



INSTITUTE FOR THEOLOGICAL ENCOUNTER WITH SCIENCE AND TECHNOLOGY

Apollo 8 - Providential Mission to the Moon

ITEST

Paul Segura 22 April 2023

Rev A



Who's Paul?

Aerospace Engineer, Historian, Catechist, Husband, Father

- 35 years in aerospace industry
- 30 years married
- 27 years of fatherhood
- 25 years RCIA at parish and archdiocesan levels
- 20 years historical projects & presentations

Agenda

- Divine Providence
- Cold War & the Space Race: Sputnik, Mercury, JFK's goal
- The world of 1968
- Project Apollo Lunar Flight Plan & Mode
- Apollo Lunar Flight Plan & Saturn V
- Apollo original flight schedule
- Apollo 6 & Problems with the LEM
- CIA intelligence April 1968 & Zond 5 September 1968
- A big decision
- Modified Apollo flight schedule
- New flight plan
- The crew
- Launch & "Go for TLI"
- LOI burn & first sight of moon
- Orbital photos
- Earthrise 4th orbit
- Christmas Eve 9th orbit
- Return
- Post-flight
- Legacy
- Divine Providence
- Sources

Divine Providence

Catechism of the Catholic Church paragraph 302

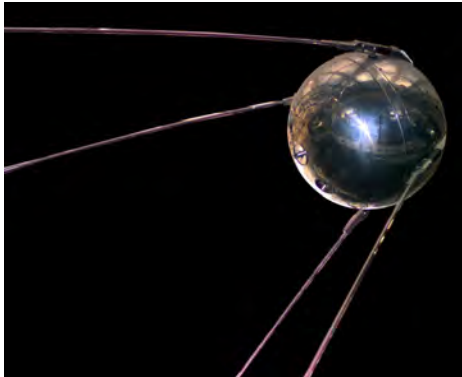
Creation has its own goodness and proper perfection, but it did not spring forth complete from the hands of the Creator. The universe was created "in a state of journeying" (in statu viae) toward an ultimate perfection yet to be attained, to which God has destined it. We call "divine providence" the dispositions by which God guides his creation toward this perfection:

By his providence God protects and governs all things which he has made, "reaching mightily from one end of the earth to the other, and ordering all things well". For "all are open and laid bare to his eyes" (*Ps 115:3*), even those things which are yet to come into existence through the free action of creatures (*Vatican Council I, Dei Filius I: DS 3003; cf. Wis 8:1; Heb 4:13*).

Cold War & Space Race: Sputnik, Mercury, JFK's goal



NASA formed
29 July 1958



Model of *Sputnik 1* at National Air & Space Museum. Launched by the Soviet Union on 4 October 1957, *Sputnik 1* trigger the Space Race in the midst of the Cold War.



Mercury spacecraft *Freedom 7* with Alan Shepard, first American manned space flight on 5 May 1961



Before a Joint Session of Congress, President John F. Kennedy sets the goal for a manned landing on the Moon by the end of the 1960s, 25 May 1961

The world of 1968

Not since the Civil War a century earlier had the United States been this divided



- Vietnam War Tet Offensive
- President Lyndon B. Johnson announces that he will not run for second term
- Martin Luther King assassinated
- Riots triggered by MLK assassination in multiple cities including Washington DC, Chicago, Baltimore, Kansas City, Detroit, New York City
- Robert F. Kennedy, Democratic presidential candidate assassinated
- Vietnam War protests including college and university campuses
- Pope St. Paul VI promulgates encyclical *Humanae Vitae*
- Warsaw Pact invades Czechoslovakia crushing “Prague Spring”



