**SPACE**

3 Americans Become First Man to Fly Around Moon

Xmas in Lunar Orbit. 3 U.S. astronauts, the first men to fly to the vicinity of the moon, circled the earth's natural satellite 10 times in orbit Dec. 24-25—on Christmas Eve and Christmas. They were not equipped to land on the moon, however. After completing the 10 revolutions around the moon, they brought their Apollo 8 spaceship back to earth and a safe splashdown in the Pacific Ocean Dec. 27.

The historic feat was accomplished by Air Force Col. Frank Borman II, 40, the spaceship commander, Navy Capt. James A. Lovell Jr., command module pilot (and navigator), and Air Force Maj. William A. Anders, 35, who was largely in charge of the trip's photographic mission. (Borman and Lovell had flown in space together in Gemini 7, and Lovell had flown in orbit again as command pilot of Gemini 11. Of the 3, only Anders had not made a space flight.)

The 6-day flight, from launching at 7:51 a.m. EST Dec. 21 at Cape Kennedy, Fla. to the watery landing at 10:51 EST (4:51 a.m. local time) Dec. 27 in the Pacific, established many records or "firsts" for space flight:

- This was the first time men had flown so far (about 233,000 miles) from the earth.
- The trip was man's longest space flight (about 550,000 miles round-trip).
- This was the first time men had gone into orbit around the moon or had even reached its vicinity.
- The 3 astronauts were the first men to reach a place where the gravitation of an astronomical body other than the earth was dominant.
- They were the first men to see the side of the moon always turned away from the earth.

On returning, the astronauts achieved a speed record of 24,530 mph. as they re-entered the atmosphere.

A record weight of 63,433 pounds (the spacecraft and the booster rocket's 3d stage) was put into earth orbit as a single assembly in the launching Dec. 21.

Lovell, who had held the record for time spent in space (696 hours 10 minutes) even before the Apollo 8 flight, increased his record to 572 hours 10 minutes.

The 3 astronauts received congratulatory messages from U.S. and other world leaders, including Pres. Johnson, Pope Paul VI, Soviet Pres. Nikolai V. Podgorny and UN Secy. Gen. U Thant. Press coverage and comment in the USSR was highly laudatory.

A major purpose of the flight was to get close-up photos of the moon and especially of areas that might be suitable for a manned landing. The photos the astronauts took, of the earth as well as of the moon, were described as of exceptionally high quality. The astronauts also transmitted to earth excellent views of the moon and of the earth during 6 "live" telecasts.

All phases of the flight and of the planning that preceded it were covered extensively by all news media. The schedule of possible launching times and optional missions (should the lunar orbital mission be canceled) were published almost as soon as the details were decided on.

The flight was said to have taken place from start to finish with "textbook" perfection. It began and ended almost precisely to the minute scheduled, and the trajectories to and from the moon were almost exactly as planned.

The Launching. Apollo 8 and its 3 astronauts were sent into space in the nose of a 3-stage Saturn-5 rocket launched from Cape Kennedy's Launch Complex 39A at 7:51 a.m. Dec. 21.

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**FACTS ON FILE**

WORLD NEWS DIGEST WITH INDEX
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**HEADLINE NEWS**

3 U.S. astronauts circled moon, returned safely to earth after 550,000-mile voyage through space.

Israeli commandos raided Beirut airport in retaliation for attack on airliner; UN voted censure.

UN Assembly's 23d session adjourned after adopting 117 resolutions.

Poverty, urban developments, racial & student unrest summarized.

Trygve Lie, John Steinbeck, Norman Thomas died.

The 363-foot rocket-spacecraft launching vehicle, weighing 6,218,558 pounds at ignition, was carried to an altitude of about 40 miles by the Saturn-5's first (S-IC) stage. The S-IC, its 5 engines developing a total of 7½ million pounds of thrust, accelerated the assembly to a speed of 6,068 mph. and dropped away.

The 2d (S-2) stage carried the remainder of the assembly to an altitude of about 115 miles, speeded it to a velocity of about 236 mph. and also dropped away.

The 3d (S-4B) stage then put itself and the attached spacecraft into a 115-mile-high orbit with an 88.2-minute period and 32.5° angle of inclination in which it traveled at a speed of 17,435 mph.

**Lunar Trajectory.** An hour and a half of checking by the 3 orbiting astronauts and various ground personnel showed that all equipment was operating satisfactorily. The Manned Space Flight Center in Houston, Tex. then radioed the Apollo 8 crew members to start on the 234,100-mile curved trajectory toward the moon.

