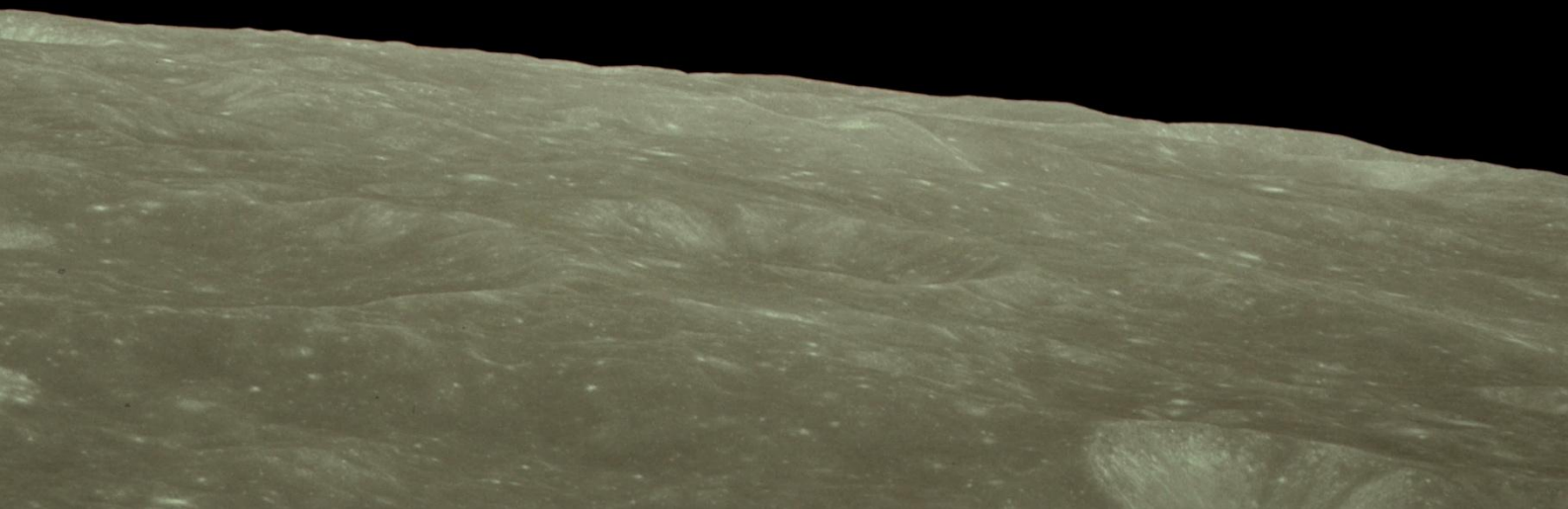




APOLLO 8

21 - 28 DECEMBER 1968

an essay by
HAMISH LINDSAY





*“Once a photograph of the Earth,
taken from the outside, is available
– once the sheer isolation of the Earth becomes known
– a new idea as powerful as any in history will be let loose.”*

Astronomer Fred Hoyle, 1948.

Quoted in New Scientist, 13 May 1982, page 430.

*“We came all this way to explore the Moon,
and the most important thing is,
that we discovered the Earth.”*

William Anders

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Extracted from content available on the
Honeysuckle Creek Tracking Station
website, developed by Colin Mackellar
www.honeysucklecreek.net

EDITORIAL NOTES

This description of the Apollo 8 mission includes tables listing key activities and times, plus tracking times, and duration, at Honeysuckle Creek.

Ground Elapsed Time (GET) is included for a quick sequential reference and to relate it directly to NASA's Apollo Flight Journal and Apollo Lunar Surface Journal.

Unless otherwise indicated, all times are Australian Eastern Standard Time (AEST, GMT +10), refer to the time of events in relation to the Honeysuckle Creek Tracking Station (HSK), near Canberra, Australia. Change of day is midnight HSK time.

Indented and italicised text are either excerpts from interviews by Hamish Lindsay with astronauts and NASA personnel, air-to-ground conversations, or other relevant commentary and quotes.

The honeysucklecreek.net website is regularly updated with new content, which also includes additions to the subject matter of this essay.

THE APOLLO 8 CREW



William A. Anders, James A. Lovell, and Frank F. Borman.
Image: NASA/JSC

AS-503/CSM-103 C-1 MISSION NCG 735

PRIME CREW

Commander : Frank F. Borman III
Command Module Pilot : James A. Lovell Jr
Lunar Module Pilot : William A. Anders

BACK-UP CREW

Commander: Neil A. Armstrong
CM Pilot: Edwin E. 'Buzz' Aldrin Jr
LM Pilot: Fred W. Haise Jr

SPACECRAFT

Command Module: **APOLLO 8** CSM-103
Lunar Module: No LM flown on this mission
Saturn V: SA-503





Borman, Lovell, and Anders. Image: NASA/KSC

Apollo 8

Apollo 8 marked the beginning of a new era in man's exploration of space and, indeed, in the history of mankind, grabbing a swag of space firsts:

- The first time humans had left the planet Earth
- The first time a human saw the whole planet Earth from space
- The first time humans had not experienced a night, with sunrises and sunsets
- The first time humans were exposed to raw solar radiation beyond the Earth's magnetic field
- The first time astronauts had experienced the full 3.4 million kilogram thrust of the big Saturn V rocket
- The first time humans had entered another gravitational field
- The first time humans orbited the Moon

- The first time humans had been occulted by the Moon
- The first to see the back side of the Moon
- The first to see Earthrise at the Moon
- The first to re-enter into the Earth's atmosphere from the Moon
- The first to travel so far and so fast

Apollo 8 also ended the American's race with the Russians. The Russians had been leading the race in the early era of space exploration, and the Americans were constantly looking for ways of catching up.

The Russians were pursuing the assembly of an Earth orbital platform from which to launch the lunar landing mission, while by 1962 the Americans had moved on to the lunar orbit rendezvous concept, which is estimated to have sliced a year off their Apollo development program.

In October 1968 the Russians were still trying to perfect their docking techniques. They launched Soyuz 3 to rendezvous with Soyuz 2 and transfer crew members between the two spacecraft but ran into problems and had to abort the docking exercise. In November an unmanned Zond 6 flew around the Moon, but the cabin depressurised on the way back and the spacecraft slammed into the Earth at a speed that would have killed a human crew. A Zond 7 flight with two cosmonauts was planned for December, but due to a number of technical problems the flight was scrubbed, and the Russian cosmonauts had to stand by and watch Apollo 8 go for the Moon.

Of all the Apollo missions Apollo 8 was the most exciting to me. Most people I have spoken to who were involved in Apollo, including Houston flight controllers, agree. Nobody knew what would happen to humans so far out in space – for the first time we were really going to leave the Earth and head off into the void.

Flight Dynamics Officer Jerry Bostick explained the view from the Trench in Mission Control,

“From a trajectory viewpoint, it meant we had to accelerate some of the software in the Mission Control Center and the spacecraft and the world-wide tracking network. Now management had decided to go into lunar orbit it required very accurate calculations. I have told people that shooting for the Moon is a bit like duck hunting – you don’t shoot at the duck; you shoot at a spot in front of it and let it fly into the shot. So, we have to aim at a spot in front of the Moon equivalent to the thickness of a sheet of paper when viewed from Earth.

We had confidence in being able to do this but were a little nervous about doing it for the first time and much earlier than planned.”

Just the navigation required to accomplish this feat was mind-bending. Every object involved in this voyage was moving and the spacecraft had to arrive exactly 128.7 kilometres ahead of the Moon, itself moving at 3,219 kilometres per hour. Just an error of 1.6 kilometres per hour in the spacecraft’s speed would mean missing the Moon by 1,600 kilometres. As for going into orbit around the Moon – that really grabs one’s stomach.

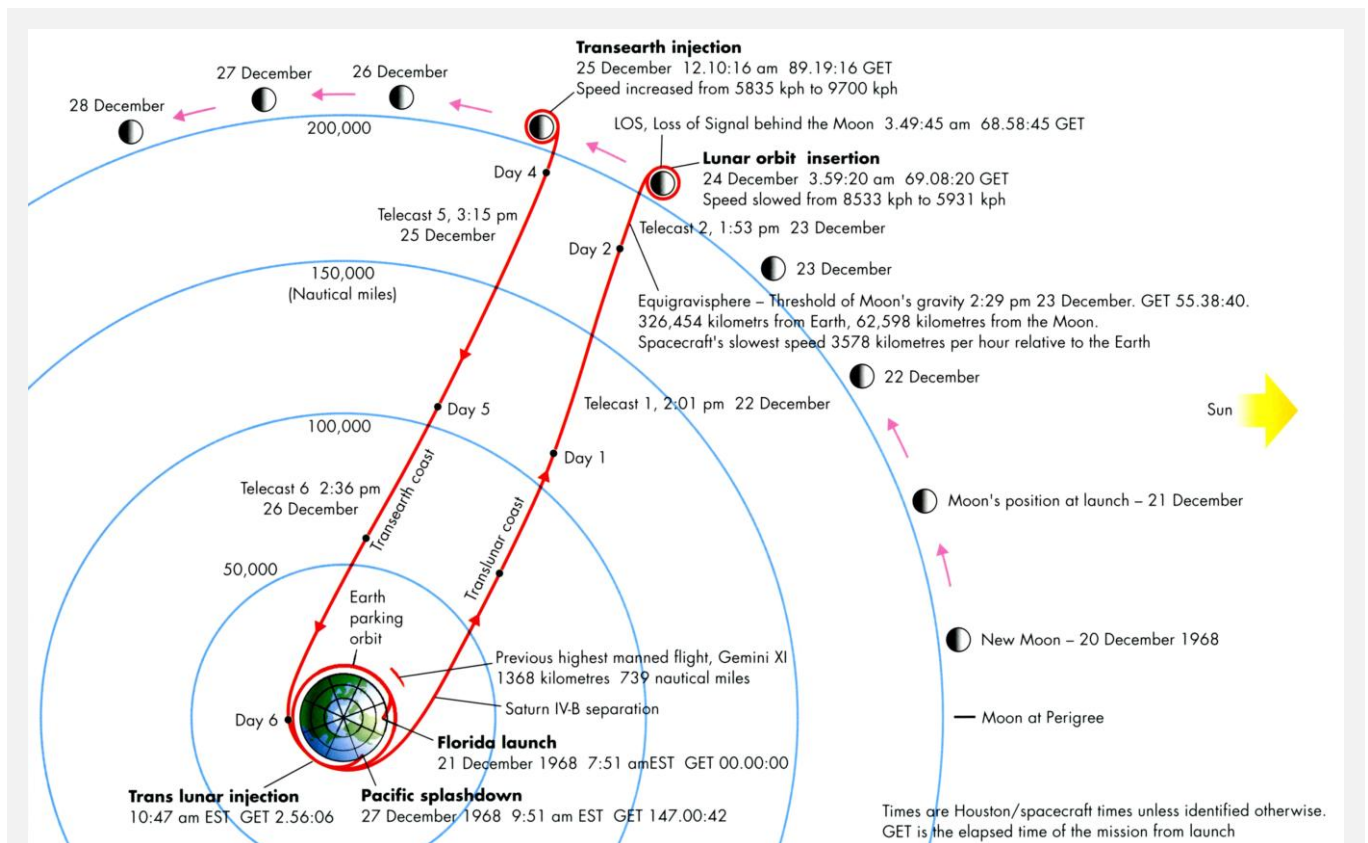
Put yourself in the crew’s place; how would you feel about going into orbit around the Moon for the first time ever? Locked up in a spacecraft not much bigger than a phone box with two other people? If anything went wrong it was days to get back to the Earth, and there was every chance of being stuck in permanent lunar orbit, or being the first human bodies buried alive in moon dust, or shooting off into solar orbit, three sitting skeletons forever circling the sun.