The world of 1968



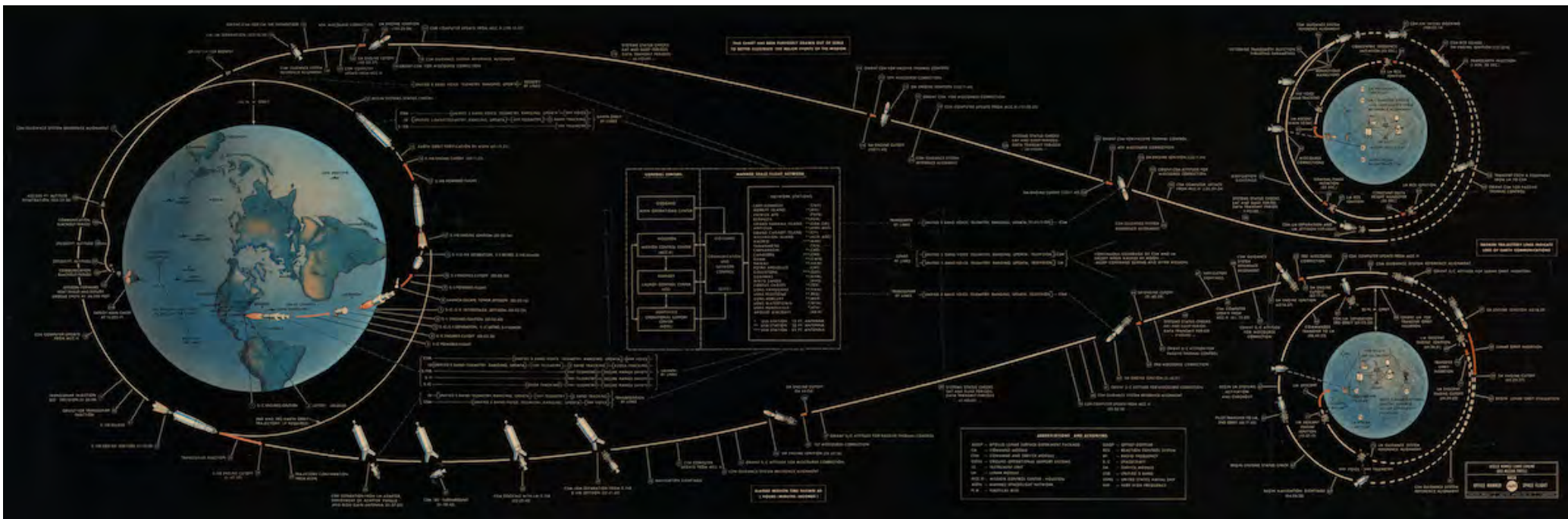
- France conducts first hydrogen bomb test
- Presidential Democratic National Convention suffers from riots in Chicago
- Mexican government crushes the Mexican Movement of 1968, known as the Movimiento Estudiantil, just before the opening of the Games of the XIX Olympiad held in Mexico City
- Richard M. Nixon elected 37th President of the United States
- Mao Zedong starts "Up to the mountains and down to the villages" re-education movement of educated urban youth in China
- Khmer Rouge is officially formed in Cambodia
- Multiple airplane crashes and hijackings