As Apollo 8 passed over the Western Pacific Dec. 21 on its 2d revolution around the earth, Borman ignited the S-4B stage for a 2d time, and the spacecraft was accelerated to an "earth escape" velocity of 24,200 mph. At 11:12 a.m. EST, about 20 minutes after completion of its 2d ignition, the S-4B separated, and the Apollo 8 continued toward the moon on its own.

The 363-foot structure that had risen from the launch pad had been divested piecemeal of its 138-foot first stage, its 81½-foot 2d stage, and its 58-foot 3d stage. The slim 33-foot launch escape system that had stood atop the launching assembly had also been jettisoned. The remaining 52.9-foot spacecraft speeding toward the moon consisted of: (1) The command module, a conical capsule 12 feet high, 12 feet 10 inches in diameter at the base, 13,392 pounds in weight (launching weight), encased in heat shields; the command module, containing the crew compartment, was the only part of the spacecraft to complete the trip and to return to earth. (2) The service module, a cylinder 22 feet long, 12 feet 10 inches in diameter, 51,258 pounds in weight (launching weight),

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**REFERENCES** in brackets give location of background information in this & preceding volumes

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*A Special Facts on File supplement completing coverage of the news of 1968 will be issued early in 1969.*
containing the service propulsion system (a rocket engine). (3) The spacecraft-M (lunar module) adapter, a truncated cone, 28 feet long, tapering from a diameter of 21 feet 8 inches to a diameter of 12 feet 10 inches, carrying a dummy lunar landing module, 4,150 pounds.

As Apollo 8 raced toward the moon, it rotated gently at a rate of about 6 turns an hour to keep the sunlit side from getting too hot and the dark side from getting too cold.

Apollo 8 used its own service propulsion system for the first time at 6:51 p.m. Dec. 21 when Borman fired it for 2.4 seconds to make the first scheduled mid-course correction. This ignition increased the speed of the spacecraft by 16 mph. As anticipated, Apollo 8 had been losing speed, due to the pull of the earth's gravity, ever since the S-4B ignition had ended. It continued to lose speed until 3:30 p.m. EST Dec. 23, when, at a velocity of 2,215 miles per hour (4,384 miles per hour of speed of 510.5 miles), it entered the "sphere of gravitational influence" of the moon—the area in which the pull of the moon's gravity was greater than the pull of the earth's. At this point Apollo 8 was about 214,000 miles from the earth and 38,300 miles from the moon. It then speeded up by the pull of the moon's gravity.

Borman Dec. 22 began suffering symptoms (vomiting and diarrhea) of viral gastroenteritis, a 4-hour sickness common (but mistakenly) called intestinal "flu."


d. astronaut Borman reported feelings of nausea, especially when they removed their spacecrafts shortly after they entered the lunar trajectory (they completed the flight in comfortable cots) and when they moved around the capsule. After several flights, Borman offered the mission, said at the Manned Space Center in Houston that the nausea was probably due to "a form of motion sickness." But all 3 were sufficiently improved by 5:01 p.m. Dec. 22 to transmit to earth the first of their 6 "live" telecasts from space. And all appeared to be in excellent health by the time they went into lunar orbit.

Another minor course correction was made as scheduled shortly after 9 p.m. Dec. 23 at a distance of less than 27,000 miles from the moon. The pre-correction trajectory, however, was so close to the one desired that if the course correction had not been made, the spacecraft would have swung around the moon at a distance of only 80 miles instead of the 71.6 miles originally planned.

Orbit around Moon. Apollo 8 was pulled around the moon by lunar gravity at 4:47 p.m. EST Dec. 24.

At 4:59 a.m., while behind the moon and hidden from earth, the spacecraft's rocket was fired in the direction of the line of flight. 4 minutes of this retrofire slowed Apollo 8 from its 5,758-mile speed of 3,643 mph. This put the spacecraft at 5:03 a.m., into a lunar orbit with an apolune (maximum altitude from the moon's surface) of 194 1/2 miles and perilune (closest distance to the lunar surface) of 69.6 miles.

Lovell's first close-up description of the moon, radiated to ground controllers shortly thereafter, was of the moon is essentially gray. No color. Looks like plaster of Paris or sort of grayish beach sand. The astronauts reported being able to see much detail. They easily and quickly recognized man of the craters, faults, peaks and maria already charted by spacecrafts and unmanned lunar probes.

