5:03 p.m. The prime recovery ship was the USS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

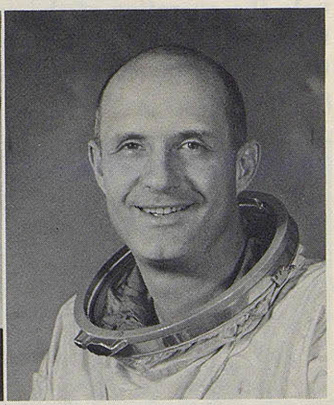
GEMINI VI-A

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.

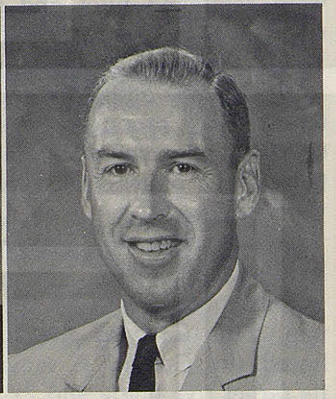
Gemini VI-A touched down in the western Atlantic 25 hours, 51 minutes, and 24 seconds after its launch. The impact point was within seven miles of the planned landing point. Schirra and Stafford elected to remain with the spacecraft until it was picked up by the USS *Wasp*, the prime recovery ship. The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

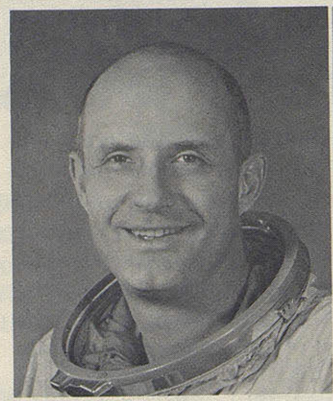
Gemini IX was scheduled to be another rendezvous mission. The Agena target was launched from Cape Kennedy May 17, 1966, at 10:15:03 a.m., EST. The target launch vehicle booster engine number two was lost two minutes and one second after lift-off and the Gemini IX mission was terminated.

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.

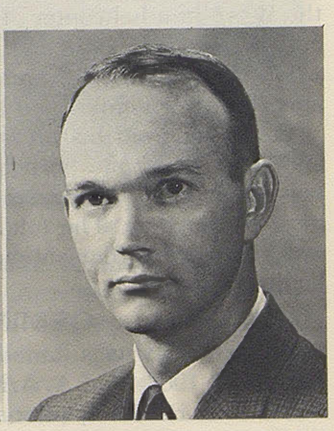
GEMINI X

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.

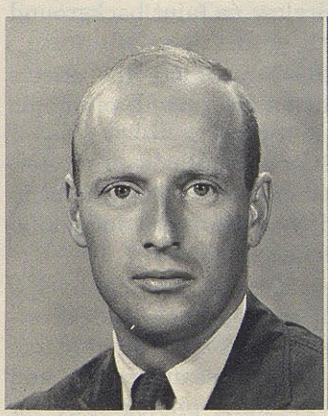
The highest apogee reached during the flight was 412.2 miles and the lowest perigee, 86.3 miles. The Gemini X spacecraft touched down in the Atlantic at 4:07:06 p.m., EST, July 21, at an estimated 3.4 miles from the planned impact point. The crew chose to be recovered by helicopter and they were landed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

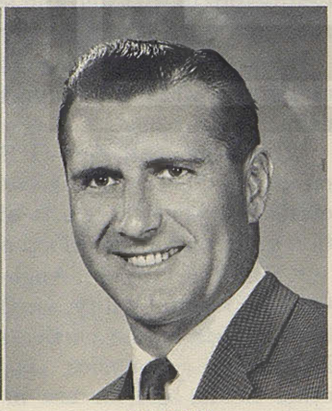
GEMINI XI

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

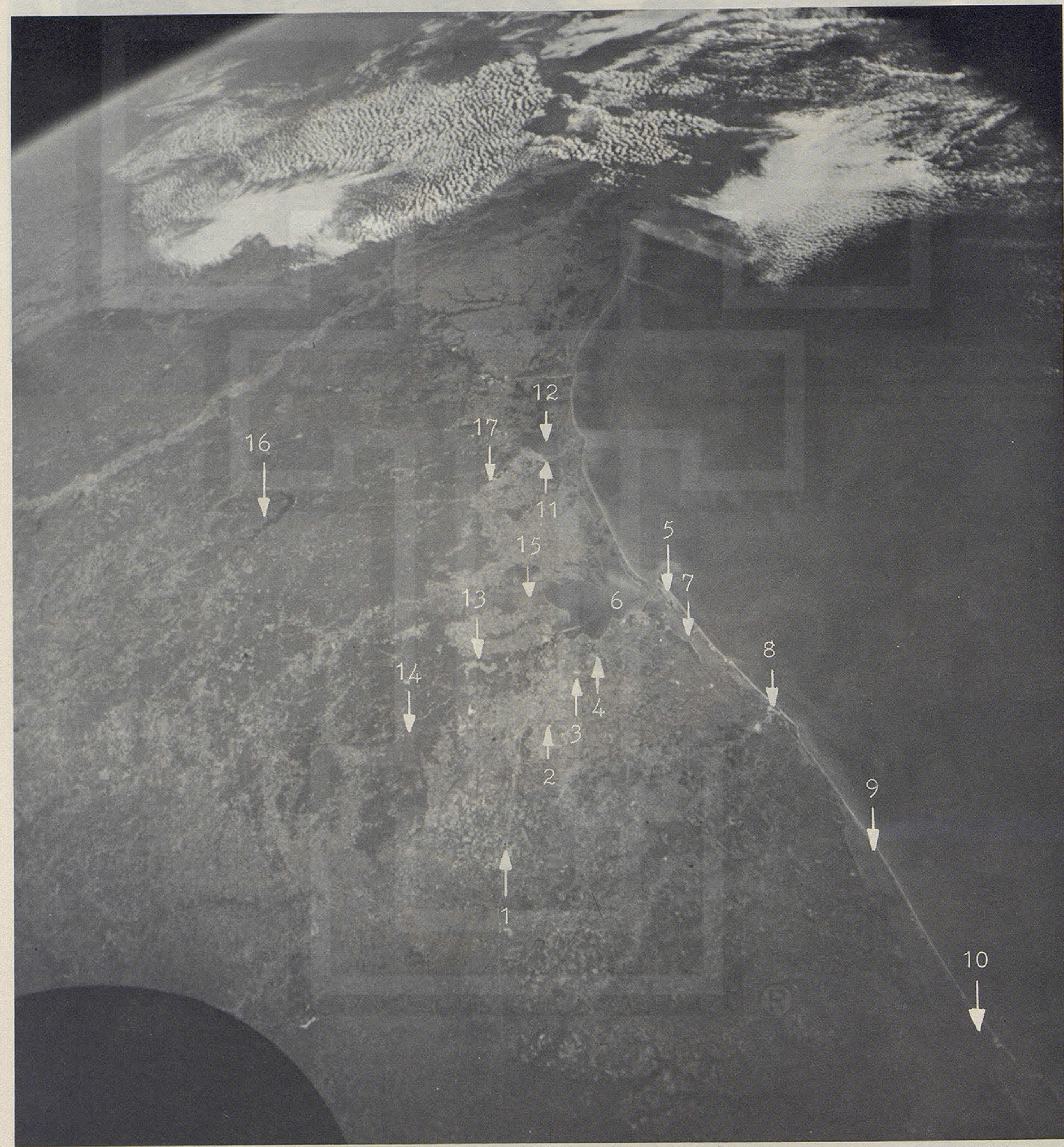
Experiment / Flight	III	IV	V	VI-A	VII	VIII	IX-A	X	XI	XII
Cardiovascular Conditioning			X		X					
In-Flight Exerciser		X	X		X					
In-Flight Phonocardiogram		X	X		X					
Bioassays Body Fluids					X	X	X			
Bone Demineralization		X	X		X					
Calcium Balance Study					X					
In-Flight Sleep Analysis					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 TH
Mission Co
flags were

GEMINI FL
Gemini IV
crew had

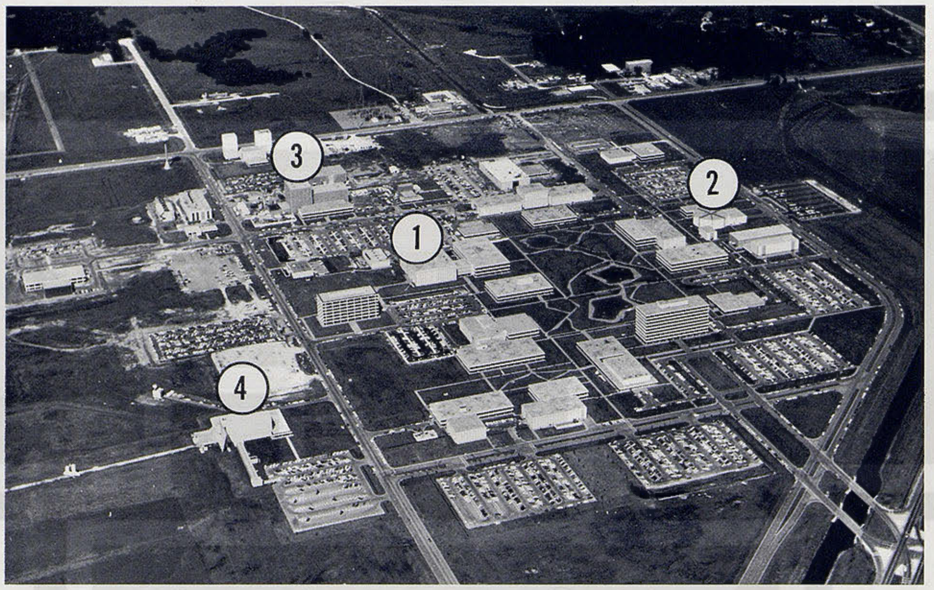
ONE OF THE MAJOR ACCOMPLISHMENTS OF THE Gemini Program was rendezvous. The photo above shows the enthusiasm generated in Mission Control Center at Houston following the first successful rendezvous in history — that of Gemini VI-A and Gemini VII. Small American flags were "raised" above all the Control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