***"Where there is
division, there is
sin." Origen***

Project Apollo Lunar Flight Plan

Mode: LOR - Lunar Orbit Rendezvous





Apollo Lunar Flight Plan & Saturn V

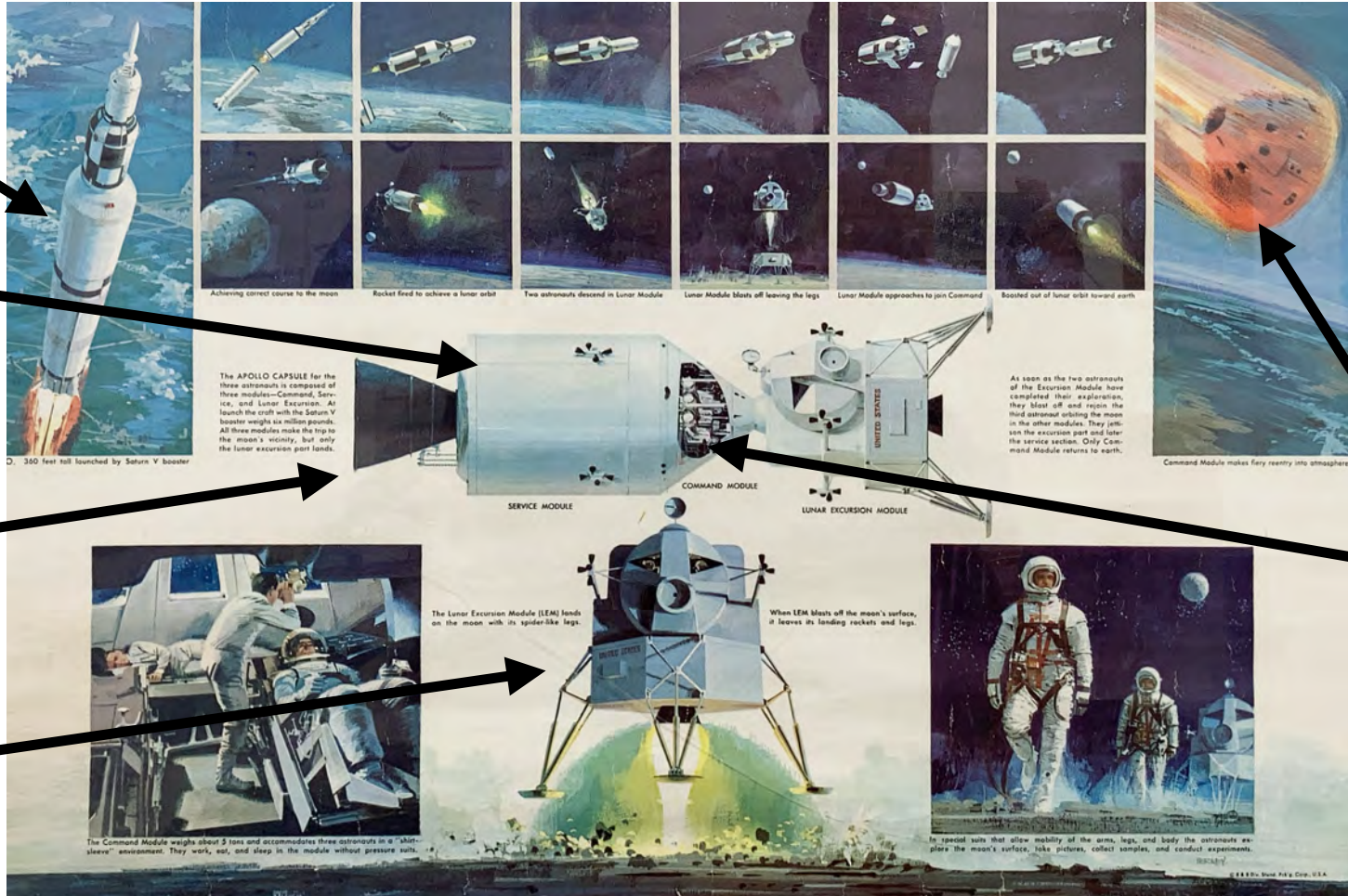
Saturn V

Service Module (SM)

Command/Service Modules (CSM)

Lunar Module (LM)

Command Module (CM)



Apollo original flight schedule



Mission Type	Missions	Description
A	Apollo 4 Apollo 6	Unmanned test flights of the Saturn V launch vehicle and the CSM - November 1967, April 1968
C	Apollo 7	Manned test flight of the CSM in low Earth orbit - September or October 1968
B	Apollo 5	Unmanned test flight of the LM in low Earth orbit - January 1968
D	Apollo 8	Manned test flight of the complete CSM and LM in low Earth orbit - December 1968
E	Apollo 9	Manned test flight of the complete CSM and LM in high Earth orbit - February 1969
F	Apollo 10	Manned test flight of the complete CSM and LM to the Moon to orbit but not land - Summer 1969
G	Apollo 11	Manned Lunar landing - Late 1969

Apollo 6 & Problems with the LEM



2nd Saturn V unmanned flight test, Apollo 6 launched on 4 April 1968 and suffered from pogo oscillation vibration damage and engine shutdowns