After circling the moon twice in this preliminary orbit, the astronauts fired their engine briefly again to put the spaceship into a circular orbit 69.8 miles above the surface. Apollo 8's speed in the circular orbit was 3,531 mph.

The astronauts transmitted 2 live telecasts to earth Dec. 24 while in lunar orbit. At the close of the 2d Christmas Eve telecast, Borman announced that the spacecraft had "a message that we would like to send to you." He then began reading the first verses of Genesis: "In the beginning God created the heaven and the earth. . . ." The other astronauts took up the reading, and Borman concluded "... and God saw that it was good."

The astronauts Dec. 24 unofficially bestowed their own names and the names of NASA colleagues and friends on previously unnamed lunar craters, peaks and other landmarks. Most of the names had been picked before the flight by 3 astronauts and scientist-astronaut Harrison A. Schmitt, a geologist. But NASA officials quickly discovered that the names had been given only for NASA and astronaut identification and that there was no plan to submit them officially to the International Astronomical Union.

Return to Earth. After circling the moon 10 times in 20 hours, the astronauts fired their engine again at 1:45 a.m. EST Dec. 25 to bring the spaceship out of lunar orbit and into a trajectory for returning to the earth. Apollo 8 passed into the earth's "sphere of gravitational influence" at 12:38 p.m. EST. Dec. 25, and a minor mid-course correction was made at 3:31 p.m. EST Dec. 31.

A final scheduled course correction was dropped Dec. 27 because the spacecraft already was on a virtually perfect course that would bring it through a 336-mile-wide re-entry "corridor" to its Pacific target area.

The service module was jettisoned at 10:23 a.m. EST. An on-board computer in the 11,000-pound command module then fired 6 thruster rockets to turn the conical capsule's blunt base in the direction of flight.

The manned capsule plunged into the atmosphere at 10:37 a.m. EST at a scoring speed of 24,530 mph, and the heat shield was heated by friction with the air to temperatures of up to 5,000°F. The 3 astronauts inside the capsule, however, were protected from the heat.

The 3 manned spacecrafts were deployed at an altitude of 23,300 feet, when the atmosphere had already slowed the spacecrafts to some 300 mph. The 3 small 'chutes pulled out the 3 83-foot main 'chutes. The removal of a cover over the parachutes uncovered a flashing beacon, which was seen in the darkness by men aboard the waiting carrier Yorktown.

The spacecraft splashed into the water at 10:51 a.m. EST (4:51 a.m. local time) Dec. 27 at a speed of 20 mph. It came down only 7,100 yards from the Yorktown, about 1,000 miles southwest of Hawaii.

The astronauts remained in the floating capsule for about 90 minutes until it was light enough for a helicopter to lower 3 frommen into the water. The swimmers secured the capsule with a flotation collar, and the astronauts then left the capsule and were brought by helicopter to the Yorktown. The spacecraft was hoisted aboard the ship an hour later.

Preliminary medical examinations aboard the Yorktown indicated that all 3 astronauts were in good condition after their 6 days in space.

Other Space Developments

Race to Moon? Prof. Leonid I. Sedov, Soviet space scientist and head of the Soviet delegation to the 19th Congress of the International Astronautics Federation, said newsmen in New York Oct. 14 that the USSR was not racing the U.S. to get a man on the moon. "The question of sending astronauts to the moon at this time is not . . . on our agenda," he declared. "The exploration of the moon is not a priority." He said that lunar exploration depended on the success of the USSR's Zond flights. (Sedov and the rest of his 40-member Soviet delegation were invited by the U.S. to inspect selected parts of the Cape Kennedy space center, but Sedov declined because, he noted, "quite frankly, we cannot reciprocate.") [See Vol. XXVII, p. 560E-F1; XXVI, 426F1]

The Mexico City newspaper Ultimas Noticias Oct. 23 quoted Soviet cosmonaut Gherman S. Titov as saying in an interview in Mexico City that the Soviets would not get to the moon before the U.S. did and that he (Titov) would be a member of the Soviet crew. [See Vol. XXVI, p. 68A2]

Tass asserted Nov. 29 that the successful unmanned Zond flights around the moon and back to earth had opened "the space route earth-moon-earth" for Soviet cosmonauts. "Automatic space probes always precede manned flights," Tass said. It reported that the Zond missions had helped to solve such problems as protection of cosmonauts from solar flares and recovery of spacecrafts after interplanetary flights. (Tass disclosed Nov. 29 that Zond 5 had carried living organisms on its flight.) [See p. 508B-E3, 157A2]

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