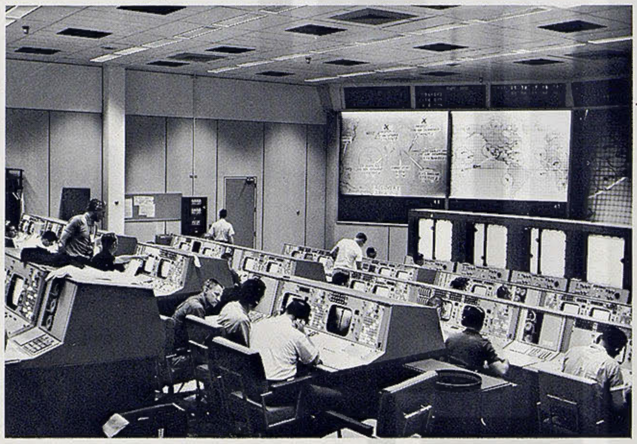


IT SEEMS APROPOS THAT excellent photography of the Houston area should have been obtained on the final Gemini flight since mission control of all flights was exercised from that location starting with Gemini IV. Points of interest in the photo above are: (1) Interstate Highway 10, (2) the Astrodome, (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.

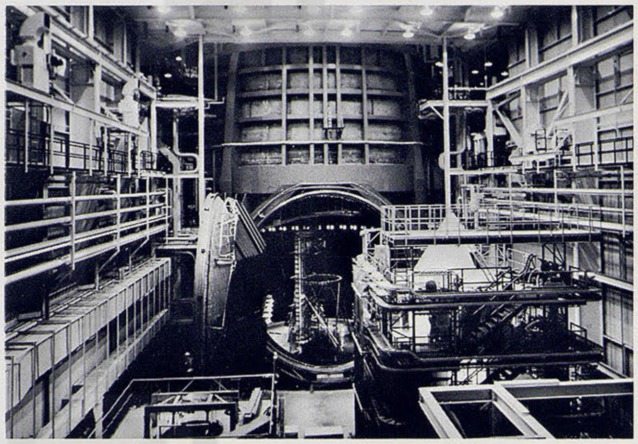
MANNED SPACECRAFT CENTER



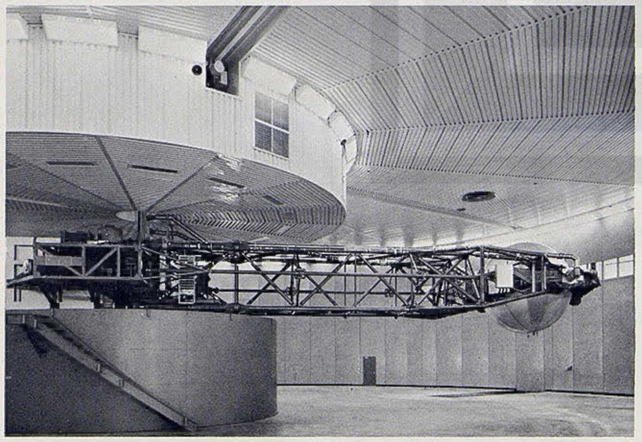
AERIAL VIEW OF CENTER



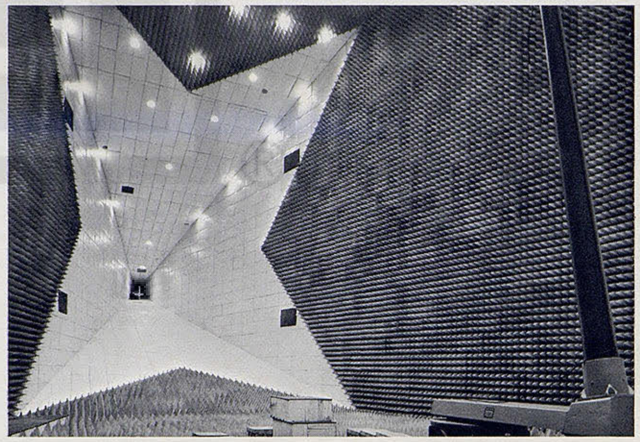
1 MISSION CONTROL CENTER



3 SPACE ENVIRONMENT SIMULATION LABORATORY



2 FLIGHT ACCELERATION FACILITY



4 ANECHOIC CHAMBER

MANNED SPACECRAFT CENTER
Houston, Texas

The primary responsibility of the Manned Spacecraft Center (MSC) is to develop and direct the technology required for manned spacecraft in present and future programs. A concerted effort is made by management, scientists, engineers, and support personnel to insure that our national goal of achieving preeminence in space research and exploration is achieved.

The center is organized into four main areas: Management, Test and Evaluation, Training, and Flight Operations.

Management involves many administrative functions in technical, engineering and legal services; procurement of equipment, facilities and contractual services; and the direction of personnel and space flight operations.

Tests and evaluation of spacecraft components are carried out in most of the center facilities. In the Anechoic Chamber, spacecraft communications are tested in an echo-free simulated space environment. The chamber is lined with thousands of carbon-filled foam pyramids that rarefy both radio frequency and magnetic fields. The Space Environment Simulation Laboratory contains two large vacuum chambers designed to simulate the pressure, temperature and lighting conditions of space. This facility allows testing of spacecraft and other mission equipment in a simulated space environment.

Astronauts are given rigorous and thorough training to prepare them for space flight. Spacecraft simulators allow them to become familiar with spacecraft control and mission tasks before an actual flight. The Flight Acceleration Facility is a man-rated centrifuge designed to train crews, test equipment, and evaluate the stress on the human body under simulated flight conditions.

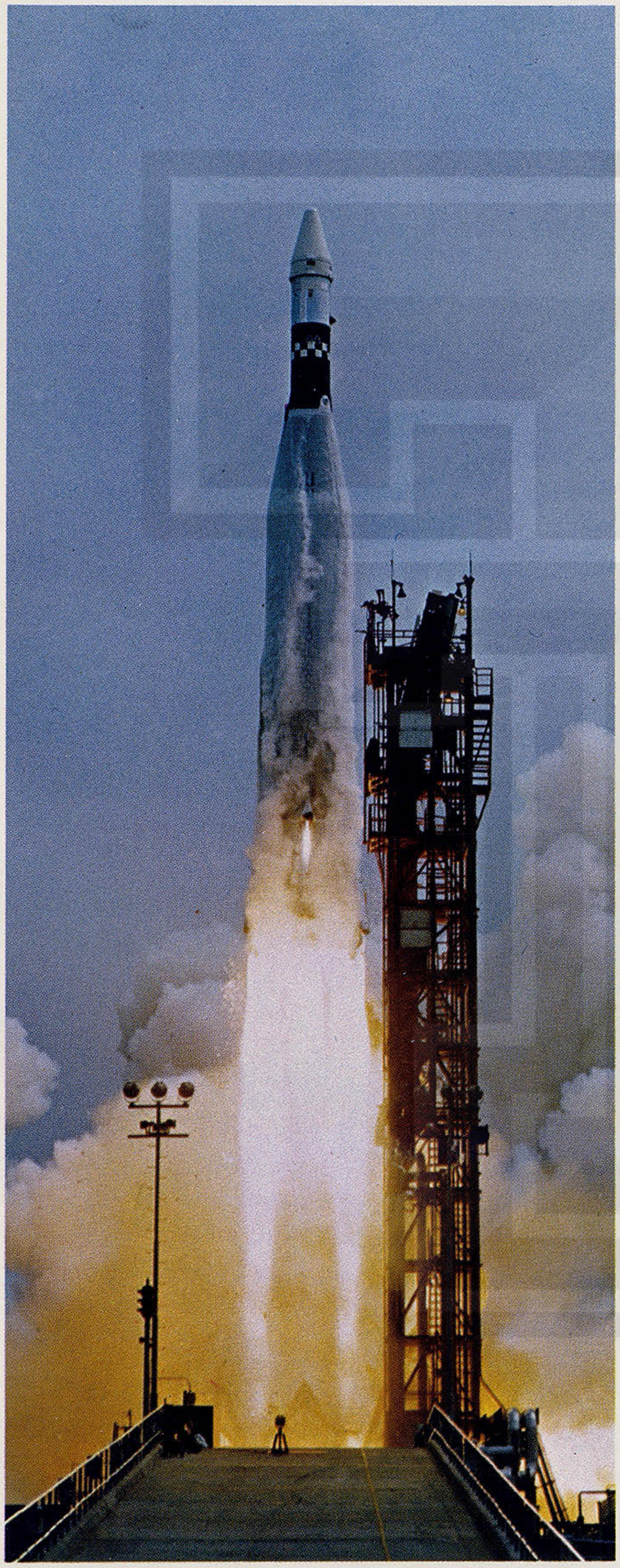
Manned space flight missions are monitored and controlled from the Houston Mission Control Center from liftoff to recovery. A majority of the personnel and much of the equipment are housed in this facility. Mission simulations and tests can be conducted on one floor for training purposes, while an actual mission is being monitored and controlled on another floor.

The Mercury and Gemini programs have been successfully completed and we gained our first experience with man in space. They also afforded us with our first opportunity to develop many of the operational techniques upon which the current Apollo Lunar Landing Program depends.