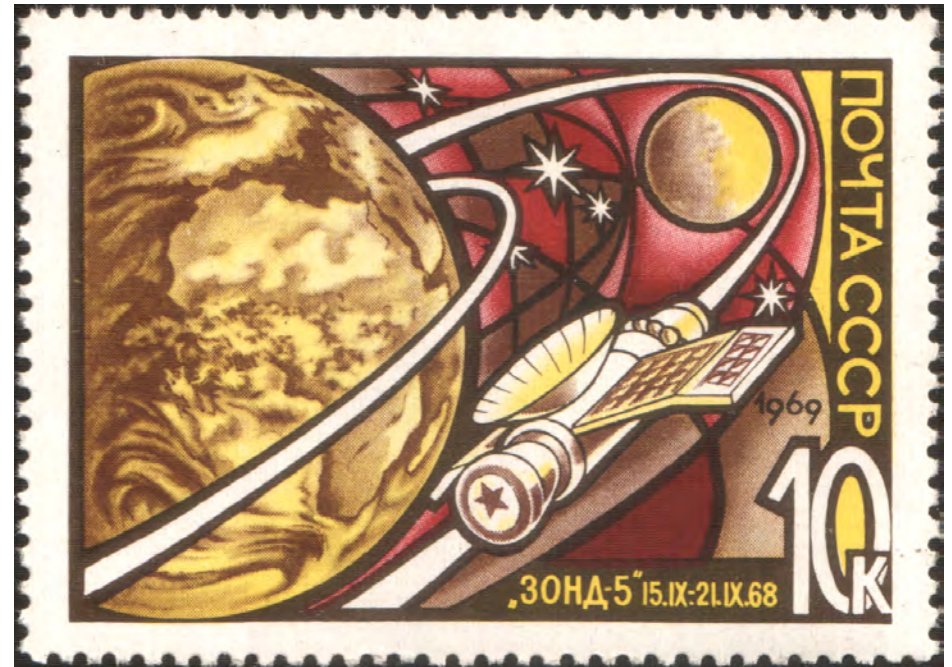


Apollo 11's Lunar Module. Production of Apollo 8's Lunar Module was behind schedule

CIA intelligence April 1968 & Zond 5 September 1968



CIA informed NASA about Soviet N-1 moon rocket being ready for a manned lunar orbital mission in late 1968



Soviet Zond 5 successfully sent the first living creatures on a flyby to the Moon, including two tortoises, and became the first spacecraft to return from a lunar mission in September 1968

A big decision



George Low



Werner von Braun



James Webb



Lyndon Johnson

- Apollo 10, first Apollo flight to the Moon, scheduled for summer of 1969
- The Lunar Module for Apollo 8, first manned flight with a Lunar Module for high Earth orbit test flight will not be ready for planned early 1969 flight
- The Soviets may be ready to send a manned mission to at least flyby the Moon before the end of 1968
- The Soviet's successful Zond 5 flight increased the pressure and further heightened the impression that NASA was behind
- George Low, manager of the Apollo Spacecraft Program Office proposed changing Apollo 8's mission to a CSM-only lunar orbit mission which would keep the program on track and possibly accelerate the overall flight schedule
- Change in training and flight plan without change to launch date results in only 4 vs. 18 months preparation time
- Dr. Werner Von Braun, director of the Marshall Space Flight Center & leader of the Saturn V design team, was confident that design changes have fixed the problems from Apollo 6
- Final decision contingent on successful Apollo 7 flight, first test of CSM; NASA Administrator James Webb and President Johnson approved the plan.
- With the successful flight of Apollo 7 in October 1968, NASA approved the change to Apollo 8's flight plan and subsequent missions' flight schedules
- The original Apollo 8 crew declined to accept the change to the lunar orbit mission, so the Apollo 9 crew as asked to take it, which they did, the two crew swapping positions. The new Apollo 8 crew had minimal time to learn the new mission.

Modified Apollo flight schedule



Mission Type	Missions	Description
A	Apollo 4 Apollo 6	Unmanned test flights of the Saturn V launch vehicle and the CSM - November 1967, April 1968
B	Apollo 5	Unmanned test flight of the LM in low Earth orbit - January 1968
C	Apollo 7	Manned test flight of the CSM in low Earth orbit - September or October 1968
C Prime	Apollo 8	Manned test flight of the CSM to lunar orbit - December 1968
D	Apollo 9	Manned test flight of the complete CSM and LM in low Earth orbit - availability of LM in February 1969
F	Apollo 10	Manned test flight of the complete CSM and LM to the Moon to orbit and descend towards the lunar surface but not land - May 1969
G	Apollo 11	Manned Lunar landing - Summer 1969