There was only one cheerful option – returning safely to Earth.

Originally Apollo 8 had been planned as an Earth orbit mission to check out the spacecraft. Flight Director Chris Kraft felt the CSM was in the best shape of any spacecraft ever. It was passing all its tough tests with flying colours. It was the LM development that was lagging with a number of problems still to be resolved. It didn’t help to receive American CIA reports inferring the Russians might be working on a lunar flight with a new Soyuz spacecraft.

In early August 1968 George Low, the Apollo Program manager, had this crazy idea of just going to the Moon with no LM on the first manned flight of the mighty Saturn V. The Russians’ spectacular fireballs had shown what it was like when things went wrong during a launch of these big rockets. At this point Low only saw a circumlunar flight. He bounced the idea off Chris Kraft and Bob Gilruth. *“His idea was a shocker,”* said Kraft, *“but if we could pull it off it would be absolutely pivotal to landing men on the Moon,”* and proposed they go into lunar orbit as well.

After consulting Deke Slayton and von Braun and getting the go ahead from a surprised NASA hierarchy and President Johnson, NASA decided to officially go for orbits around the Moon with a CSM flight only, subject to a successful Apollo 7 manned flight. It was decided to make the first attempt on 21 December with a liftoff time of 1251 GMT (0751 USEST or 2251 AEST) Choosing this day and time would allow the crew to observe the first planned landing site at the ideal Sun elevation of 6.7°. At least it would make sure of beating the Russians and confirm that a manned lunar flight in orbit was possible.



Plan of the trajectory to the Moon followed by Apollo 8.

Diagram: Source – NASA, via Hamish Lindsay

This dramatic change of flight plan disrupted Deke Slayton's carefully planned crew schedules. The original Apollo 8 crew of McDivitt, Scott and Schweickart had been training hard for an Earth orbit mission to check out the Lunar Module. Slayton decided to keep them with their LM mission, and to swap McDivitt's crew with Borman, Lovell and Anders from Apollo 9, with their backups of Armstrong, Aldrin and Haise.

Slayton: *"I thought that this crew could be ready in four months, no problem,"*

...and on 10 August 1968 called Jim McDivitt into his office to tell him he was rescheduled for Apollo 9. McDivitt could see,

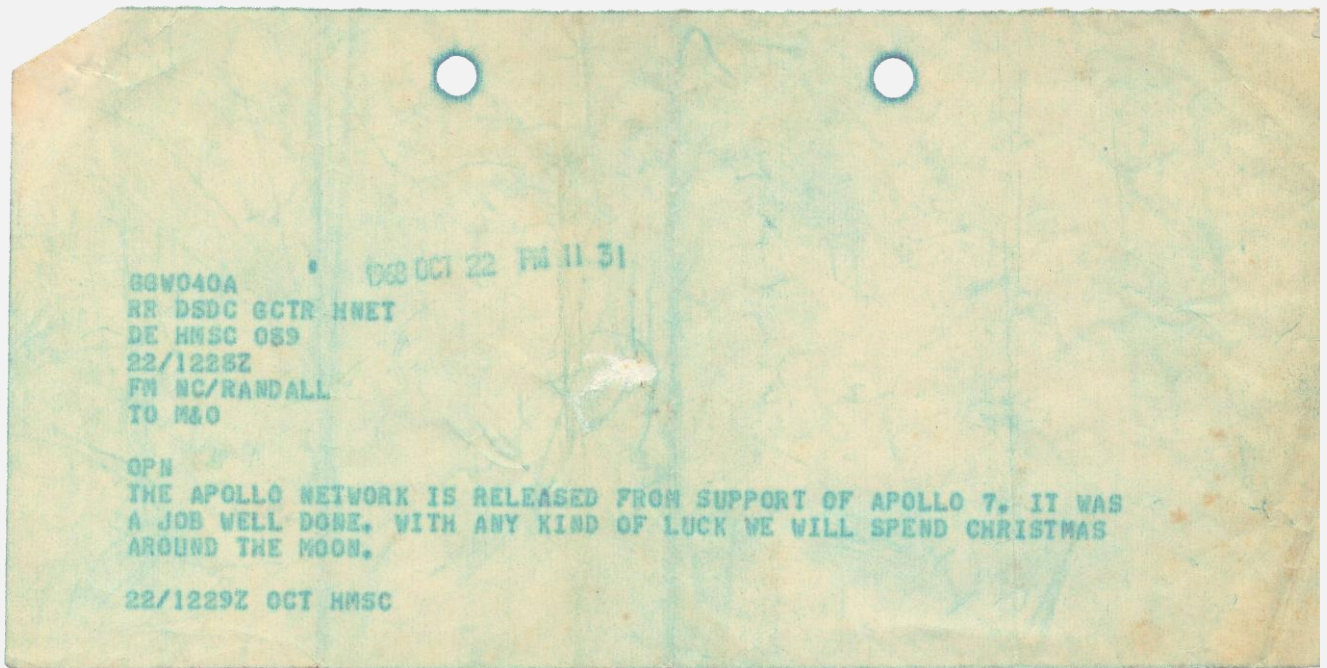
"...NASA didn't want to throw away our training... I think it was that Rusty (Schweickart), and I knew more about this particular lunar module than anybody else,"

...and agreed to the swap.

Two days later Slayton called Frank Borman and told him Apollo 8 was his if he wanted it. Frank said "yes" without any hesitation and the new crew for 8 was announced on 19 August 1968 – but not the flight plan.

These plans were kept secret from the media until Apollo 7 was safely back home. In mid-September a news release was issued saying that NASA was looking at options beyond Apollo 7 that included a long duration flight in high orbit, or maybe a circumlunar or lunar orbit flight. Surprisingly the wording fooled the media, who did not pick up the hint of the impending lunar orbit mission.





This TWX was sent Network Controller Ernie Randall to the tracking network at the successful conclusion of Apollo 7. Received at the Guam Tracking Station. Preserved by Brian Riehle.

Dated 22nd October 1968, it reads, *"The Apollo Network is released from support of Apollo 7. It was a job well done. With any kind of luck, we will spend Christmas around the Moon."*

The Crew



Colonel Frank Frederick Borman

Born in Gary, Indiana, on 14 March 1928, which would have made him 40 years of age during the mission. As he suffered sinus problems in Indiana's cold damp weather the family moved to Tucson, Arizona, which Borman considers his home town.

He began flying at the age of 15. He received his Bachelor of Science degree from the United States Military Academy in 1950 and moved on to become a fighter pilot in the US Air Force. He received his Master of Science degree in aeronautical engineering from the California Institute of Technology in 1957 and went on to become a test pilot.

He was selected by NASA for the second intake in September 1962 and his first trip into space was in Gemini 7 as Command Pilot with Jim Lovell, a long duration flight which set a record of fourteen days in space. They also performed a rendezvous with Gemini 6-A, flown by Wally Schirra and Tom Stafford.

In 1967 Borman was the only astronaut to serve as a member of the Apollo 1 204 Fire Investigation Board, which killed Gus Grissom, Ed White and Roger Chaffee.

He received the Congressional Space Medal of Honor from the President of the United States and also was awarded the Harmon International Aviation Trophy, the Robert J. Collier Trophy, the Tony Jannus Award and the National Geographic Society's Hubbard Medal--in addition to many

honorary degrees, special honours and service decorations. In September 1990, Borman along with fellow Apollo 8 astronauts Lovell and Anders, was inducted into the International Aerospace Hall of Fame. In October 1990 he received the Airport Operators Council International Downes Award. In March 1993, he was inducted into the U.S. Astronaut Hall of Fame.

He spent a total of 477 hours 35 minutes in space. He resigned from the Air Force in 1970 to take up numerous civilian posts.



Captain James Arthur Lovell, Jr.

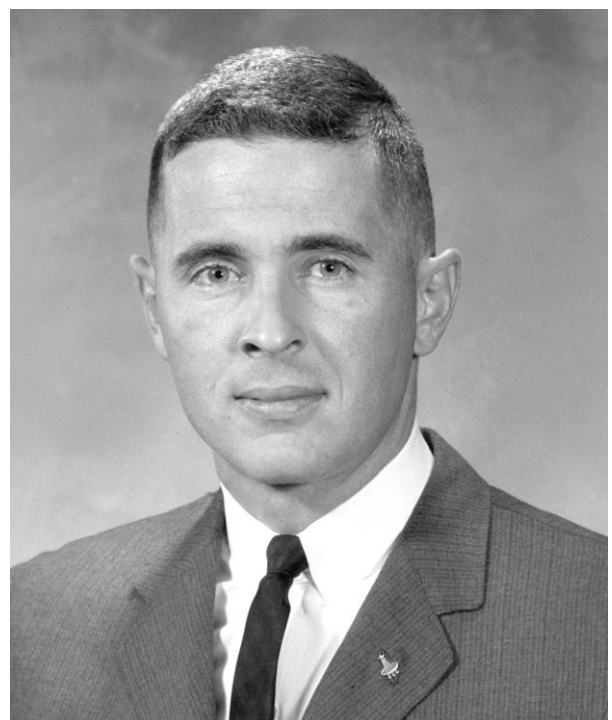
Born in Cleveland, Ohio, on 25 March 1928, only 11 days after Frank Borman. He received his Bachelor of Science degree at the United States Naval Academy in 1952 and during his naval career had numerous aviator assignments including a four year tour as a test pilot at the Naval Test Center in Maryland.