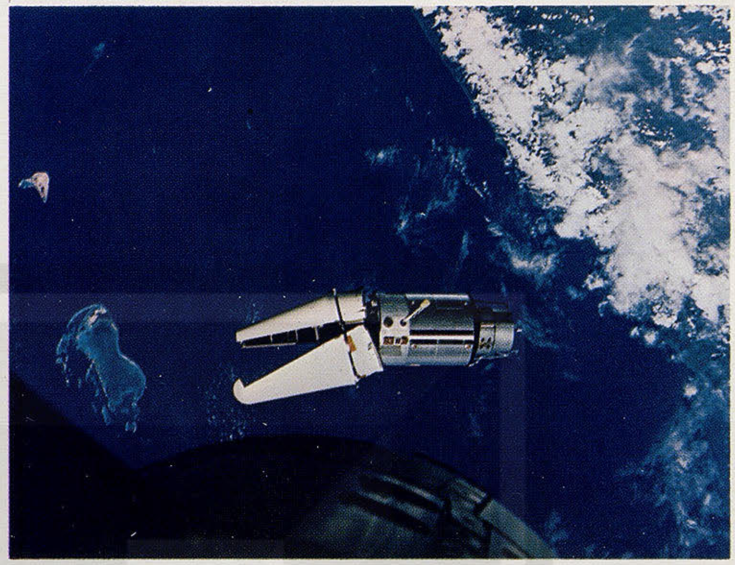
THE MOON AS SEEN FROM THE GEMINI VII SPACECRAFT
DECEMBER 8, 1965

GEMINI IX-A

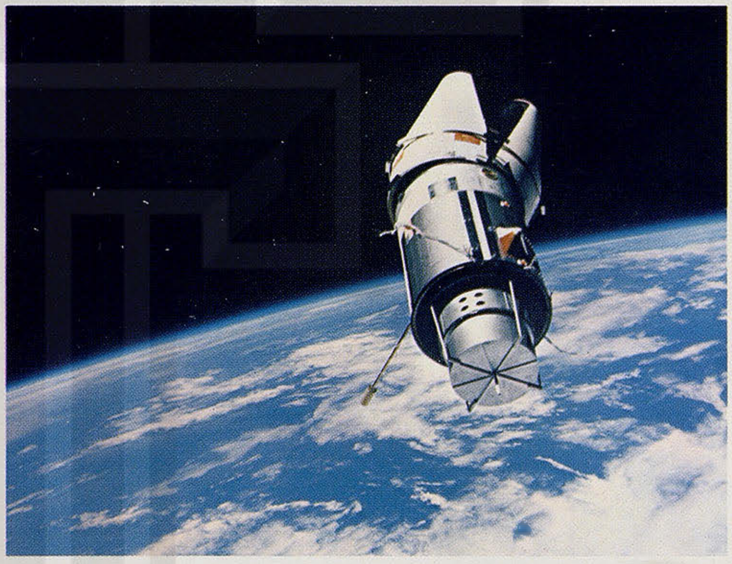
Augmented Target Docking Adapter



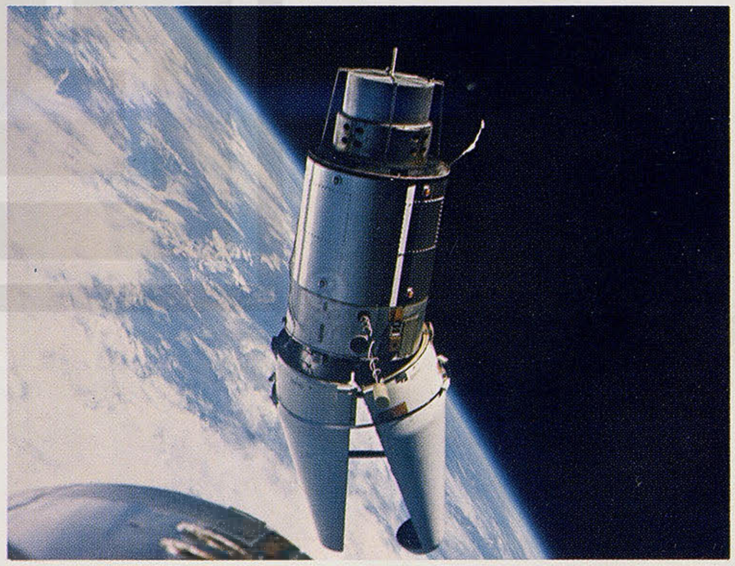
Launch of Atlas/ATDA at 10 a.m. (EST), June 1, 1966, Cape Kennedy, Florida



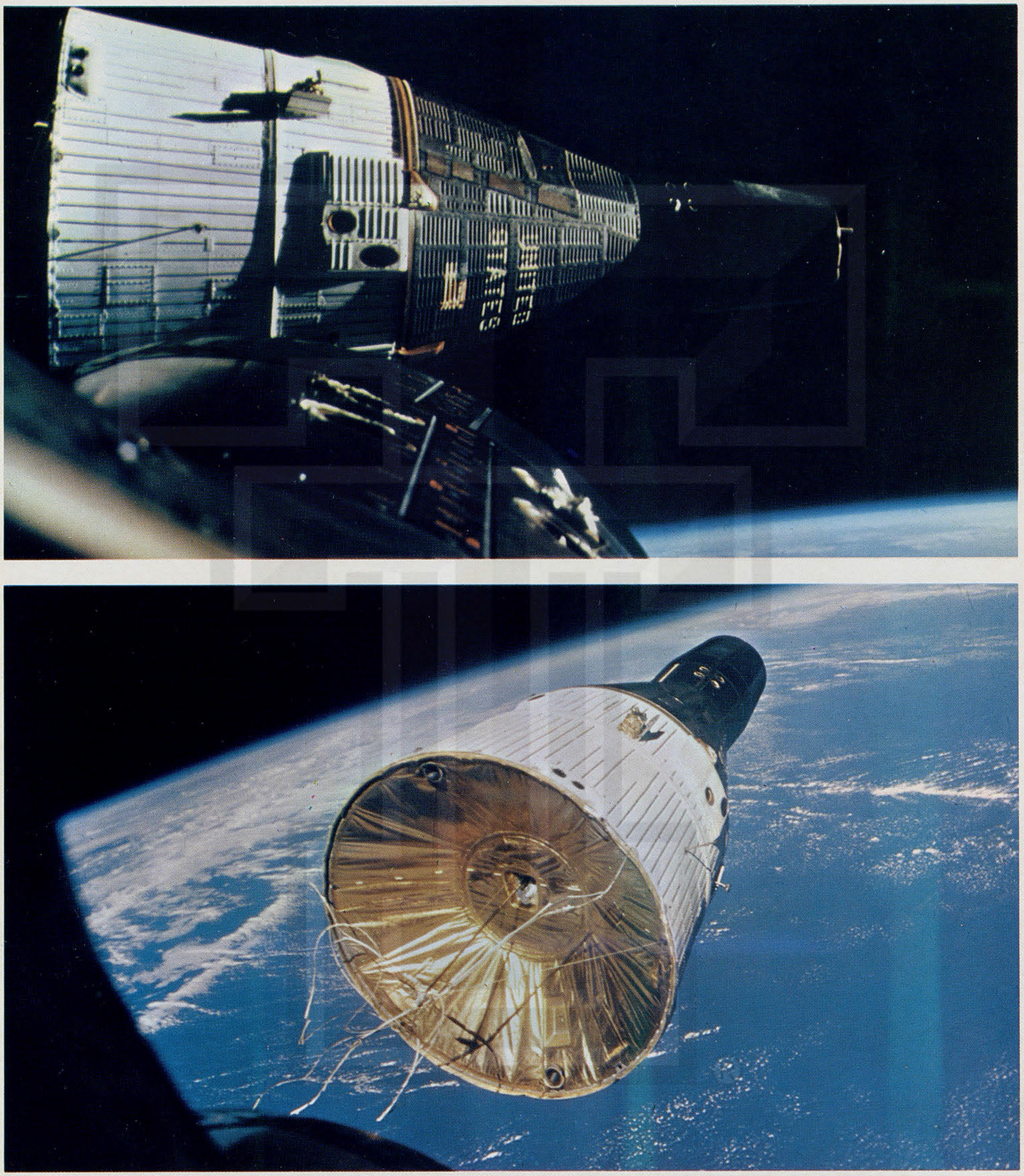
Gemini IX-A and ATDA are only 66½ ft. apart. Below is Caribbean Coast of Venezuela.



ATDA as seen by Stafford and Cernan from Gemini IX-A spacecraft only 38½ ft. away.