New flight plan

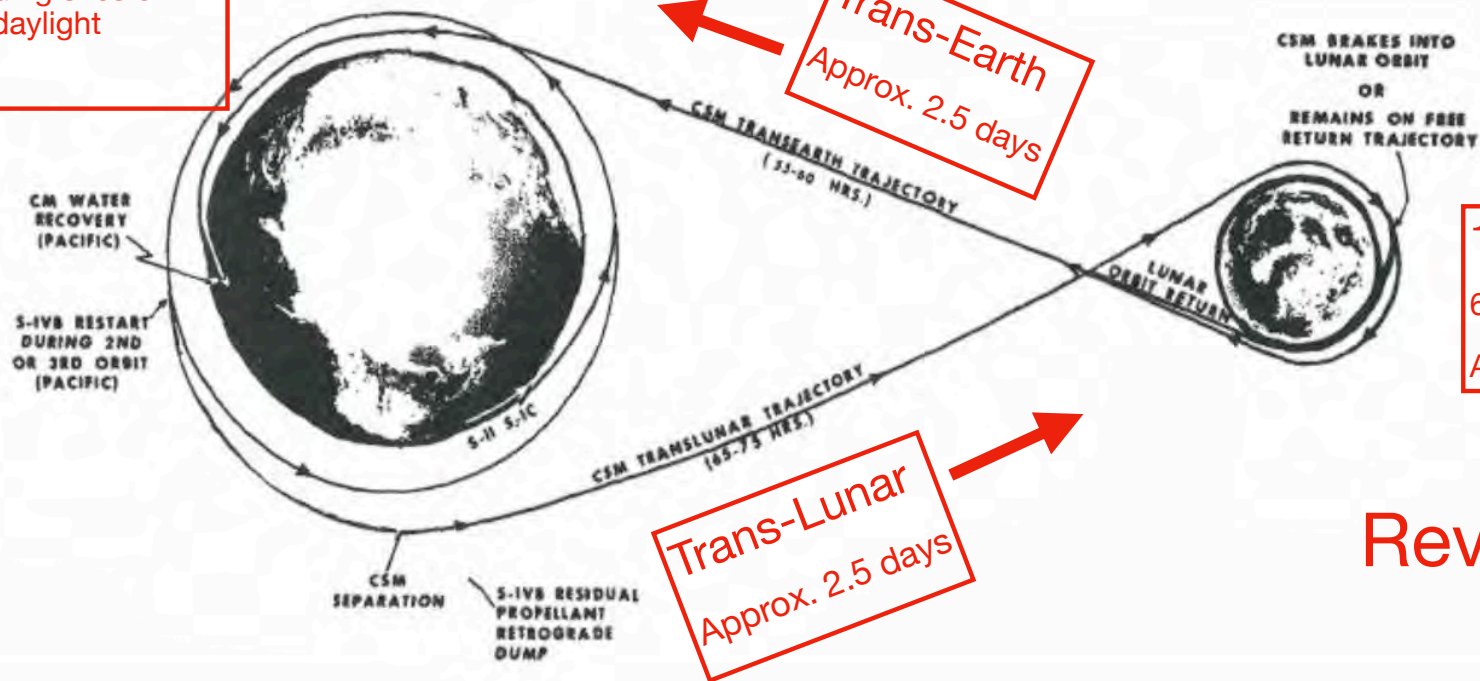


APOLLO 8 ORBIT PROFILE

21-27 December 1968

Timed for photography of future potential lunar landing sites on near side in lunar daylight

Approx. 6 days



Trans-Earth
Approx. 2.5 days

Trans-Lunar
Approx. 2.5 days

10 orbits
60 miles altitude
Approx. 1 day

Rev A

The Crew



Frank Borman, Commander

- Colonel, USAF
- West Point Class of 1950
- U.S. Air Force Test Pilot
- Married to Susan, two children
- Episcopalian



Jim Lovell, Command Module Pilot

- Captain, US Navy
- Naval Academy Class of 1952
- U.S. Navy Test Pilot
- Married to Marilyn, four children
- Episcopalian



Bill Anders, Lunar Module Pilot

- Major, USAF
- Naval Academy Class of 1955
- U.S. Air Force Fighter Pilot
- Married to Valerie, six children
- Catholic

Launch & “Go for TLI”

A number of “firsts”