His many honours include: Presidential Medal for Freedom, 1970; NASA Distinguished Service Medal; two Navy Distinguished Flying Crosses; 1967 FAI De Laval and Gold Space Medals (Athens, Greece); the American Academy of Achievement Golden Plate Award; City of New York Gold Medal in 1969; City of Houston Medal for Valor in 1969; the National Academy of Television Arts and Sciences special Trustees Award, 1969; the Institute of Navigation Award, 1969; the University of Wisconsin's Distinguished Alumni

Service Award, 1970; co-recipient of the American Astronautical Society Flight Achievement Awards, 1966 and 1968; the Harmon International Trophy, 1966, 1967 and 1969; the Robert H. Goddard Memorial Trophy, 1969; the H. H. Arnold Trophy, 1969; General Thomas D. White USAF Space Trophy, 1969; Robert J. Collier Trophy, 1968; Henry G. Bennett Distinguished Service Award; and the AIAA Haley Astronautics Award, 1970.

He joined NASA in the second intake with Borman in 1962 and began his space career as a backup pilot for Gemini IV and backup Commander for Gemini IX. In December 1965 he joined Borman as Pilot for their record breaking 14 day Gemini VII flight and finished the Gemini Program as Commander of the Gemini XII flight with Buzz Aldrin. Lovell was backup Commander for the Apollo 11 mission before commanding the Apollo 13 mission, making him the first man to travel twice to the Moon.

Lovell held the record for the longest time in space until the Skylab missions with 715 hours and 5 minutes. He retired from NASA in 1973.



Major General (USAF) William Allison Anders

Born in Hong Kong on 17 October 1933, but considers La Mesa, California as his home town. He received his Bachelor of Science degree from the United States Naval Academy in 1955 and a Master of Science degree in Nuclear Engineering from the Air Force Institute of Technology at Wright-Patterson Air Force Base in Ohio in 1962.

He has been awarded the Distinguished Service Medals from the Air Force, NASA and the Nuclear Regulatory Commission; Air Force Commendation Medal; National Geographic Society's Hubbard Medal for Exploration; Collier, Harmon, Goddard and White Trophies; and the American Astronautical Society's Flight Achievement Award. He held several world flight records and received the American Defense Preparedness Association's first Industry Leadership Award in May 1993.

Anders joined NASA in the third group in October 1963 as an astronaut with responsibilities for dosimetry, radiation effects and environmental controls. He was backup pilot for Gemini XI and backup CM Pilot for the Apollo 11 mission.

Anders resigned from NASA in 1969 having logged 147 hours in space in Apollo 8, his only mission in space.

Ready to go

By 11 November 1968 all the ground work for a lunar mission was complete and the message officially advising the President was laid on Lyndon Johnson's desk just as he was handing the Presidency over to Richard Nixon.

The next day NASA's new Acting Administrator, Thomas Paine, announced,

"After a careful and thorough examination of all the systems and risks involved we have concluded that we are now ready to fly the most advanced mission for our Apollo 8 launch in December, the orbit around the Moon."

President Lyndon Johnson backed up Paine's announcement with a message to the astronauts,

"I am confident that the world's finest equipment will strive to match the courage of our astronauts. If it does that, a successful mission is assured."

With Apollo 8 going into lunar orbit the Service Propulsion System (SPS) motor had to perform flawlessly to put them into orbit and bring them back home.

There was some concern about its reliability, so it was planned to give it a trial burn for a few seconds on the way to the Moon. If it worked the mission would proceed as planned; if it had problems the brief burn would still let Apollo 8 loop around the Moon and return back to Earth.



Nevil Eyre took this photo of Super Constellation NASA 421 at Canberra Airport. Photo: Nevil Eyre

Apollo 8 was the first time the steerable four-dish Unified S-Band High Gain antenna was used and the three big 26 metre stations of the MSFN were called on for what they were designed for, tracking manned spacecraft at the Moon.

On Friday 15 November 1968 the Goddard Simulation Team in the Super Constellation NASA 421 flew up from their temporary base in Sydney to put us through a series of lunar passes peppered with typical faults and problems they had dreamed up. Although we were now familiar with their antics, after they left we felt confident we were ready for Apollo 8.

For this mission we had two 12½ hour shifts from 0600AEST to 1830 throughout the mission. Apollo 8 was our first experience of tracking a “manned” (talking) spacecraft for more than 12 minutes. We had to sit and keep alert and on the ball for up to 11 hours. With an hour and a half travelling to work and back home it meant we did little else outside our job while the missions were on. It was my good fortune to draw the night shift where most of the action was, because that was daytime in Houston, the time the astronauts used on the spacecraft for their day. Once on their way to the Moon they had no night and day so could choose any time zone on Earth for their local spacecraft time.

Day one of the mission for us was Saturday, 21 December 1968. From my arrival at the station at 1800 I had to wait 4 hours 15 minutes for the launch and about another 40 minutes before we saw the spacecraft come over the horizon. We began our H-30 countdown to station acquisition shortly after launch. My position was USB Tracking 1, responsible for the Timing, Ranging, Antenna Position Programmer (APP), Tracking Data Processor (TDP) and the System Monitor chart recorder. Frank Campbell was Tracking 1 on the Day Shift. We had parallel positions at the Wing site at Tidbinbilla.

Honeysuckle Creek was the prime two-way station, transmitting to the spacecraft when the mission began, but this was to change for a while, as we shall see.

The day before the Apollo 8 launch the director of the Manned Spacecraft Center in Houston, Dr Robert Gilruth, sent a Christmas greeting to all

the staff at the Manned Spacecraft Center in Houston. This is part of that address:

“Tomorrow's launch of Apollo 8 marks man's first attempt to leave the space that surrounds our familiar planet and venture out into the depths of space towards another celestial body. Perhaps the ancient mariners had the same feeling of anticipation as they set sail through the Straits of Gibraltar past the limits of the known world.

Our technology gives us an advantage over those iron men in wooden ships as we push outward into a different kind of ocean. And coming as it does during the Christmas season, the Apollo 8 mission epitomises the effort that this center has put forth during the last several years to reach the national goal of a manned lunar landing.

Apollo 8 commander Frank Borman said a few weeks ago that he hoped the mission would be ‘the type of experience that might lead to at least some basic understanding among the peoples of the Earth’. He was speaking of viewing the entire sphere of the Earth for the first time from deep space when indeed our planet would appear as one world where hopefully peace will come to all men of good will. What better time is there for such sentiment than now in this Christmas season.”

At 0235 USEST on 21 December 1968, Deke Slayton roused up the Apollo 8 crew for their traditional breakfast of steak and scrambled eggs. At 0458 USEST (1958 AEST) the three astronauts eased themselves into their cramped spacecraft, to be their home for the next 6 days. First in, on the left, was Borman. He had the instruments to monitor the Saturn V rocket's performance. Lovell the last to crawl in, sat in the middle, operated the Command Module's computer and kept an eye on their trajectory and navigation, while Anders in the right seat was in control of the spacecraft's electrical and communications systems. Borman and Lovell were Gemini veterans, suffering 14 days together in space with Gemini VII. Lovell then joined Buzz Aldrin for the last Gemini flight, so was the most experienced of the three. Anders was the rookie.

The hatch was closed, sealing the three men from the world, at 0534 USEST, and the count proceeded smoothly.



The Apollo 8 astronauts (from left: Anders, Lovell, Borman) walk out to the crew transfer van for the drive to the pad. Image: NASA/KSC

GGW046A
 NN DSDR GCEN DSSW GWAB WNET KOPS 003 DEC 20 130
 DE HMSC 003
 20/0218Z
 SUB COR HMCP

TO M&O

OPN
 NCG-735 AT 02:51:00Z THE COUNT STARTED AT 1-28:00:00. THE PAD COUNT IS PROCEEDING SMOOTHLY. THE S/C COUNT IS ON TIME AND THE LAUNCH VEHICLE IS APPROXIMATELY 2 HRS AHEAD OF SCHEDULE - BUT REST ASSURED THE L/V AND S/C WILL LIFT OFF TOGETHER. LIFT OFF ESTIMATED AT 21/12:51:00Z.

20/0227Z DEC HMSC

Countdown status report TWX. Received at the Guam Tracking Station. Preserved by Brian Riehle. "The Pad Countdown is proceeding smoothly. The S/C count is on time, and the launch vehicle is approximately 2 hrs ahead of schedule – but rest assured the L/V and S/C will lift off together."

HSK MISSION – DAY 1

Saturday, 21 December 1968

Times: AEST (HSK local time)

EVENT	GET	AEST
Launch ¹	00:00:00	2251:00

¹ Launch Complex 39A, Kennedy Space Center, Florida

Launch

The weather on launch day was fine with some feathery cirrus clouds covering about 40% of the sky while on the ground an 11 knot northerly breeze kept the temperature down to a cool 15°C. Relative humidity was 88%.

Listen to the MSFN Status Check

Apollo 8 Network Status check MSFN Network Status Check. As recorded at Honeysuckle just before launch.



2.7mb mp3 file. Running time – 5m 44s



Apollo 8 was launched from Pad 39A at 0751USEST (2251 AEST) on 21 December. Although noisy, Borman and Lovell found the ride much smoother than their Gemini launches, apart from being thrown from side to side as the giant rocket continuously corrected its trajectory.

Borman: *“It was powerful and noisy and vibrated, and the stagings were really kind of violent. But when you got on the third stage, the Saturn IVB, it was smooth and quiet and was just like the upper stage of the Gemini. Actually, it was less demanding than Gemini from a ‘g’ standpoint because it didn’t reach the high ‘gs’.*

I remember I had my hand on the abort handle, and all I had to do was ‘like that’ and we’d have gone on (to abort), but I didn’t want to take my hand off there.”

Anders: *“The first seconds of flight were a total surprise to everybody because the Saturn V, which is a big, tall rocket, kind of skinny, and we were like a bug on the end of a whip. It gets very massive near the bottom, with the centre of gravity near the bottom, so if you rotate it, what little bit of wiggle at the bottom translates to a big wiggle up at the top.*

Those giant F-1 engines, each producing a million and a half pounds of thrust, were trying to keep the rocket going straight. So, it was being thrashed at the bottom, and we were getting really thrashed at the top. I mean, violent sideways movement and massive noise that nowhere near had been simulated properly in our simulations. For the first ten (it seemed like 40) seconds we could not communicate with each other. Had there been a need to abort detected on my instruments, I could not have relayed that to Borman.”

Public Affairs announced, *“We have cleared the tower. Tower clear at 13 seconds.”*

Once clear of the tower responsibility of the mission passed over to Mission Control in Houston and the world-wide tracking network, so Borman checked the communications,

“How do you hear me Houston?”