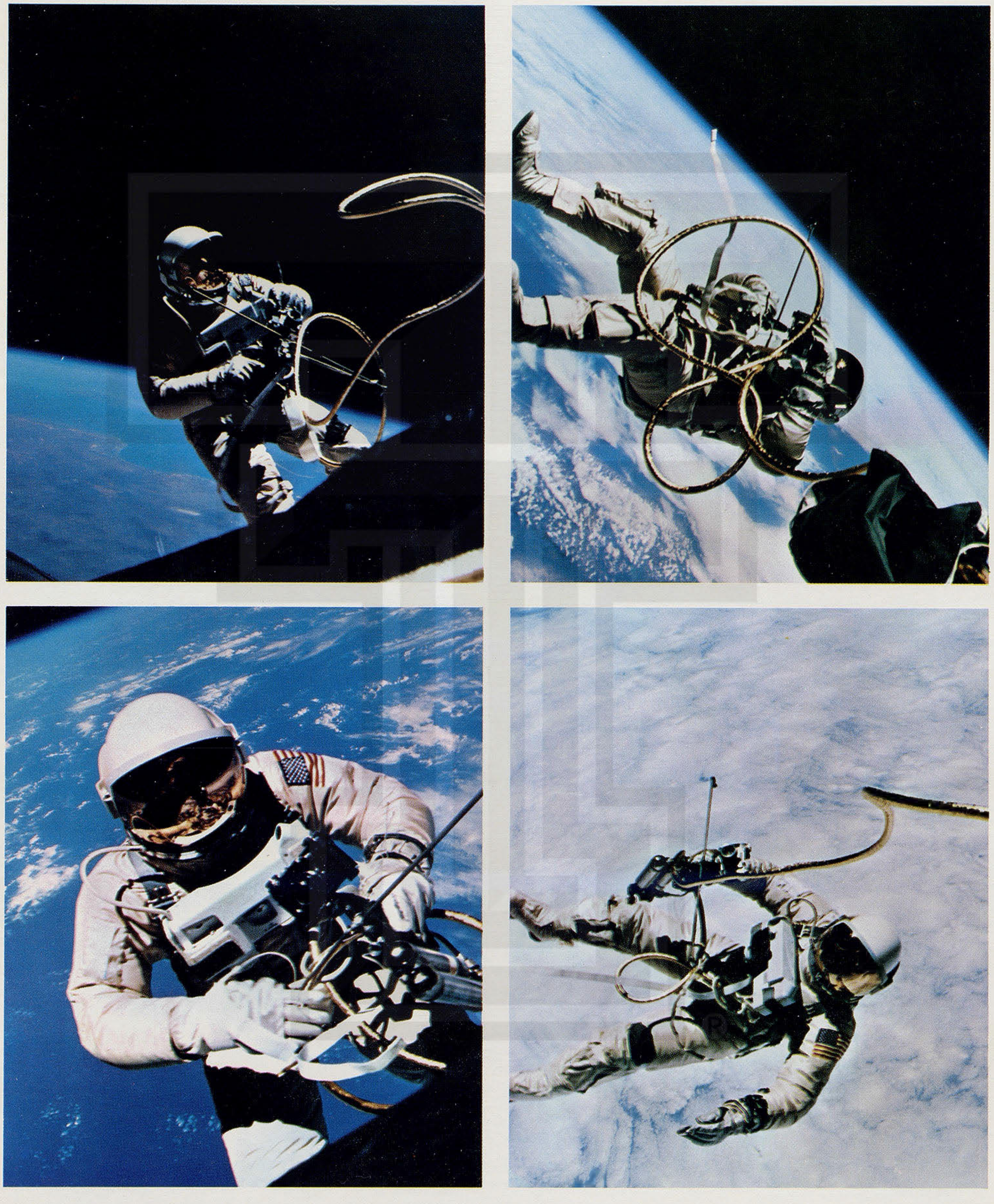


Gemini IX-A approaches within 29½ ft. of ATDA during rendezvous in space.



GEMINI 7/6 RENDEZVOUS
Gemini VII spacecraft as photographed by Gemini VI crew, December 15, 1965, 160 miles above the earth.

GEMINI VII SPACECRAFT FROM GEMINI 7/6 RENDEZVOUS
December 15, 1965



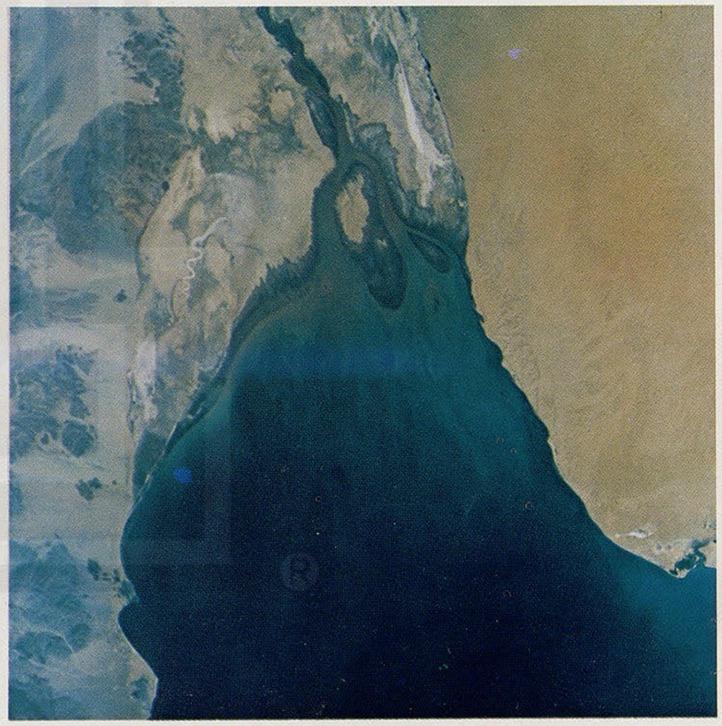
GEMINI IV ASTRONAUT EDWARD H. WHITE II WALKS IN SPACE.
Command Pilot James McDivitt Took These Pictures.

GEMINI IV EARTH TERRAIN VIEWS

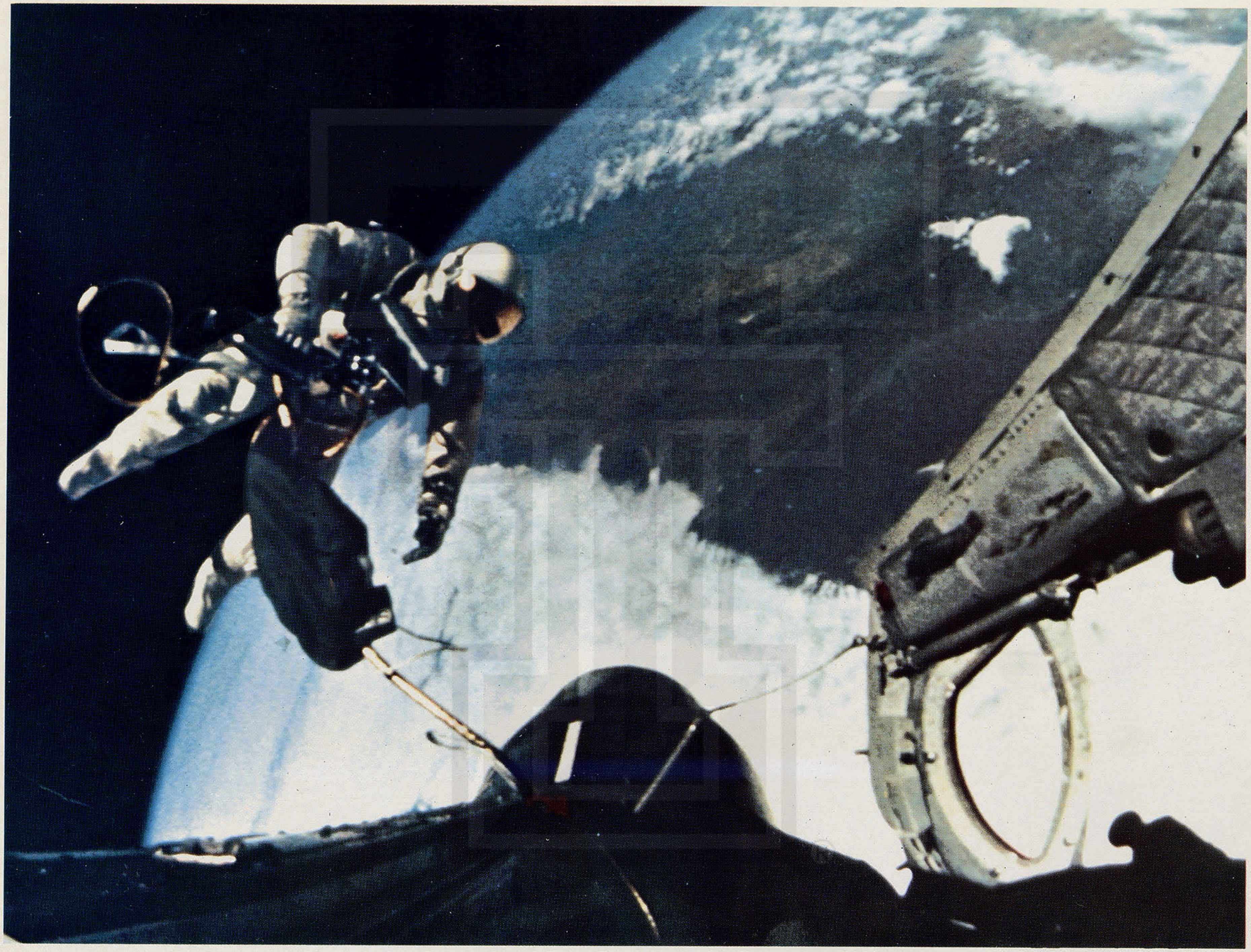
View toward southeast of Hadhramaut Plateau, Arabian Peninsula, and Gulf of Aden, showing branch-like dry valley cutting into plateau.

View to the east of the cultivated area of the Nile River delta, with Mediterranean Sea on left. In upper half are Suez Canal and Gulf of Suez, and Sinai Peninsula. Near horizon are Dead Sea (far left) and Gulf of Aqaba.

Dhar Adrar, a plateau in Mauritania, northwest Africa. Circular structure (about 25 miles in diameter) is Richat Crater, series of concentric ridges believed to be roots of ancient crater impact. Similar, smaller feature called Semsiyyat is below and to right.