- First time humans flew on Saturn V
- Successful launch and Earth orbit
- TLI - Trans Lunar Injection -
Michael Collins: “Apollo 8, you are Go for TLI.”
Woods & O’Brien, Apollo 8 Flight Journal, 02:27:22
- Saturn third stage fires for second time and accelerates spacecraft from over 17,000 mph to almost 24,000 to escape Earth’s gravity
- First humans to leave Earth orbit
- First to pass through the Van Allen radiation belts
- First televised pictures of the Earth
- First to enter gravitational field of another celestial body
- Borman suffered from vomiting & diarrhea & recovered



Michael Collins,
Capsule
Communicator
(CAPCOM),
Mission Control in
Houston



Apollo 8 launch 21 Dec 1968

LOI burn & first sight of moon

A number of “firsts”

- LOI - Lunar Orbit Insertion. Single engine fires to slow spacecraft into lunar orbit
- First to have LOS - Loss of Signal, or lose contact with Earth on far side of the Moon, about 35 minutes each orbit; LOI burn took place during LOS
- Moon first came into view as they approached lunar day, exactly when flight plan indicated while on far side, prompting awe by Borman for the human calculators, scientists, engineers and mission planners who did all the analysis for the flight plan
- First humans to orbit the Moon
- First humans to see the far side of the Moon



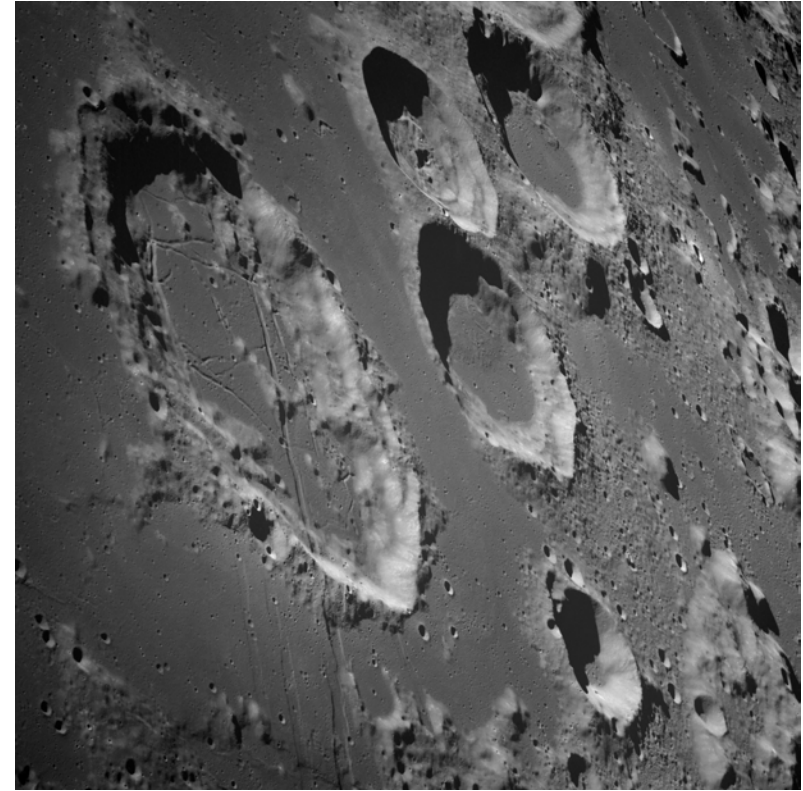
Lunar far side taken by Apollo 8

Lunar orbit

Frank Borman recorded a prayer that would be played at his Episcopal service that night

- 074:50:01 Collins: Apollo 8, Houston. Go ahead, Frank, with your message.
- 074:50:07 Borman: Okay. This is to Rod Rose and the people at St. Christopher's, actually to people everywhere. Give us, O God, the vision which can see thy love in the world in spite of human failure. Give us the faith to trust the goodness in spite of our ignorance and weakness. Give us the knowledge that we may continue to pray with understanding hearts, and show us what each one of us can do to set forth the coming of the day of universal peace. Amen.
- 074:50:35 Collins: Amen.
- 074:50:36 Borman: I was supposed to lay-read tonight, and I couldn't quite make it.
- 074:50:42 Collins: Roger. I think they understand.

Woods & O'Brien, Apollo 8 Flight Journal, Day 4, Lunar Orbits 1, 2, and 3



Potential landings sites on the lunar nearside.

Earthrise 4th orbit

After a maneuver to change from an elliptical to circular orbit, and a change in the orientation of the CSM, the crew could now see the horizon of the Moon.