Capcom Collins replied, *“Loud and clear ...”*

At 1 minute 19 seconds, at an altitude of 13.4 kilometres, the rocket experienced the maximum point of dynamic pressure while still in the Earth’s atmosphere.

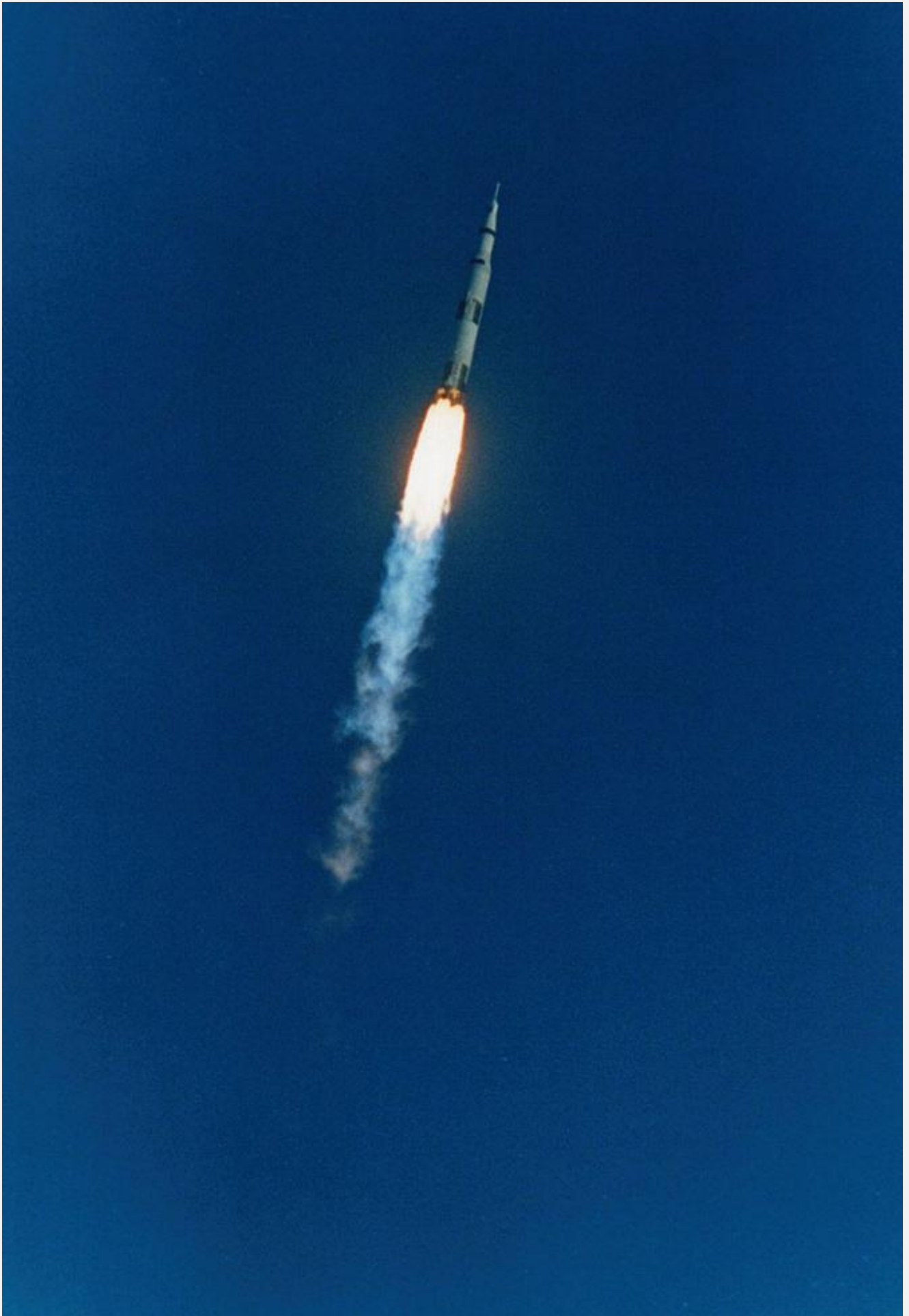
At 2 minutes 7 seconds they were looking to jettison the big booster rocket, Collins advising, Apollo 8, Houston. You are GO for staging. Over.

Borman, *“Roger.”*

After two minutes 34 seconds of powerful acceleration the five main F1 engines cut at an altitude of 66.7 kilometres. The astronauts, locked in their harnesses, were flung forward then thrown violently back when the second S-II stage ignited for 6 minutes 7.85 seconds and increased



Apollo 8 on its way to the Moon. Image: NASA/KSC



Apollo 8 thunders through blue Floridian skies on its way to the Moon. Image: NASA/KSC

their speed to over 24,140 kilometres per hour. Rookie Anders felt he was going to be thrown into the instrument panel, but the two Gemini veterans were exhilarated by the ride.

At a height of 173.8 kilometres the third stage, the Saturn IVB, burned for two and a half minutes and pushed them into earth orbit at 00:11:34 GET (2302:35 AEST), so 11 minutes 34 seconds after leaving the launch pad they were travelling at 28,054.2 kilometres per hour in an orbit of 185.2 x 184.4 kilometres with a period of 89.2 minutes.

Listen to the Launch

Recording starts at t-60s and runs to 00:14:35 GET. The audio appears to switch from the PAO commentary to Net 1 at 5'51" into the segment. As recorded by Bernard Scrivener at Honeysuckle Creek.



3.1mb mp3 file. Running time – 15m 35s



Coming up to 25 minutes Lovell announced, *“Well, how about let’s take off our gloves and helmets, huh?”*

The three astronauts had been locked up in their suits and helmets since the suiting up room about three hours ago.

Anders replied, *“Okay.”*

Borman agreed, *“Yes.”*

Lovell, *“I mean, let’s get comfortable. This is going to be a long trip.”*

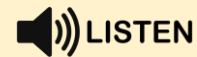
Lovell, *“We can breathe a little bit, hear a little bit more, huh?”*

AOS on the first pass over Carnarvon was at 00:52:44 GET (2343:44 AEST) where Borman commented on the lights he could see on the

ground below. Initial orbital tracking was by Carnarvon, their C-Band FPQ6 radar and S-Band system confirming the spacecraft was in a proper parking orbit for the final checks.

Listen to Comms via Carnarvon

Communications through Carnarvon on Rev 1 at 00:52:44 GET. As recorded by Bernard Scrivener at Honeysuckle Creek.



872kb mp3 file. Running time – 4m 37s



Honeysuckle Creek was next. I had a brief tense moment when I had to change to 30 minute APP tapes while the antenna was still in Program Mode, but it all went smoothly and we had no trouble finding the strong signal right on time. Peter Cohn had no trouble locking the ranging system up. By the way, if any crackpot says we never really went to the Moon, we were measuring the distance to the spacecraft the whole time, so we know they went to the Moon.

At Honeysuckle Creek, we had AOS just before midnight at 59:27:00 GET (2350:27 AEST) with Anders calling down, *“Hello Houston, how do you read?”*, but there was a voice communication hitch as the spacecraft could not hear Houston, though we could hear the spacecraft. The telemetry data was being received at Houston fine. The cause was never located as communication was established 4 minutes 46 seconds after AOS.

Anders,

“Roger, Houston. Read you loud and clear.”

Collins, *“We are reading you loud and clear also, Bill. The problem here over Honeysuckle has been on the ground. Your spacecraft equipment is all working fine.”*

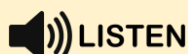
We are going to have LOS in about a minute, and we will pick you up over Guaymas (Mexico) at 1:28:13 over.”

Anders, *“Roger. 1:28:13. Thank you.”*

Listen to AOS at Honeysuckle

AOS at Honeysuckle on Rev 1 at
01:01:20 GET.

John Saxon responds to TIC (Telemetry Instrumentation Controller) who asks if they have had acquisition. Mike Dinn announces AOS. John responds to a question about data, and Mike announces Honeysuckle is go for command for the CSM and IU.



144kb mp3 file. Running time – 0m 44s



Away round on the other side of Earth at Goldstone, Bill Wood remembers,

“An hour and twenty minutes after launch we tracked the CSM as it made its first orbit of Earth. Ninety minutes later we tracked it during most of its TLI burn, which started over the Hawaiian tracking station.”

Everything was looking good.

In Houston the Flight Director called the roll around the consoles for a unanimous ‘Go,’ so Capcom Michael Collins announced the fateful words,

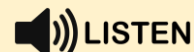
“Apollo 8 – you’re Go for TLI.”
(Trans Lunar Injection)

After eight years of preparation, at last Apollo 8 was on its way to the Moon.

Bill Wood at Goldstone, *“We were poised to track it during most of its Translunar Injection Burn, which started over Hawaii, slightly before our acquisition. A chill ran down my spine after Borman reported the Saturn IVB had been*

Listen to Go for TLI

Mike Collins speaks to the crew through Carnarvon on Rev.2
As recorded at Honeysuckle Creek.

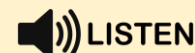


36kb mp3 file. Running time – 0m 08s



Listen to just before LOS at Carnarvon

At 02:31:26 GET on Rev.2, just prior to TLI.
The next comms will be through ARIA 1.
As recorded at Honeysuckle Creek.

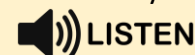


48kb mp3 file. Running time – 0m 13s



Listen to the TLI Burn

At 02:31:26 GET – Comms apparently through the tracking ship *Mercury* in the Pacific Ocean - Hawaii would have had AOS during the burn.
As recorded at Honeysuckle Creek.



2.0mb mp3 file. Running time – 10m 55s





At Honeysuckle Creek, from left, Jim (Dutchy) Holland, Ron Hicks and Clive Cross mark the first time humans have ventured beyond Earth orbit. Photo from Ron Hicks.

The fine print reads: "21 Dec 68. In space: Borman, Lovell, Anders. On the ground: Hicks, Cross, Holland."

ignited for the long burn that would accelerate Apollo 8 out of Earth orbit towards the Moon.

Both the Saturn IVB and CSM stayed in view of Goldstone for what seemed to be all day. The spacecraft rose in the west and travelled nearly all the way over to the east and then came back and set in the west in the evening. This was repeated on 22 and 23 December."

HSK MISSION – DAY 2

Sunday, 22 December 1968
Times: AEST (HSK local time)

EVENT	Track Duration	AOS/LOS
TLC – Day 1 ¹	10:59:00	1034:00 2133:00

Trans Lunar Coast (TLC)

At 1:25:00 GET (0024:16 AEST) they plunged back into daylight with sunrise as they approached America.