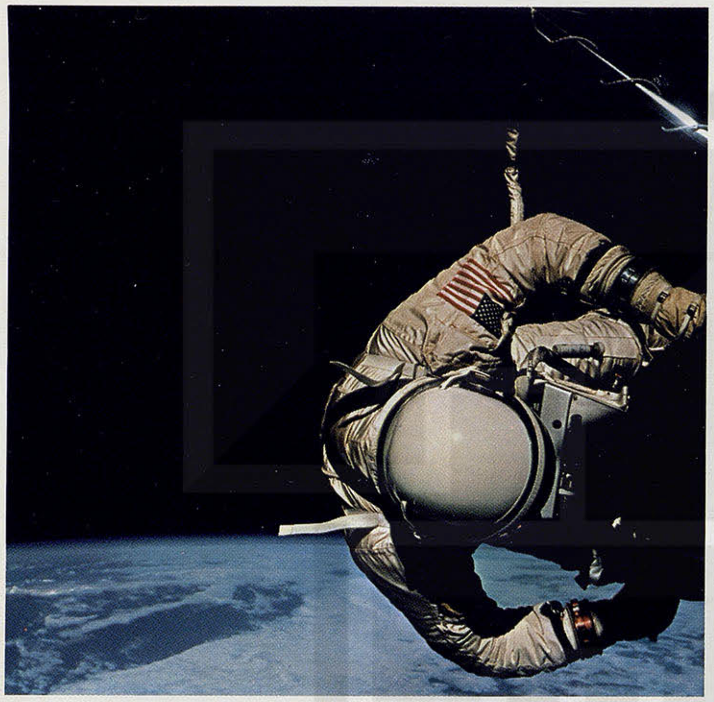
Northern end of Gulf of California, mouth of Colorado River, and great Desert Sonora (Mexico). Wavy feature at left is course of meandering stream. Straight white feature on right of river is part of San Andreas fault system. Photograph covers about seventy miles across.



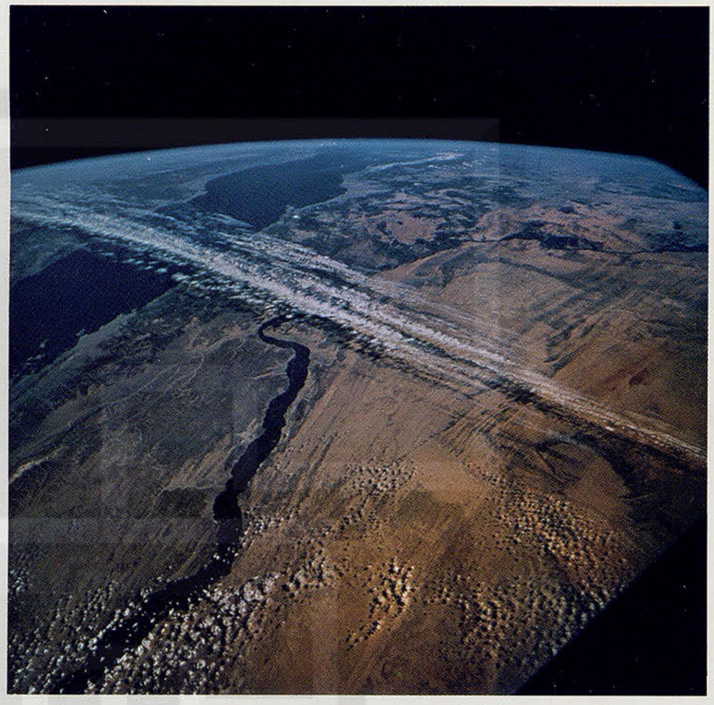
GEMINI IV ASTRONAUT EDWARD H. WHITE II TAKES WALK IN SPACE

DOUBLE EXPOSURE OF THE LAUNCH OF GEMINI VII (RIGHT)
AND GEMINI VI (LEFT)

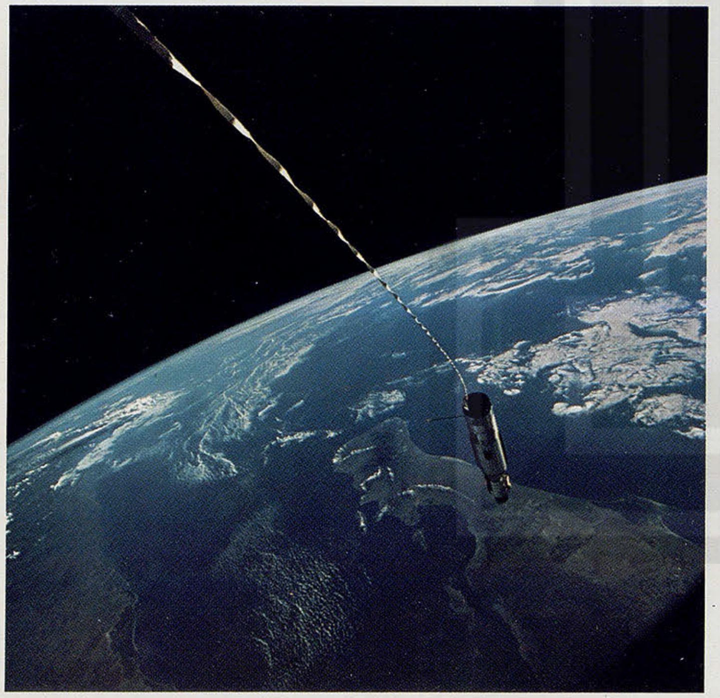
GEMINI XII EARTH-SKY VIEWS



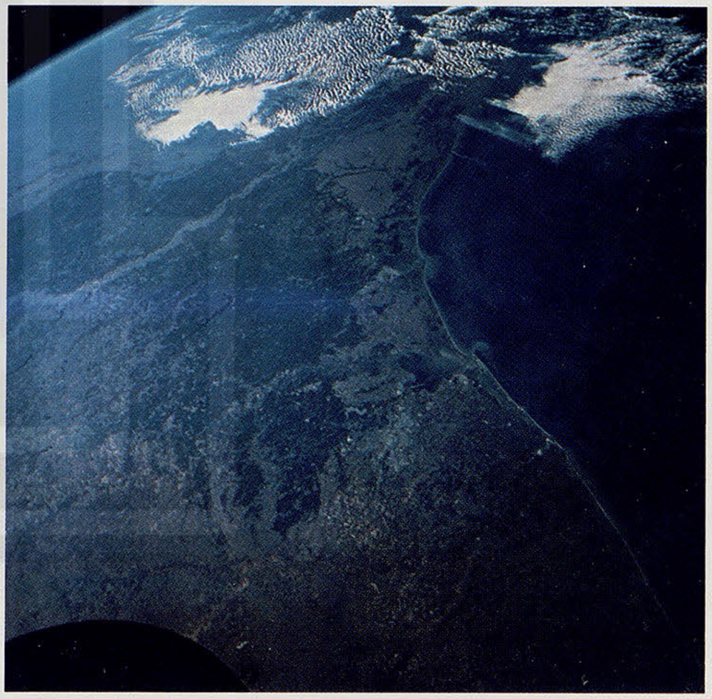
Astronaut Edwin E. Aldrin Jr. during his Gemini XII Extravehicular Activity.



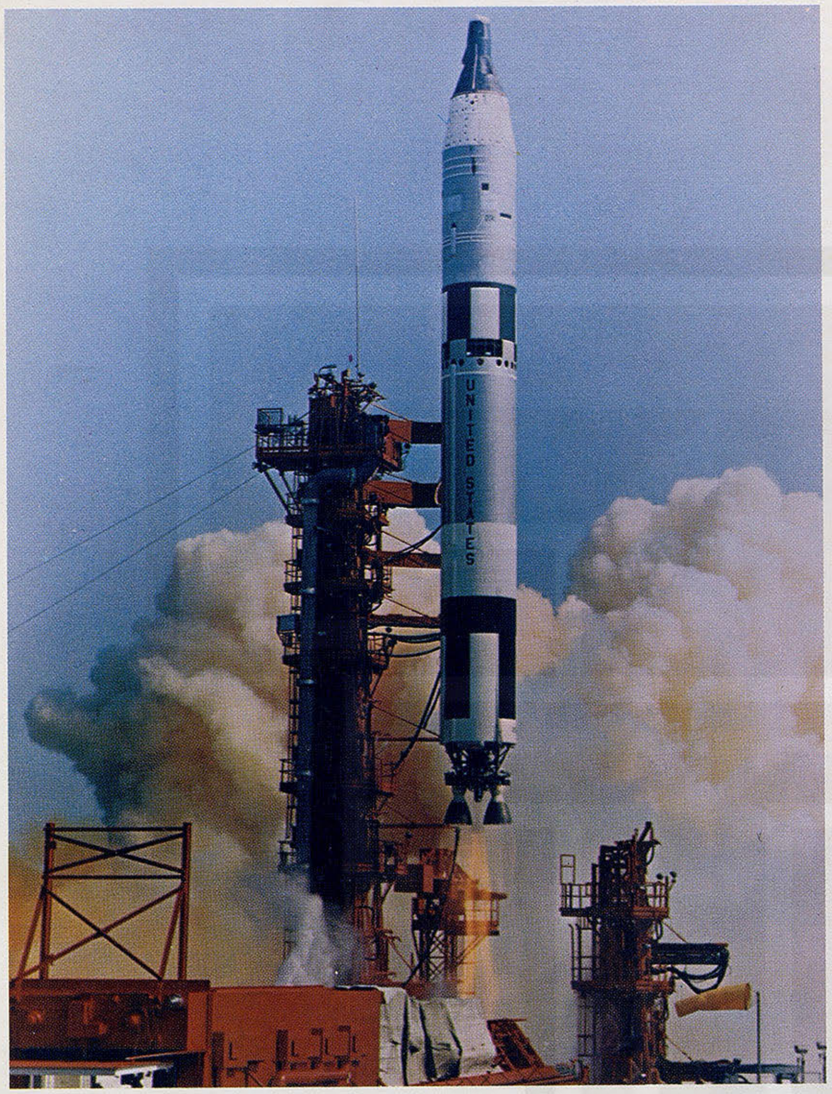
United Arab Republic (Egypt), Nile Valley, Red Sea, and Arabian Peninsula. View is looking southeast.



Agena Target Docking Vehicle tethered to the Gemini XII spacecraft over Baja California and Gulf of California. View is looking south.