All three astronauts were taking pictures of the surface of the Moon. For the first time, something happened that was not mentioned on the flight plan or simulations: the Earth appeared on the horizon of the Moon and rose higher and higher in the sky. All three were caught up in the beauty of the moment, ignored the Moon, and took multiple pictures of the rising Earth. Bill Anders, asking Lovell for color film and took the famous picture that became known as “Earthrise.”

“There was this beautiful planet, blue with white clouds, kind of brownish pink that you could clearly distinguish...terribly isolated with a black background of space...but it was everything that we held dear was back there 240,000 miles away. Our families, our country, everything and it was Christmas Eve so it was a very nostalgic moment looking back at the Earth.” Frank Borman

Hildebrandt, 1:37:50



“The thought you know...how insignificant we all are. Everybody I ever knew... 5 billion people could be behind my thumb as I put it up...” Jim Lovell
Hildebrandt, 1:38:03

Christmas Eve 9th orbit

Live broadcast from Moon sets record for largest at that time

About a quarter of the globe listened live; more to the recording a day later

After describing views of the Moon:

Bill Anders

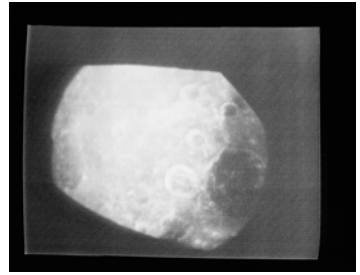
We are now approaching lunar sunrise, and for all the people back on Earth, the crew of Apollo 8 has a message that we would like to send to you.

In the beginning God created the heaven and the earth.

And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters.

And God said, Let there be light: and there was light.

And God saw the light, that it was good: and God divided the light from the darkness.



View of Moon's surface from earlier 2nd lunar orbit TV broadcast.

Christmas Eve 9th orbit

Live broadcast from Moon sets record for largest at that time

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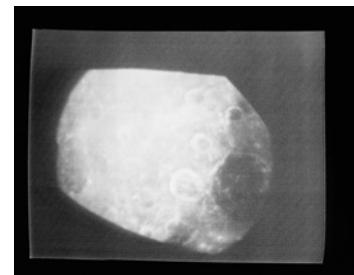
Jim Lovell

And God called the light Day, and the darkness he called Night. And the evening and the morning were the first day.

And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters.

And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament: and it was so.

And God called the firmament Heaven. And the evening and the morning were the second day.



View of Moon's surface from earlier 2nd lunar orbit TV broadcast.

Christmas Eve 9th orbit

Live broadcast from Moon sets record for largest at that time

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Frank Borman

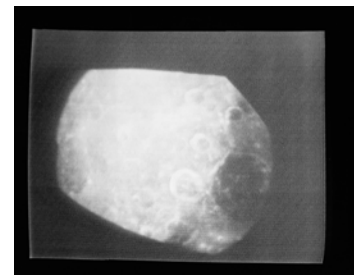
And God said, Let the waters under the heaven be gathered together unto one place, and let the dry land appear: and it was so.

And God called the dry land Earth; and the gathering together of the waters called he Seas: and God saw that it was good.

And from the crew of Apollo 8, we close with good night, good luck, a Merry Christmas – and God bless all of you, all of you on the good Earth.

Woods & O'Brien, Apollo 8 Flight Journal, Day 4, Lunar Orbits 7, 8, and 9

Back in Houston, only a few at Mission Control had dry eyes. Thankful for the historic moment, some prayed. The same could be said of many of the billion people who saw or heard the live coverage.



View of Moon's surface from earlier 2nd lunar orbit TV broadcast.