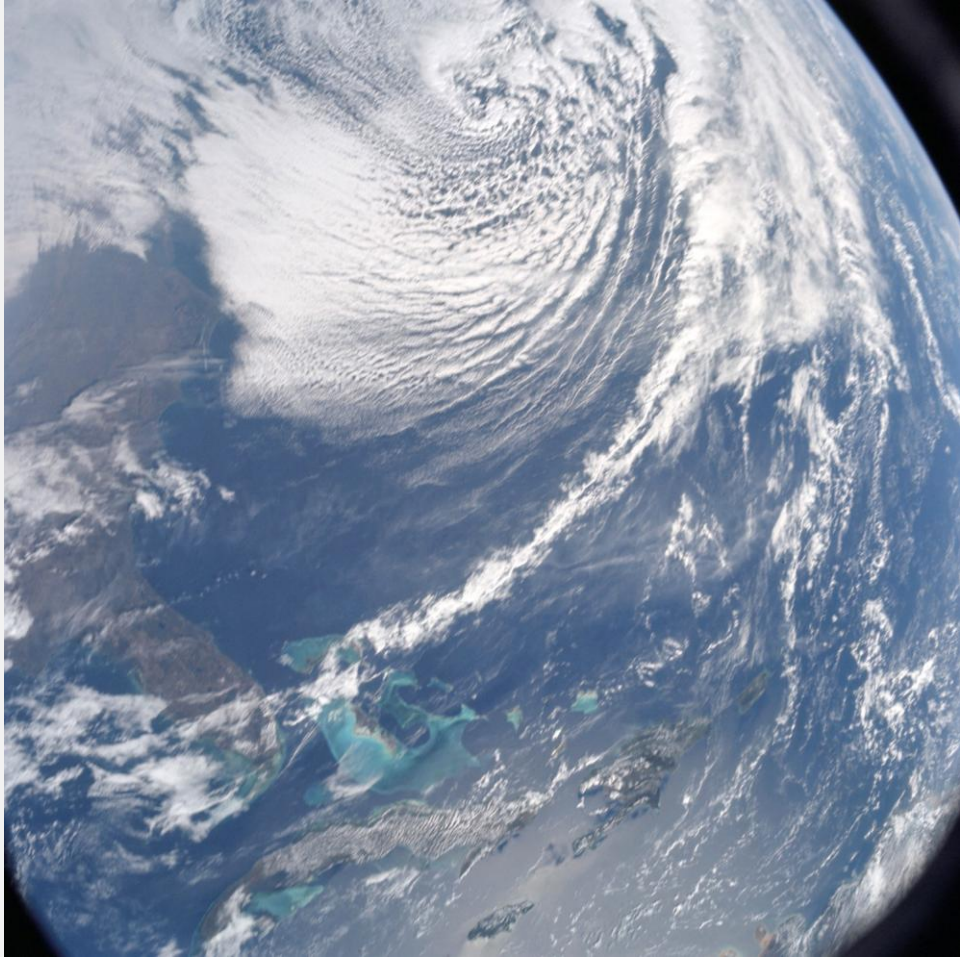
Lovell commented, "Here comes the Sun – take a look. It crept up on us."

At 2:50:37.79 GET (0141:37 AEST), the S-IVB stage burned for 5 minutes 17.7 seconds to boost the spacecraft's velocity by 7,451.2 kilometres per hour, and Apollo 8 left Earth orbit and headed for the Moon at 38,959.4 kilometres per hour.

At Honeysuckle Creek we were out of range for the second orbit so didn't see the burn, but the tracking station at Hawaii reported it had no trouble seeing the red glow of the S-IVB.

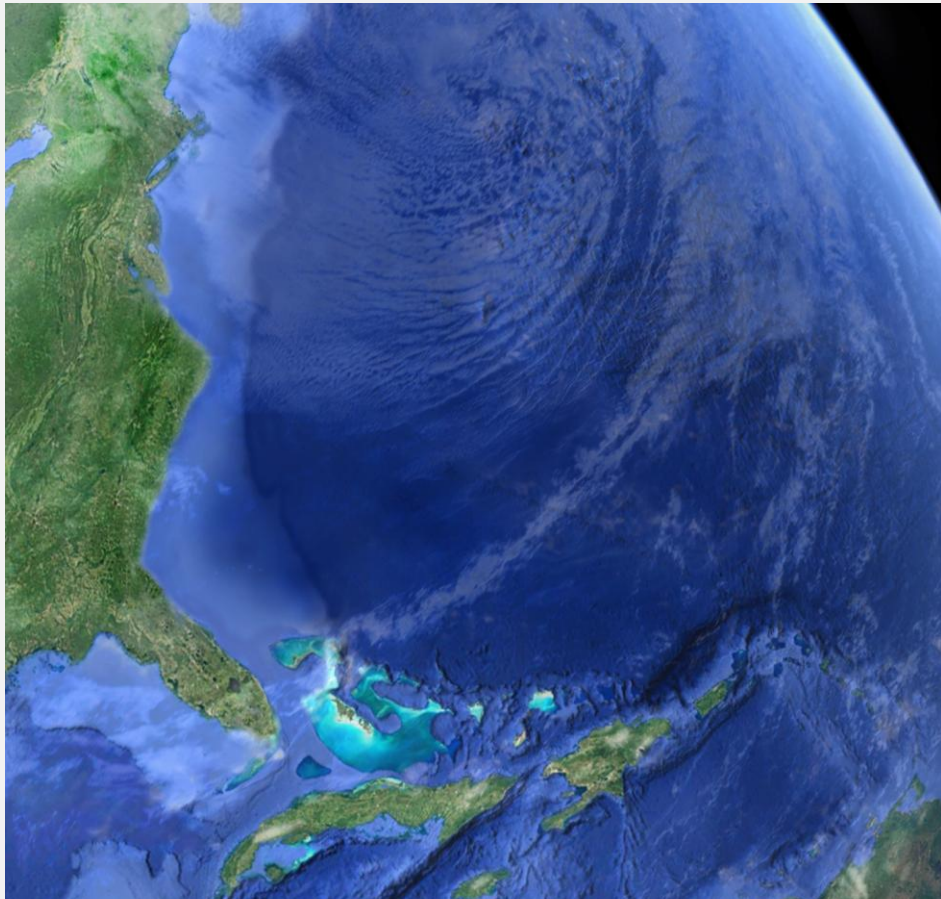
Thirty minutes after the TLI burn, at 3:20:59.3 GET (211:59 AEST) the S-IVB separated from the CSM with a bone-jarring shock, and Borman aligned the CSM to look back at it, now following them about 150 metres behind.

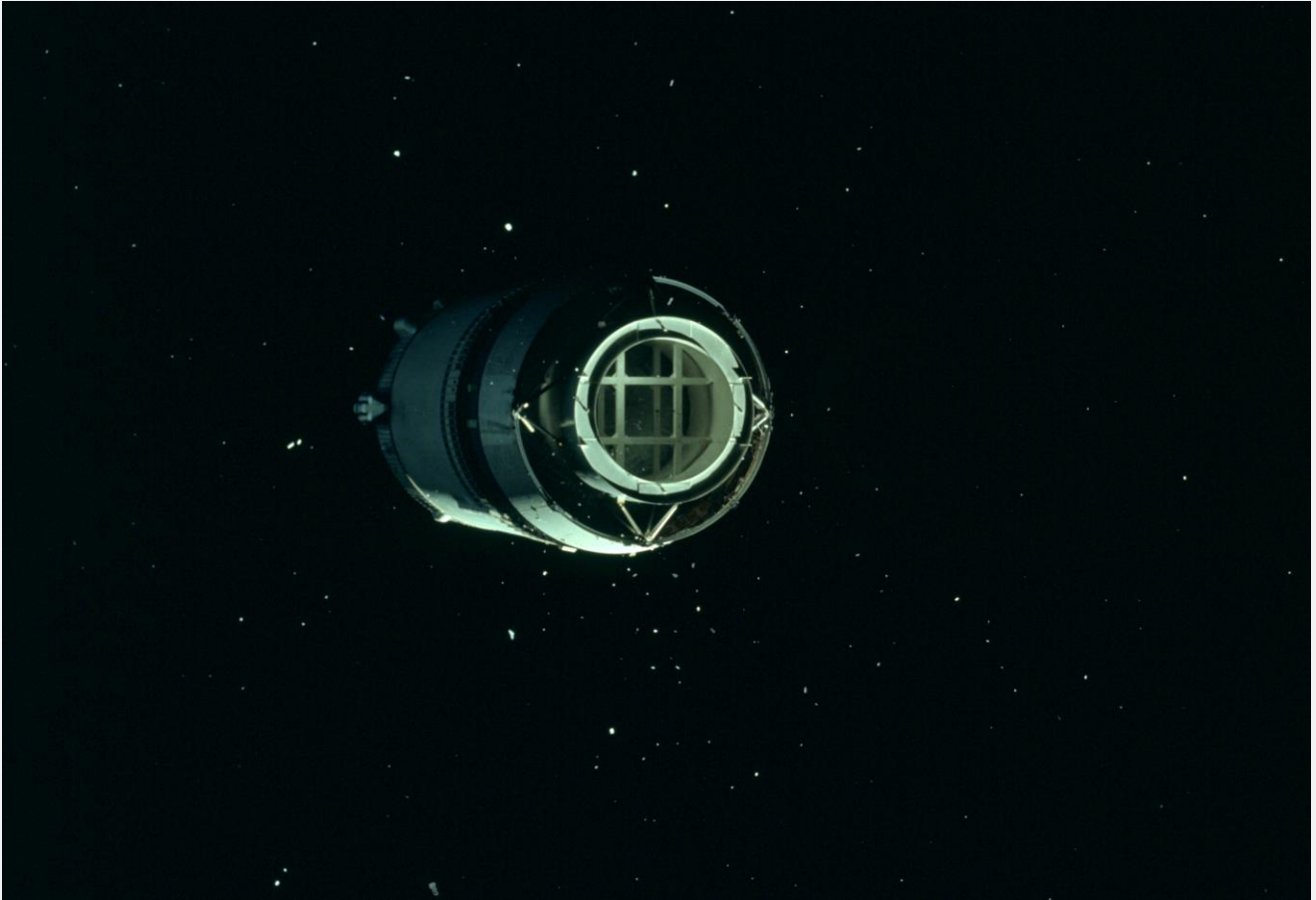
The Apollo 8 S-IVB was sent off into solar orbit, where it will orbit the Sun forever. Later missions smacked the S-IVB into the lunar surface for the ALSEP seismometers to record the impact.