Texas-Louisiana Gulf Coast looking east with view of Houston, Galveston and Manned Spacecraft Center area. Coast line is seen from Matagorda Bay to Vermillion Bay.

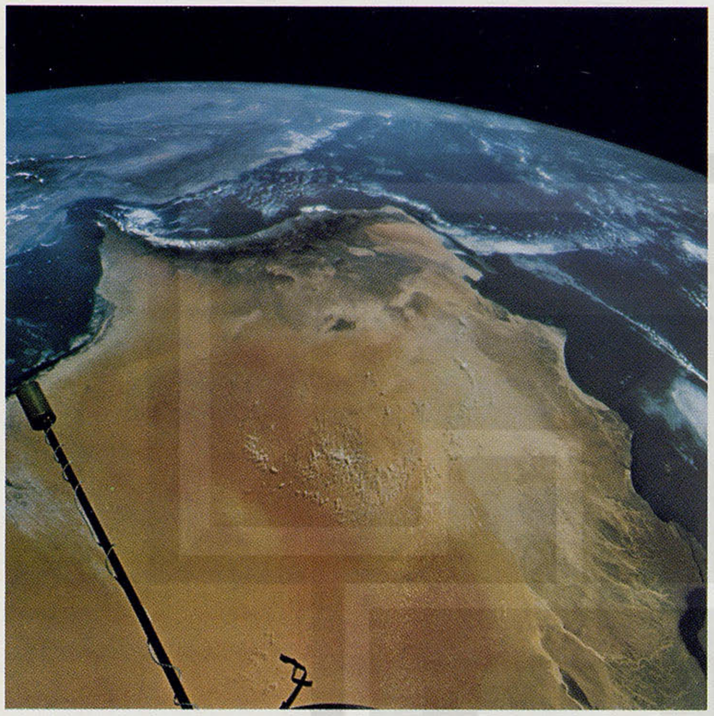


Launch of Gemini IX-A at
8:39 a.m. (EST), June 3, 1966,
Cape Kennedy, Florida

GEMINI IX-A
Three-Day Flight

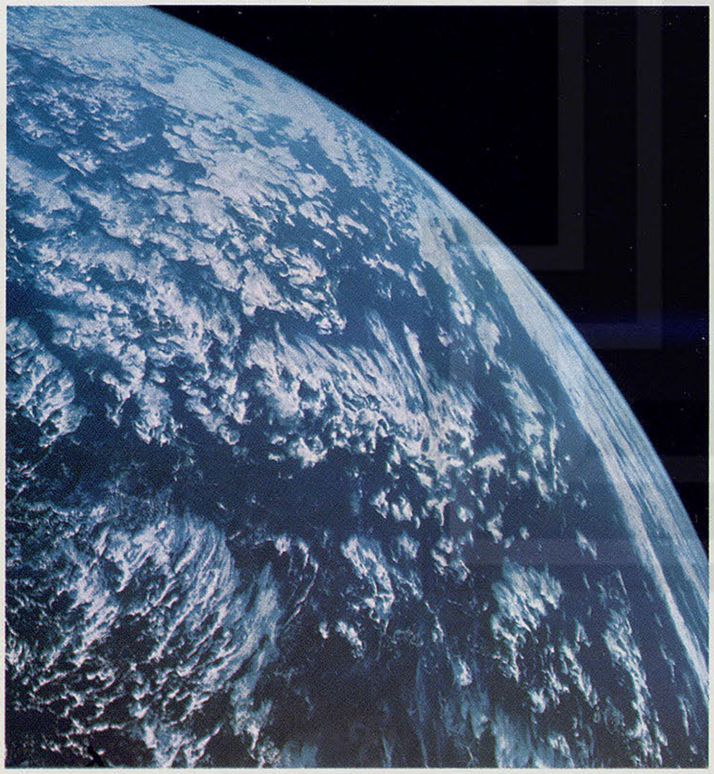
Splashdown of Gemini IX-A
at 9 a.m. (EST), June 6, 1966,
Western Atlantic

GEMINI XI RECORD HIGH-ALTITUDE EARTH-SKY VIEWS



Arabian Peninsula area, including Iran, Saudi Arabia, Trucial Oman, Muscat and Oman, Empty Quarter, Arabian Sea, and Persian Gulf, as seen from the Gemini XI spacecraft at an altitude of 250 nautical miles.

India and Ceylon, Maldive Islands, Arabian Sea, Indian Ocean, Bay of Bengal, looking nortb, as seen from the Gemini XI spacecraft at an altitude of 410 nautical miles.

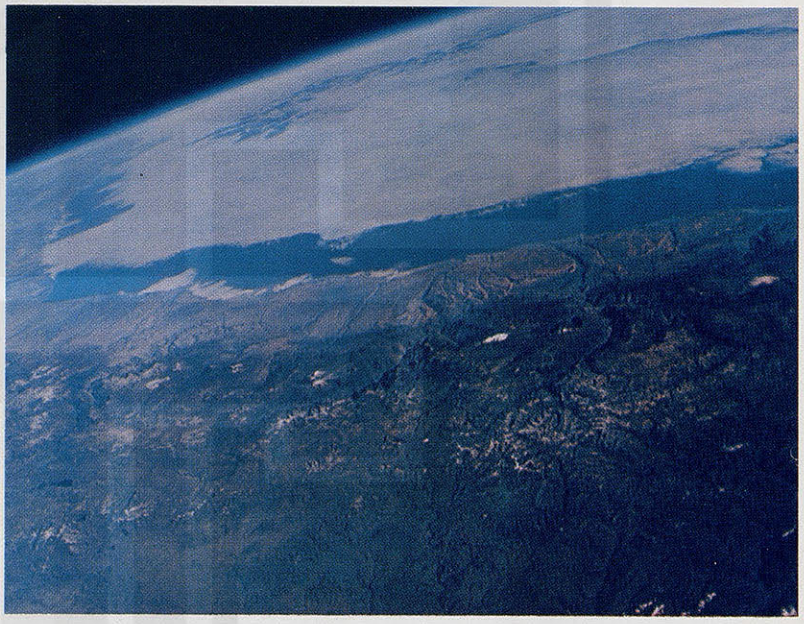


Curvature of earth as seen from the Gemini XI spacecraft at an altitude of 670 nautical miles. Below is Indian Ocean, west of Australia, looking to northeast.

Western half of Australia, with coastline from Perth to Port Darwin, looking west, as seen from the Gemini XI spacecraft at a record-high altitude of 740 nautical miles.

GEMINI IX-A
Space Walk and Terrain Views

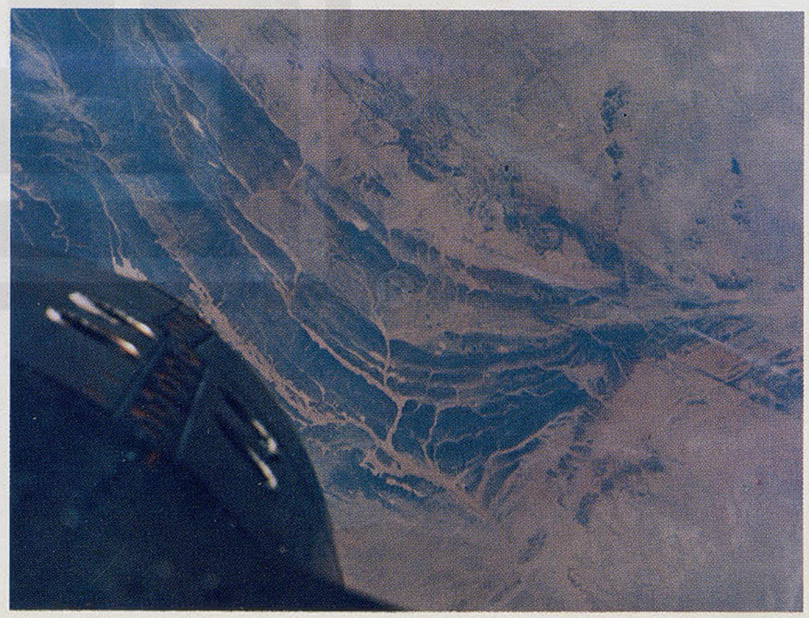
Astronaut Eugene A. Cernan during his Gemini IX-A Extravehicular Activity.

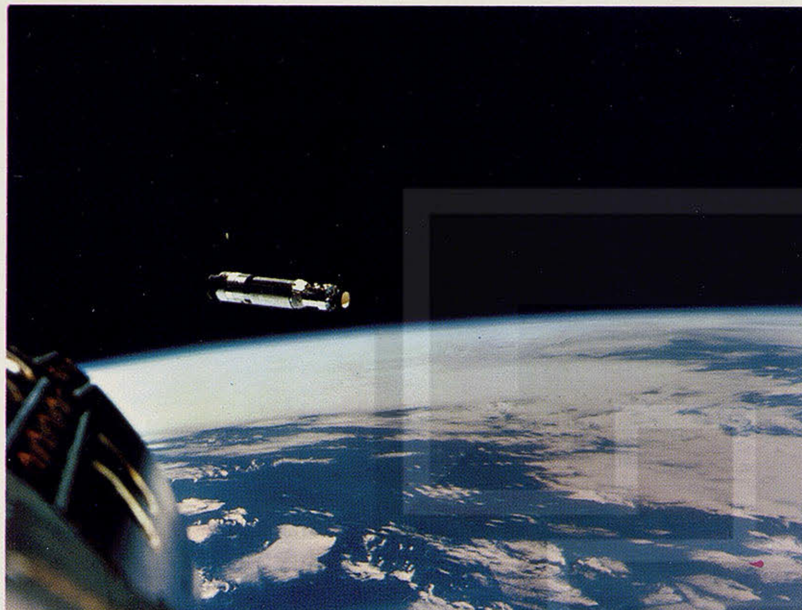


Pacific Coast of Peru and Chile and Andes Mountains seen from Gemini IX-A.