Return

- TEI - Trans Earth Injection - same single engine fire to escape lunar orbit from the far side and fly back to Earth
- *“Roger. Please be informed there is a Santa Claus.”*
Jim Lovell, 12:25 AM Houston time on Christmas morning
Kurson, p. 274
- Approximately 60 hour journey back to Earth

Apollo 8 Command Module
aboard USS Yorktown



View of Earth on return trip from the Moon



Borman, Anders and Lovell
aboard USS Yorktown after
splashdown 27 December 1968

Post-flight

- Reporter: *"Is the moon made of green cheese?"*
Bill Anders: *"Nope, it's American cheese."*
Risk, 01:34:35
- *"Almost without exception, spacecraft systems operated as intended. All temperatures varied in a predictable manner within acceptable limits, and consumables usage was always maintained at safe levels. Communications quality was exceptionally good, and live television was transmitted on six occasions. The crew superbly performed the planned mission."*
Low, p. 1-2
- New York City ticker tape parade, UN visit, joint meeting of Congress, NASA Distinguished Service Medal from President Johnson at the White House
- Frank Borman & family on European tour - Speaking of the Genesis readings, Pope Paul VI told Borman, *"For that particular moment of time, the world was at peace."*
Kurson, p. 318
- *Time* magazine Men of the Year
- Letters & telegrams:
"Thank you, Apollo 8. You saved 1968."
Kluger, p. 288



Frank Borman addressing Joint Session of Congress
Philips, A Lunar Christmas

Legacy

All the “firsts”

“We often talk about going to heaven when we die. But in reality, don’t we go to heaven when we’re born? Because don’t we arrive on a body that has the proper mass that can contain water, and an atmosphere, the very essentials of life? And don’t we arrive on a body that’s just at the right distance from a star that provides the energy to the earth; and that energy is what caused life to evolve in the beginning? In some aspects, God has really given us a stage, a stage on which to perform. And I think that how this play comes out is really up to us. ” Jim Lovell

Hildebrandt 01:38:49



“Realizing that we had done our job well, that we’d beat the Russians to the moon and there was no doubt in my mind now that the rest of the program was going to work. I had a feeling almost of euphoria, I was so pleased, I was so thankful for, you know, because let’s face it, God must have been looking after us or we wouldn’t have made it so it was a very, very, very religious experience for me.” Frank Borman

Risk, 01:04:00

Legacy

*“The Earth from here is a grand oasis in the big vastness of space.” Jim Lovell
Woods & O’Brien, 085:46:23*

*“We came all this way to explore the Moon, and the most important thing is that we discovered the Earth.” Bill Anders
Hildebrand, 01:55:04*

Earthrise has been counted as one of the 100 most significant photos in history & helped launch the environmental movement

Genesis reading & Madalyn Murray O’Hair

It took a trip to moon to prompt questions about who we are, what does all this mean, and what do we need to do with this knowledge

For the first time, people saw themselves as inhabitants on a small world in a large universe



Legacy: Original Wives Crew

**Only Apollo crew
still in original
marriages**

Frank Borman, Commander

- Colonel, USAF (Ret.)
- Married to Susan,
two children, grandchildren,
great grandchildren



Jim Lovell, Command Module Pilot

- Captain, US Navy (Ret.)
- Married to Marilyn,
four children, grandchildren,
great grandchildren

Bill Anders, Lunar Module Pilot

- Promoted to Colonel when crew
returned to Houston;
Major General, USAF (Ret.)
- Married to Valerie,
six children, grandchildren

Divine Providence

Catechism of the Catholic Church paragraphs 307 & 308

To human beings God even gives the power of freely sharing in his providence by entrusting them with the responsibility of "subduing" the earth and having dominion over it (*cf Gen 1:26-28*). God thus enables men to be intelligent and free causes in order to complete the work of creation, to perfect its harmony for their own good and that of their neighbors. Though often unconscious collaborators with God's will, they can also enter deliberately into the divine plan by their actions, their prayers and their sufferings (*cf Col 1:24*). They then fully become "God's fellow workers" and co-workers for his kingdom (*1 Cor 3:9, 1 Thess 3:2, Col 4:11*).

The truth that God is at work in all the actions of his creatures is inseparable from faith in God the Creator. God is the first cause who operates in and through secondary causes: "For God is at work in you, both to will and to work for his good pleasure (*Phil 2:13, cf 1 Cor 12:6*)." Far from diminishing the creature's dignity, this truth enhances it. Drawn from nothingness by God's power, wisdom and goodness, it can do nothing if it is cut off from its origin, for "without a Creator the creature vanishes (*GS 36, 3*)." Still less can a creature attain its ultimate end without the help of God's grace (*cf Mt 19:26, Jn 15:5; 14:13*).

Sources & References

All photos are public domain; Apollo 8 photos are NASA

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Thank you!

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Paul Segura 22 April 2023