Above: Looking back to the Earth as they begin the journey to the Moon. The Florida Peninsula and Cape Canaveral are in the lower left. The Caribbean chain of islands can be seen. Image: NASA

Below: Computer-generated (from Google Earth) of approximately the same view, for orientation.





Above: The S-IVB third stage booster, following Apollo 8 to the Moon.

Images: NASA

Below: The third stage as Apollo 8 backs away.





The first time humans saw their whole planet at a glance. Image: NASA

Taken not long after the previous picture, Florida and the Bahamas can still be seen at upper left, but now all of South America has come into view with Chile and the Cape Horn area pointing off the Earth's bottom edge. Africa is on the upper right.

Borman,
"Man, where's the S-IVB? Anybody see it now?"

Lovell, *"There it is!"*

Borman, *"You found it?"*

Lovell, *"Right in the middle. Right in the middle of my window."*

Borman, *"What a view!"*

Collins, *"Looks pretty good, huh?"*

Borman,
"We see the Earth now, almost as a disk."

Collins, *"Good show. Get a picture of it."*

Borman, *"We are. Tell Conrad he lost his record."*

In September 1966 Pete Conrad and Richard Gordon reached a record height of 1,369 kilometres above Australia in the Gemini XI mission.

Lovell, *"We have a beautiful view of Florida now. We can see the Cape ... just the point."*

Collins, *"Roger."*

Lovell, *"At the same time we can see Africa. West Africa is beautiful. I can also see Gibraltar at the same time as I'm looking at Florida."*

This was the first time anybody had spanned the whole Earth at a glance. They were 12,038 kilometres from Earth, staring in awe at the sight of the whole Earth shrinking into the distance behind the third stage. Lovell felt he was driving a

car into a dark tunnel and was watching the entrance dwindle into a distant speck. Borman thought this must be how God sees the Earth.

Bill Anders tried to put it into words:

“How finite the Earth looks. Unlike photographs people see there’s no frame around it. It’s hanging there, the only colour in the black vastness of space, like a dust mote in infinity.”

They were the first living creatures in the history of the planet to have ever seen the whole Earth at a glance. It was a really awesome thought at the time, though we are used to seeing pictures of it now.

I can still remember listening to Net 1 (the astronauts’ communication channel) in my headset with the astronauts describing the weather around Tierra del Fuego, sounding as though they were discussing a tourist’s view of the Florida Everglades.

Lovell, “Boy, it’s really hard to describe what this Earth looks like. I’m looking out my centre window, which is a round window, and the window is bigger than the Earth is right now.

I can clearly see the terminator. I can see most of South America, all the way up to Central America, Yucatan, and the peninsula of Florida.

There is a big swirling motion just off the East Coast, and then going on over toward the east, I can still see West Africa, which has a few clouds right now. We can see all the way down to Cape Horn in South America.”

Collins, “Good grief – that must be quite a view.”

Borman, “Tell the people in Tierra del Fuego to put on their raincoats – it looks like a storm down there.”

Collins, “Roger. Will do. Do you care to give them a 24 hour forecast?”

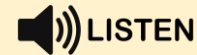
Borman, “Probably as good as any other.”

By the time we next picked up the signal from the spacecraft at Honeysuckle Creek it was already on its way to the Moon.

As the Earth turned we would pick up the spacecraft signal with Goldstone in California transmitting to the spacecraft, then as it set over the horizon at Goldstone, we would take over

Listen to the S-band Comms Test

12:06:46 GET - Capcom Ken Mattingly says,
“This comm is unbelievably good.”
As recorded at Honeysuckle Creek.



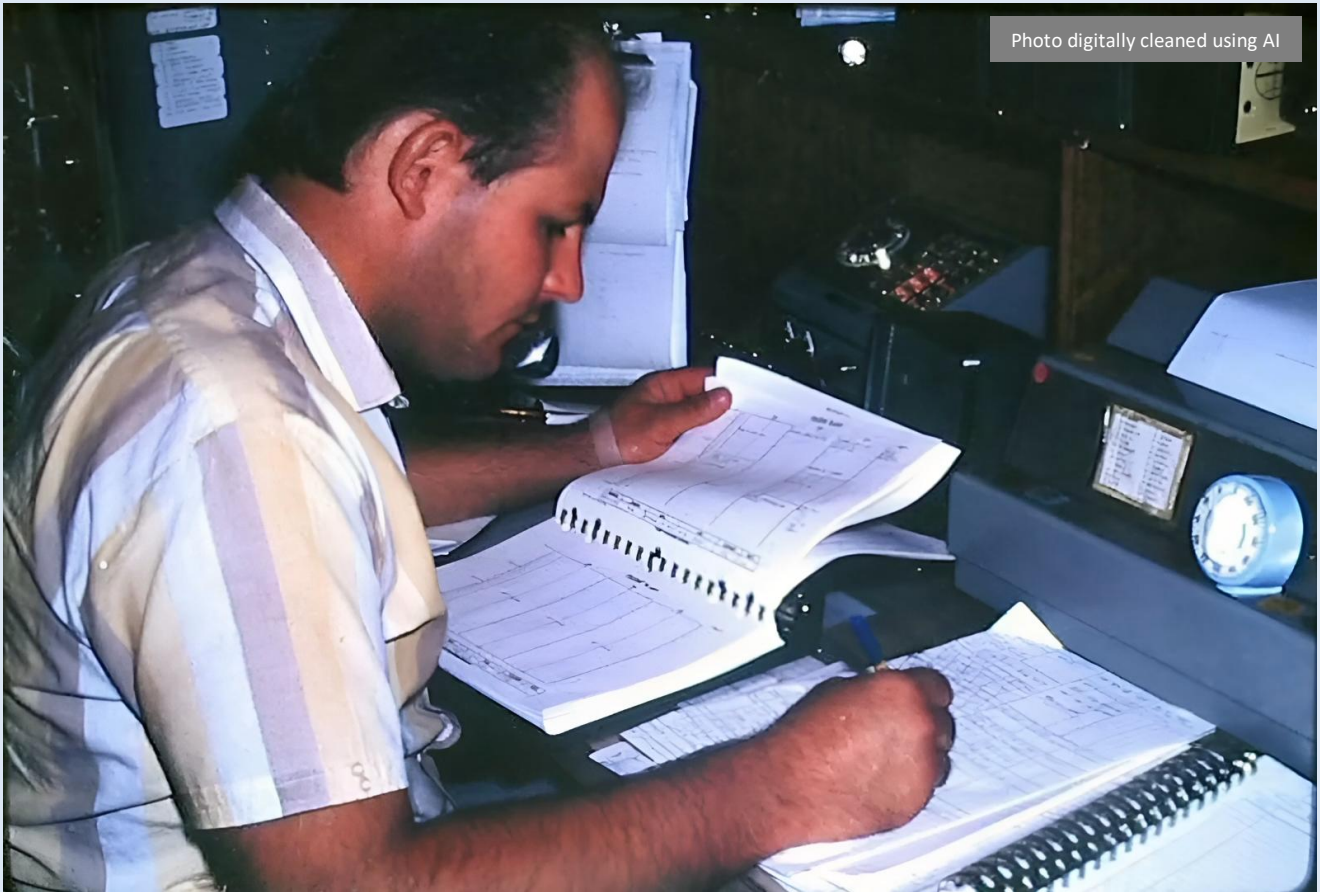
1.8mb mp3 file. Running time – 10m 01s



transmitting the signal from the ground. The Deep Space 26-metre dish at Tidbinbilla, DSS42, and the 9-metre dish at Carnarvon were backing us up, receiving one way only, that is, they were not transmitting a signal to the spacecraft. The 64-metre dish at Tidbinbilla had yet to be built, and the 64-metre dish at Parkes wasn’t called up for this mission.

This did not last long. At Honeysuckle Creek we had been suffering a problem in the antenna feed-cone that we called the ‘Search for the Spurs.’ Bill Kempees, the Chief Engineer, and Jim Kirkpatrick, the Facilities Engineer, and their teams were trying to track down random bursts of noise, or spurs, appearing on each side of the uplink when the transmitter was on. It was visible on a spectrum analyser we had sitting in the USB area. Although we could see it, there wasn’t a simple explanation for its source.

The theory was it was arcing in the flanges of the waveguide – but how do you find it and stop it? Nobody could be observing in the feed-cone when the transmitter was on. Before the mission they had asked me to try and photograph any arcing inside the feed-cone, so one night I slung a Polaroid camera over the window looking down straight into the guts of the feed-cone. A moonless night was chosen, and all the floodlights were turned off, and the camera was set with the shutter open all through the night so if an arc occurred it should cause a spark, be recorded on the film, confirm it was arcing and identify where



Ron Hicks in the Honeysuckle Computer area works through the Apollo 8 Flight Plan. Photo from Ron Hicks.

the fault was located. Unfortunately, the film didn't like the transmitter's 20 kilowatt signal beamed straight at it, just showing a mysterious white circle, so the idea had to be abandoned.

As soon as Apollo 8 was on its way the spurs were back so there was a high level decision to pull the feed-cone apart and smooth and coat all the flanges, as we didn't want to compromise the mission, so this day, Sunday, Honeysuckle USB went 'Red cannot support' for a couple of days. Technical specialist Dick Albert was flown out from Goddard to help with the exercise.

First Midcourse Correction

The second of the two manoeuvres that separated the CSM from the Saturn IVB rocket altered the spacecraft's trajectory so that a correction was needed at 10:59:59 GET.

So, for the first of two mid-course corrections the Flight Plan called for the use of the SPS engine, but some of the flight controllers wanted to use Apollo 8's smaller thrusters in case the big SPS engine might disrupt the free-return trajectory and make it difficult to return to Earth in an

emergency, but Director of Flight Operations Chris Kraft told them,

"We need that SPS engine to get into lunar orbit and I want to see it work before they go behind the Moon. Stick to the plan."

At 10:59:59 GET (0950:59 AEST), 97,730 kilometres from Earth, the SPS motor was fired for the first time for 2.4 seconds for a slight course correction to reduce the closest approach to the Moon from 848 kilometres to 122.8 kilometres, and to check the motor was functioning properly. If there had been any problems with it, the spacecraft wouldn't go into lunar orbit, but loop around the Moon to return back to Earth.

The SPS engine did not work quite as planned; the thrust had been less than expected. Experts gathered to analyse the data from the spacecraft and decided that some Helium must have become trapped in the fuel lines before launch; If true, it probably meant the bubble had been purged – but no one was sure. Kraft decided to go ahead and take a chance their diagnosis was correct.