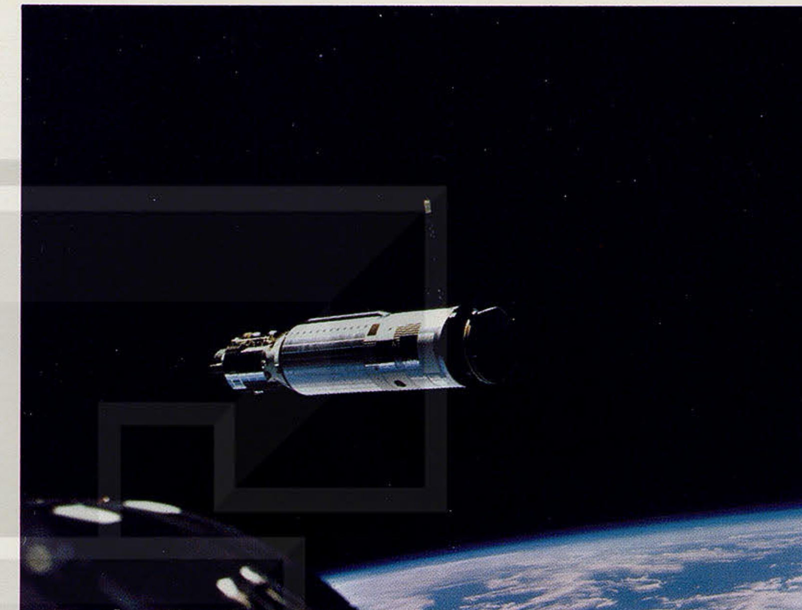
Command Pilot Thomas P. Stafford during Gemini IX-A's three-day mission in space.

Spanish Sahara, Mauritania and Algeria area as seen from Gemini IX-A.

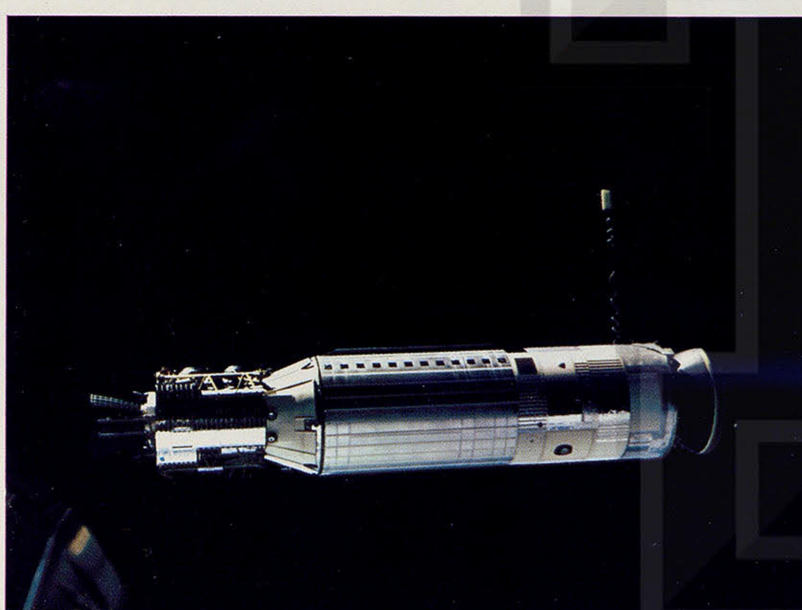




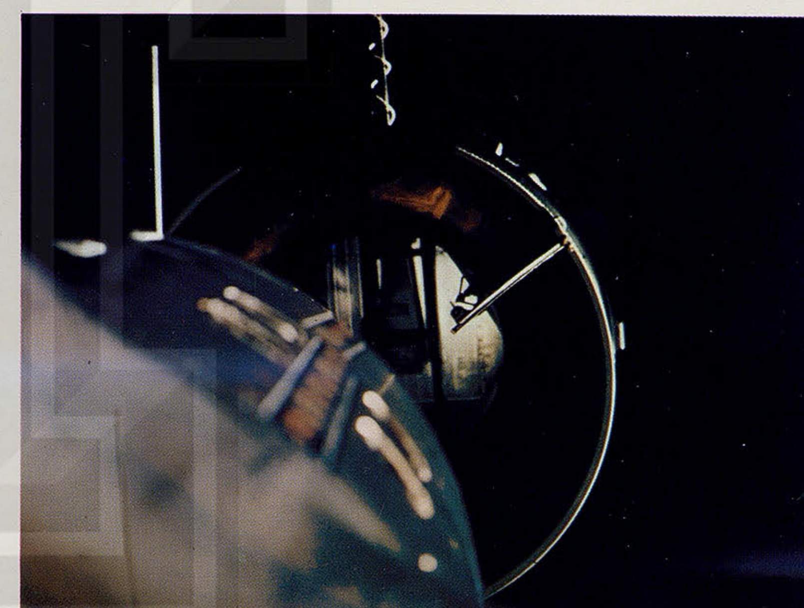
The two spacecraft are 210 feet apart.



Distance between two spacecraft is 55 feet.



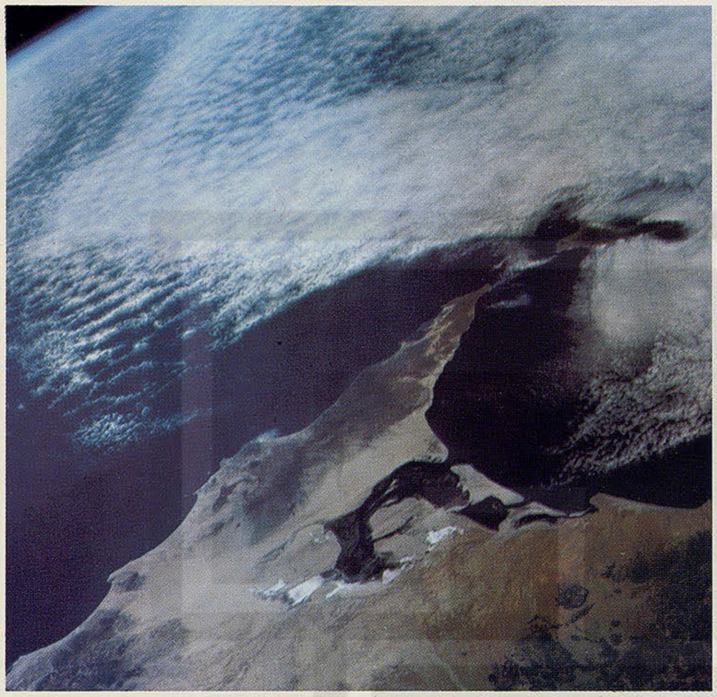
Distance between two spacecraft is 44 feet.



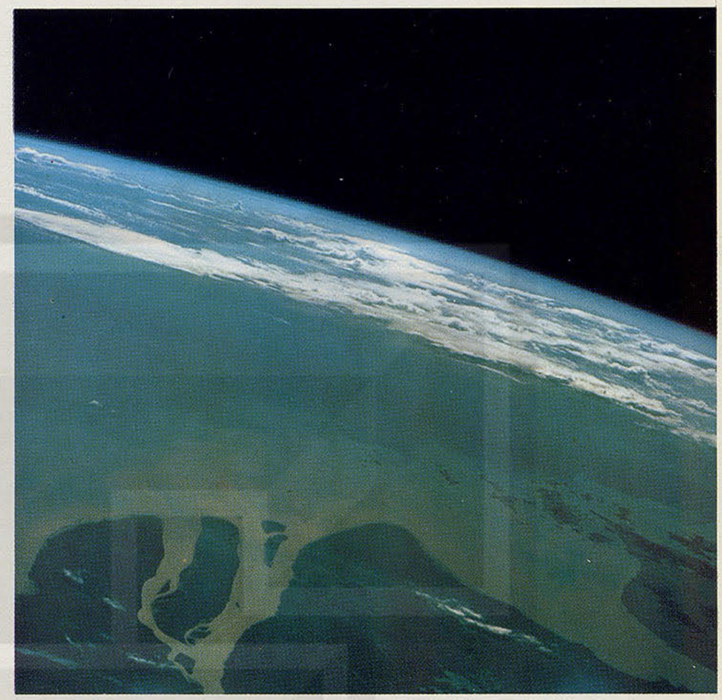
Distance between Gemini VIII and Agena spacecraft is two feet.