About to remove the feed cone on the antenna. Photo and caption: Hamish Lindsay

We had to remove the feed cone during the Apollo 8 mission. The crane and one of the cherry pickers was borrowed from Tidbinbilla. Luckily with no Lunar Module, Tidbinbilla was able to keep tracking with no interruption to the signals and data while we pulled our antenna down.



Above: Here's a detail from the photo above. Photos: Hamish Lindsay and Alan Foster.

Below: This photo and on the following page, appear to have been taken in November 1970 when Goddard specialist Dick Albert returned with a new feed-cone.





John Saxon writes, *“One Cherry picker occupant was probably Jim Kirkpatrick and the other Ted Burt.”*

Photo: Alan Foster.

The next time the engine was to be fired was the crucial burn to put them into orbit around the Moon, and it had to work perfectly.

At 11:32:44 GET (1023:44 AEST) Borman began a planned 7 hour rest/sleep period while Lovell and Anders continued with mission activities such as

communications tests. He had trouble getting to sleep, taking Seconal sleeping pills. After about 5 hours of restless, interrupted sleep Borman took over while Lovell and Anders had their rest period.

At 22:41:24 GET (2132:24 AEST) Borman decided to call Houston,

"Houston, how do you read?"

Collins, "Apollo 8 – go ahead."

Borman, "How do you read?"

Collins, "Reading you loud and clear, Frank. Good morning. How are you doing?"

Borman, "Hi Michael. We broke lock for a minute and I wondered why?"

Collins, "Roger – your break lock is due to the fact we switched our antennas over from Honeysuckle to Madrid."

Borman, "Roger, thank you."

HSK MISSION – DAY 3

Monday, 23 December 1968

Times: AEST (HSK local time)

EVENT	Track Duration	AOS/LOS
TLC – Day 2	--:--:--	----:00 ----:00

No tracking by Honeysuckle USB today, the Wing at Tidbinbilla carried the day, going two-way with Apollo 8. However, all their data was being sent to us over the microwave link to be processed and sent to Houston. Luckily there was no LM to need two stations for a simultaneous track.

Our feed-cone was taken off using a crane and two cherry pickers and the waveguide flanges were honed and filled with very expensive silver-filled epoxy, and after purging the nitrogen for the maser we were operational again before Apollo 8 reached the Moon. After the feed-cone was reassembled the spurs were still there, though not as bad. As they didn't seem to degrade our signal to noise ratio we decided to live with them.

At 31:10:36 GET (0601:36 AEST) the first television pictures were received through Goldstone in California from a distance of 223,393.8 kilometres. Those were the days when television was poor quality by later standards, with a tendency for the white areas to smear when the camera was moved.

The first scenes were inside the spacecraft and showed Lovell upside down in the lower equipment bay. He spoke, *"This is known as preparing lunch and doing P3 at the same time."*

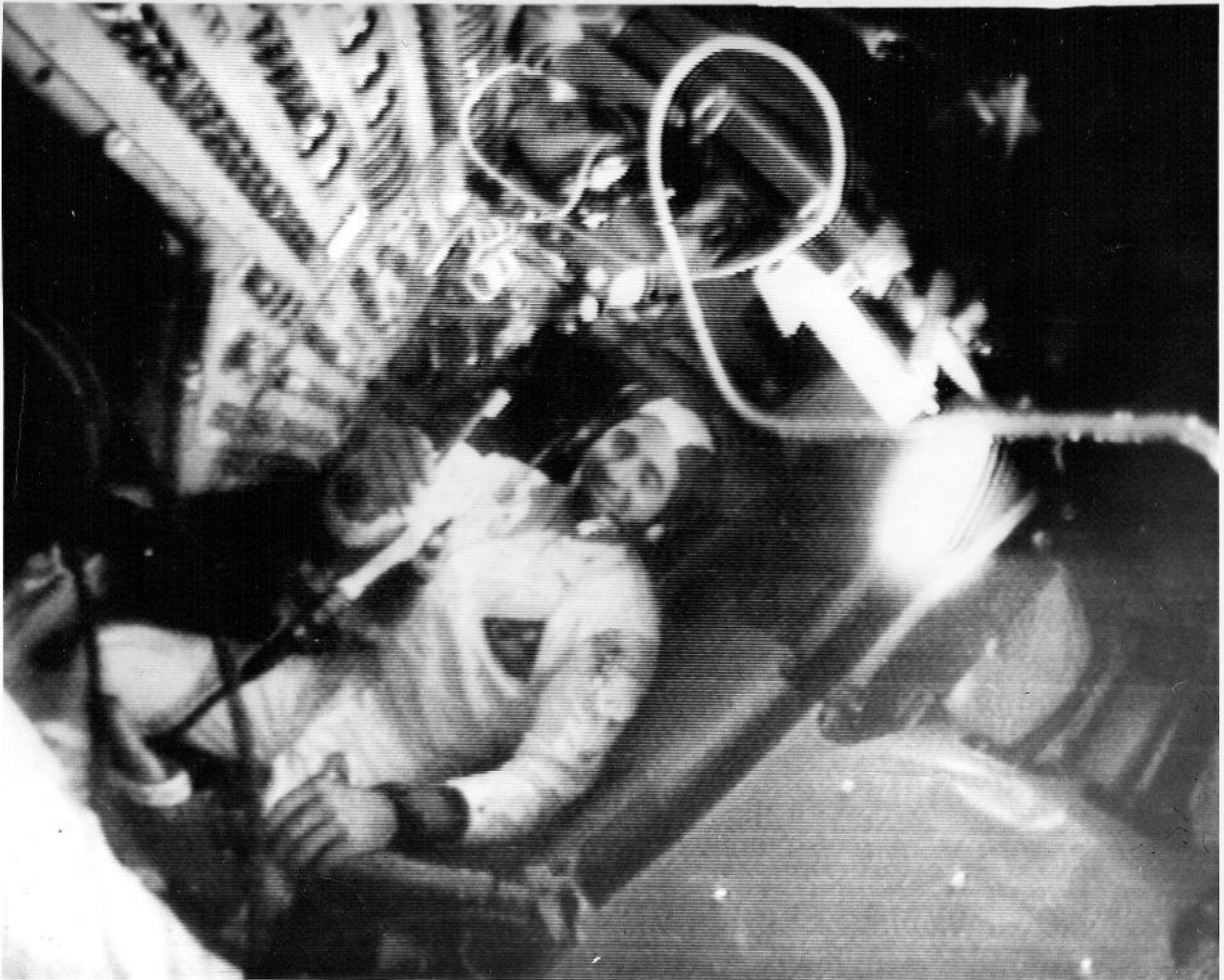
Mattingly, "You've got everybody standing on their heads down here."

Borman, "How go ... has he got it turned upside down? You've got the wrong REFSMMAT."

This was an attempt at humour as the REFSMMAT is a reference to which way is 'up' in the spacecraft, and Borman was inferring that Mission Control did not know which way was 'up'.

Mattingly, "Well, we all have our problems."





Slow Scan TV picture: Bill Anders twirls a toothbrush in zero G for the camera during the first television broadcast, at 31:20 GET. Photo taken by Goldstone Telemetry Supervisor Don Johnson using a Polaroid camera mounted on the Fairchild Slow Scan monitor. Photo ID by Colin Mackellar.

Frank Borman announces: "This transmission is coming to you approximately halfway between the Moon and the Earth. We have been 31 hours and about 20 minutes into flight. We have about less than 40 hours left to go to the Moon. You can see Bill's got his toothbrush here. He's been brushing his teeth regularly."

They changed the lens from wide angle to telephoto to show the Earth through the window but, as there was no television monitor in the spacecraft, it was very difficult for the astronauts to see what they were photographing. They had to give up on the shots of Earth and finished with more interior scenes.

On the way to the Moon the spacecraft was set up for the PTC (Passive Thermal Control) mode, also known as barbecue mode, slowly turning to keep temperatures evenly distributed over the surface. In this mode the glowing blue and white Earth would pass by their windows every so often, and they were aware it was getting steadily smaller,

until eventually they could cover the whole planet with a thumb.

During the three day TLC, Borman, and to a lesser extent Lovell and Anders, went down with motion sickness (technically called SAS, or space adaption syndrome) but we never heard this on the loop as it was passed down through one of the tracking stations (it could have been us) on a voice tape dump to be heard in private in Houston.

We were advised down Net 2 (the tracking station's communication line from Houston) that Borman had a stomach upset and Lovell was feeling a bit sick too – and it was a mild threat to the mission for a while when Dr Charles Berry



"Happy birthday Mother!" – Jim Lovell sends birthday greetings to his mother, during the first TV transmission, at 031:23:28 GET. Frame grab of the scan-converted television picture by Colin Mackellar.

GGW039A
NN DSDB DSSW HNET GWAB
DE HMSC 011
22/0844Z
SUB COR HMCP

1968 DEC 22 PM 7 59

TO APOLLO 8 STATUS REPORT FOR RELEASE BY STADIRS & DOD PERSONNEL

OPN
THE APOLLO 8 SPACECRAFT RACED THROUGH THE HEAVENS MORE THAN 84,000 NAUTICAL MILES FROM EARTH AT APPROXIMATELY 0751 GMT, 22 DECEMBER --SOME 19 HOURS AFTER A PERFECT LIFT OFF FROM THE KENNEDY SPACE CENTER.

MAJOR MANEUVERS CONDUCTED DURING THE PAST SEVERAL HOURS INCLUDED THE FIRST MID-COURSE CORRECTION, A 2.4 SECOND SPS BURN OF 24 FEET PER SECOND DESIGNATED TO CORRECT APOLLO'S COURSE FOR LUNAR INTERCEPT. THE CREW CHANGED FROM THE BULKY PRESSURE SUITS THEY WORE DURING LAUNCH TO THE MORE COMFORTABLE FLIGHT SUITS. THEY TOOK TIME OUT TO EAT AND THEN ASTRONAUT FRANK BORMAN WAS SCHEDULED FOR REST AND SLEEP. IN THE MEANTIME, ASTRONAUT JAMES LOVELL CONTINUED HIS NAVIGATION DUTIES WHILE WILLIAM ANDERS MONITORED THE SPACECRAFT'S MULTIPLE SYSTEM.

22/0850Z DEC HMSC

Status report, 0850Z, 22 December 1968. Preserved by Brian Riehle.

Watch Lovell's Birthday Message

31:08:00 GET – TV transmission 1.



19.4mb mp4 file. Running time – 05m 11s



thought Borman might have a virus. The astronauts' description of the gut-wrenching smells and errant pulsing balls of vomit floating around the cabin sounded revolting, but after taking the prescribed medication everything settled down before reaching the Moon.