Rendezvous and Docking Maneuvers
GEMINI VIII/AGENA MISSION
March 16, 1966

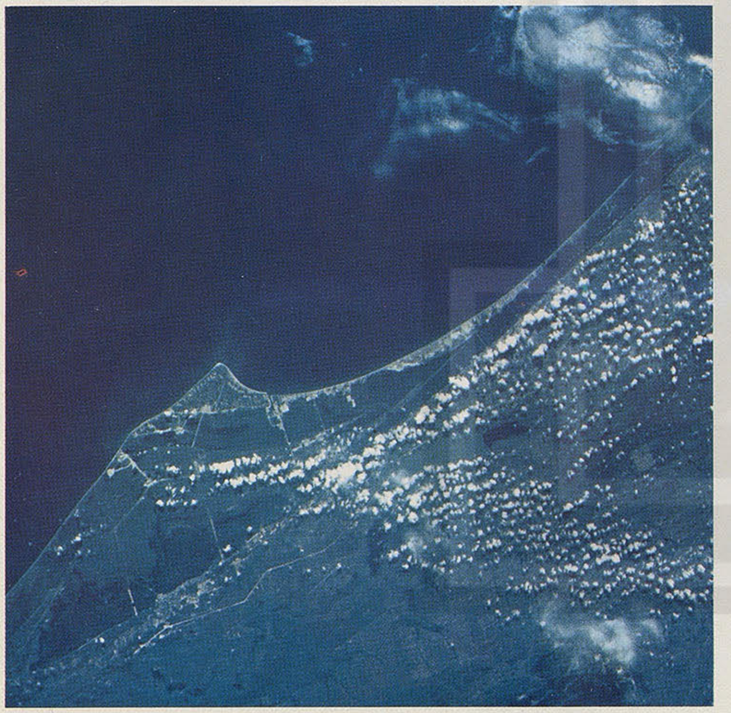
GEMINI V EARTH-SKY VIEWS



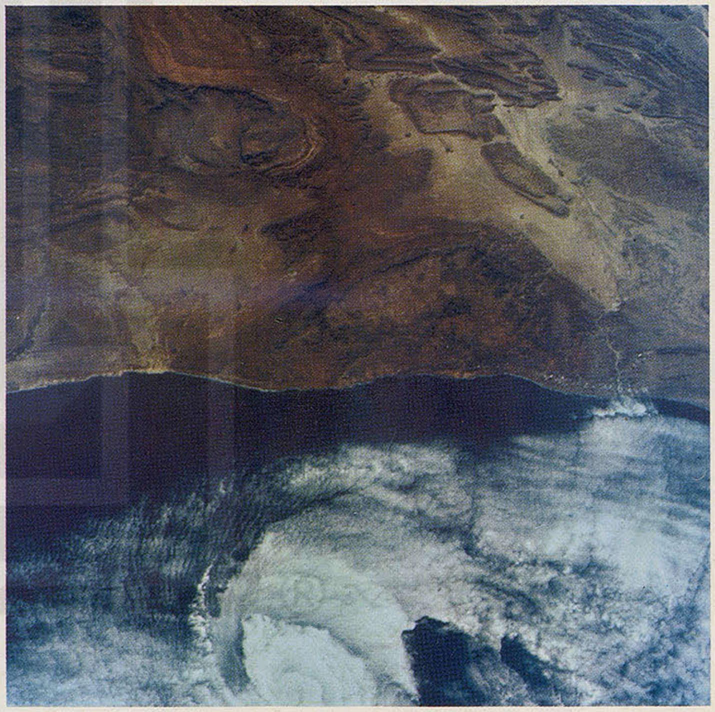
Punta Eugenia area of Baja California, Mexico, looking toward the west. Body of water at right center is Bahia de Sebastian Vizcaino. Pacific Ocean covers upper half of picture. Isla de Cedros is at upper right. This photograph was taken on August 21, 1965, during the fourth revolution of the Gemini V spacecraft.



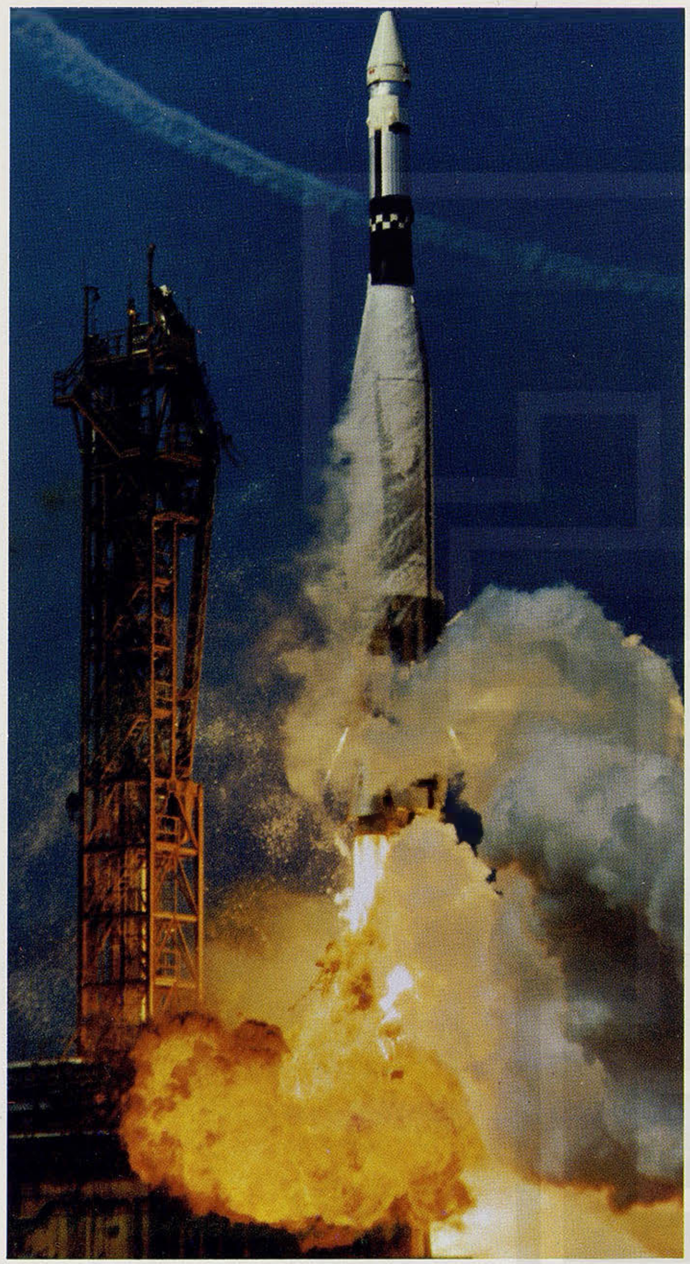
Mouth of Yangtze River, coast of China (Kiangsu and Chekiang provinces), looking to the east. City of Shanghai is located at junction of river and canal, just to left of clouds in lower center of picture. The alluvial silts are clearly visible, being carried out into the East China Sea from the Yangtze (left) and from the Hangchow Wan River (right) for a distance of up to 75 miles. This photograph was taken August 23, 1965, on the 23rd revolution of the Gemini V spacecraft.



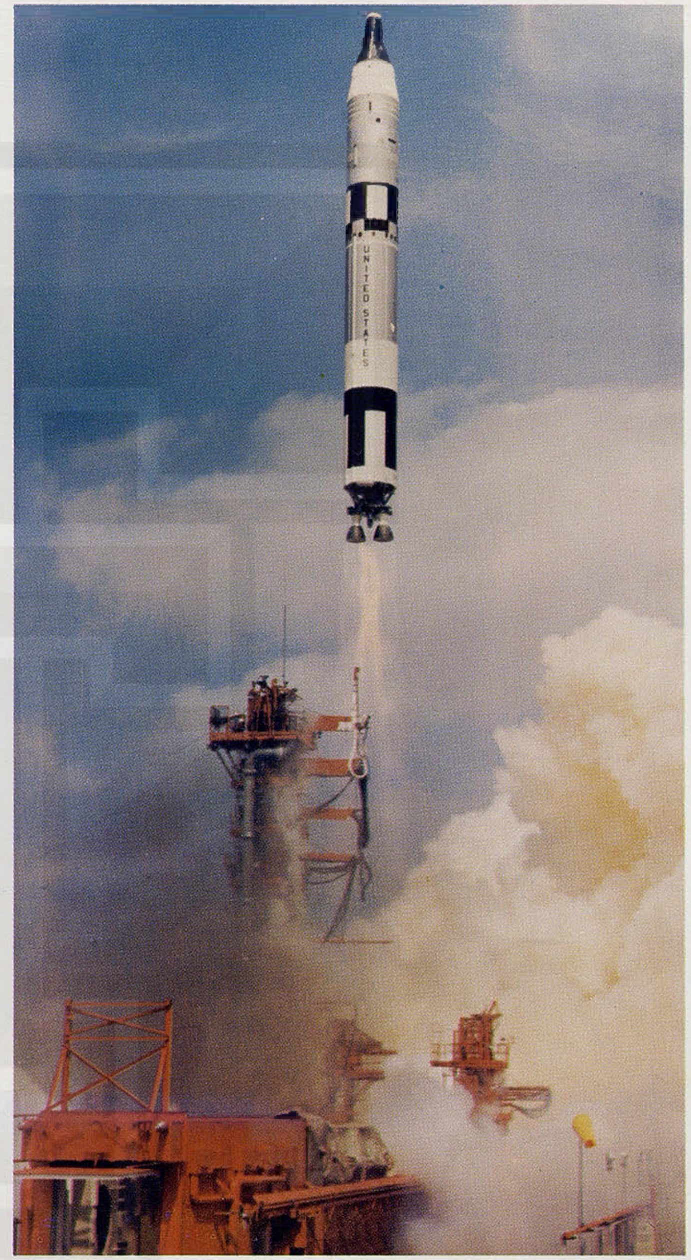
Cape Kennedy, Florida, and vicinity, showing the National Aeronautics and Space Administration's John F. Kennedy Space Center. The details of the launch pads at Cape Kennedy and at Merritt Island are visible. Also, the Vertical Assembly Building is recognizable. The coastline in this picture extends from Daytona Beach south to Fort Pierce, a distance of 120 miles. This photograph was taken on August 28, 1965, during the 106th revolution of the Gemini V spacecraft.



Coast of Morocco, showing a small offshore cyclonic weather disturbance. The counterclockwise air rotation of the cyclone is clearly visible. The cyclone is located over the North Atlantic Ocean, about 60 miles west of the shoreline. The Spanish Colony of Ifni is situated along the coast near the center of the picture. This photograph was taken at an altitude of 125 miles on August 26, 1965, during the 74th revolution of the Gemini V spacecraft.



Atlas/Agena Launch
10 a.m. (EST)



Gemini VIII Launch
11:41 a.m. (EST)

GEMINI VIII/AGENA MISSION
March 16, 1966