HSK MISSION – DAY 4

Tuesday, 24 December 1968

Times: AEST (HSK local time)

EVENT	Track Duration	AOS/LOS
TLC – Day 3 and Lunar Orbit Insertion	08:36:16	1112:00 1948:16

The astronauts were disappointed to find their view of the approaching Moon was washed out by the Sun's powerful glare. It should have been a spectacular sight to see the huge bulk of the Moon getting bigger and bigger as they closed in, but they never really saw the Moon on the way out.

This was part of the conversation during a second TV broadcast of 25 minutes at 55:02:45 GET (0553:45 AEST) as they tried to keep the Earth's image in the middle of the screen. This time they managed to get an image of the Earth on the screens in Mission Control.

Anders, *"Well, I hope that everyone enjoys the picture we are taking of themselves. How far away from Earth are we now, Jim, about?"*

Collins, *"We have you about 180,000 (nautical miles, or 333,360 kilometres)."*

Anders, *"You are looking at yourselves at 180,000 miles out in space."*

Lovell, *"Mike, what I keep imagining is, if I'm a ... some lonely traveller from another planet, what I think about the Earth at this altitude – whether I think it's inhabited or not."*

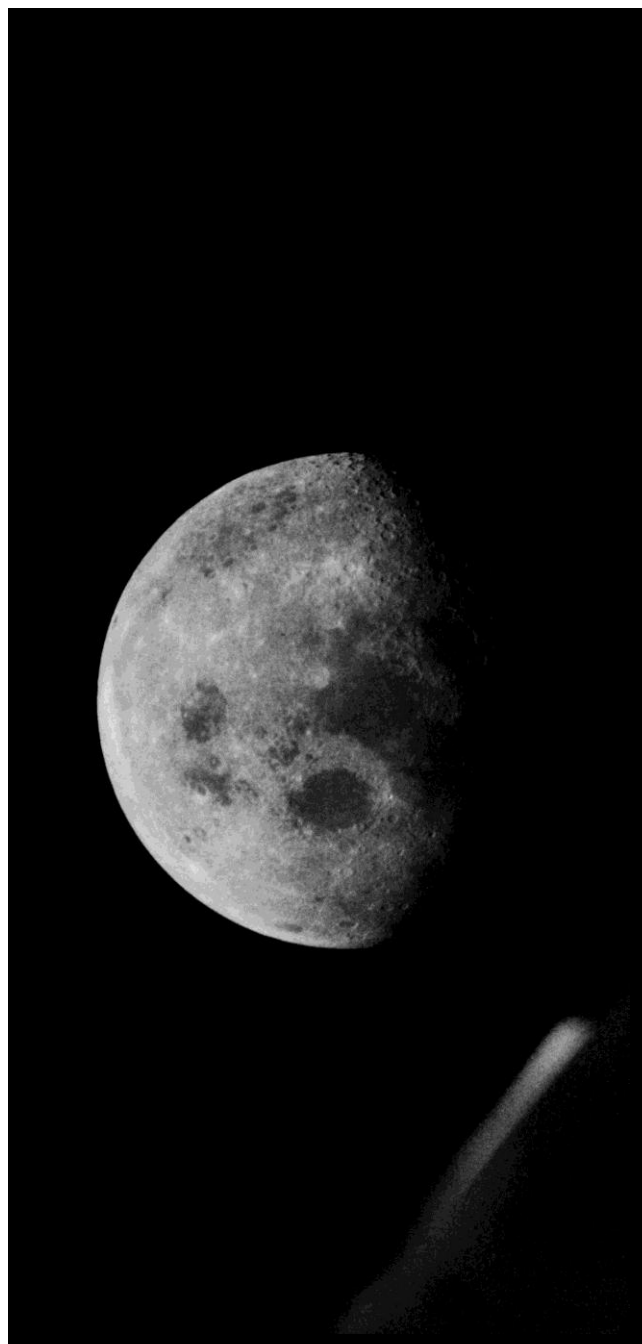
Collins, *"Don't see anybody waving; is that what you are saying?"*

Lovell, *"I was just kind of curious whether I would land on the blue or the brown part of the Earth."*

Anders, *"You better hope that we land on the blue part!"*

Collins, *"So do we, babe."*

Anders, *"Jim is always for land landings."*





The Earth as seen during the second TV transmission. Frame grab of the scan-converted TV by Colin Mackellar.

Equigravisphere

Borman, Lovell and Anders were the first humans to leave the Earth's gravity. They also never felt any physical change when the spacecraft slowed down to 3,578 kilometres per hour relative to Earth and crossed over into the Moon's gravity field at 55:38:40 GET (0629:40 AEST). They were 326,415 kilometres from Earth and 62,598 kilometres from the Moon.

Capcom Mattingly,

"Welcome to the Moon's sphere."

Borman, *"The Moon's fair?"*

Mattingly,

"The Moon's sphere – you're in the influence."

Borman,

"That's better than being under the influence."

Jack Garman, in the Guidance Support Room in Mission Control, remembered that moment,

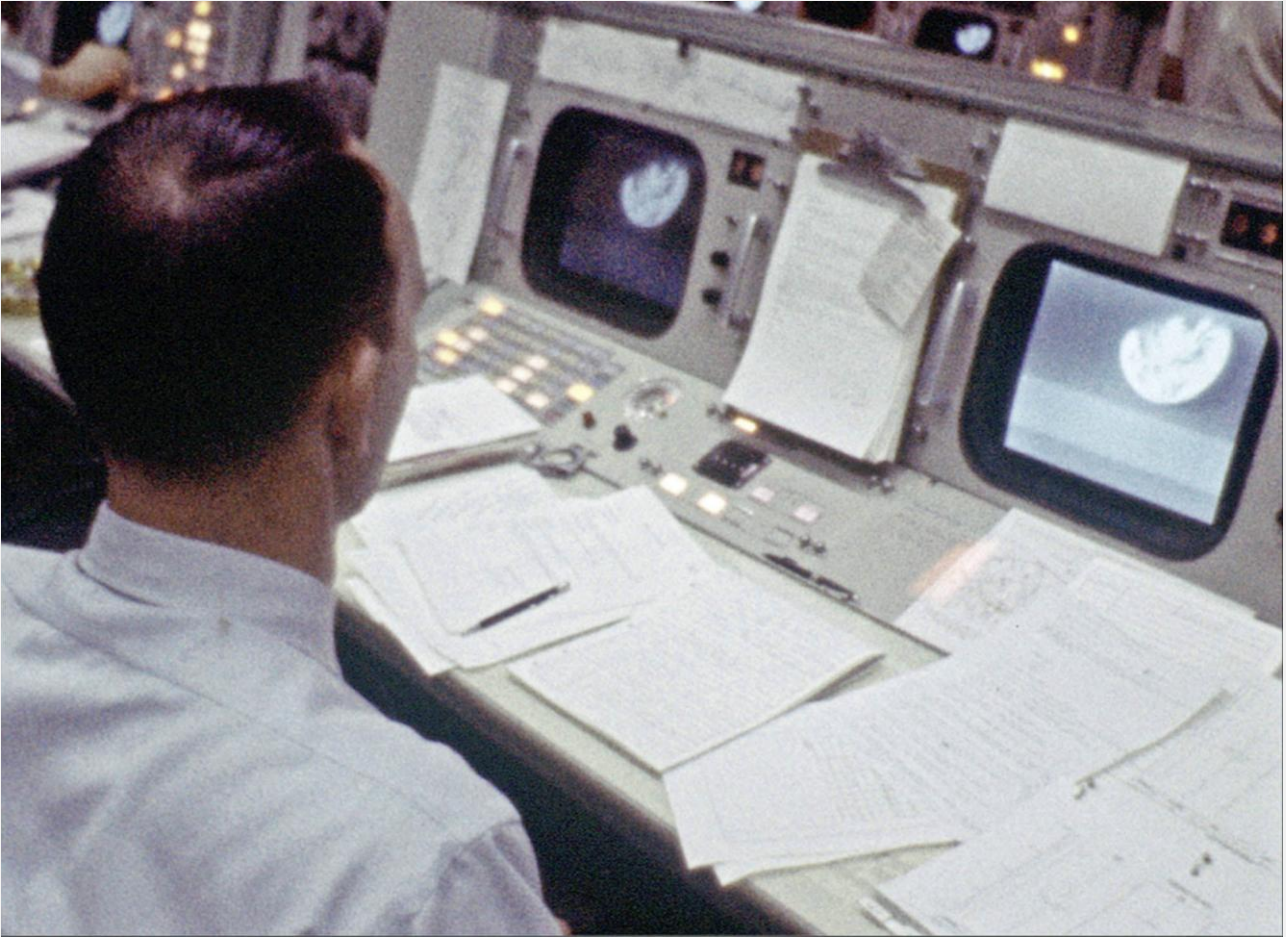
"One of my anecdotal stories as they were coasting towards the Moon, which was a long and fairly boring period, a number of us decided to take a bet on exactly when a light would light

up on our consoles. This light was connected to a telemetry reading from the on-board computers, that signalled when they determined that they were falling towards the Moon instead of rising away from the Earth, that is, when they had escaped from the Earth. ...

When that light came on there was silence – it was a kind of dawning – we were witnessing the first time human beings were falling away from the Earth."

Meanwhile in one of the back rooms at Mission Control Director of Flight Crew Operations, Deke Slayton, cornered Neil Armstrong and told him that Mike Collins was back on flight status, and would he mind Collins joining his crew in place of Fred Haise for Apollo 11?

"No problem," replied Armstrong, thinking back that he had worked well with Aldrin in their training for Apollo 8, and he was quite confident in Collins' abilities. They thought it over and both agreed that Armstrong as Commander, Collins as Command Module Pilot and Aldrin as Lunar Module Pilot would be the crew for Apollo 11.



Above: Capcom Mike Collins watches the second TV transmission at his console in Mission Control. Frame grabbed by Colin Mackellar from a transfer of the 16mm footage courtesy of Stephen Slater.

Below: Behind Collins, (left to right) astronauts Ken Mattingly, Harrison Schmitt, Buzz Aldrin (standing) and Neil Armstrong also focus their gaze on the TV monitor built into the Capcom console.



FORECAST

CANBERRA: Showers clearing, cooler winds. Max 72.
LAKE: Wind WNW/SW, 10-20 knots, gusty, moderating.
S. TABLELANDS: Few showers, storms.
S. COAST: Some showers. Strong wind warning.
Weather details, South Coast tides — Page 15

The Canberra Times

To serve the National City and through it the Nation

Vol. 43, No. 12,191

TUESDAY, DECEMBER 24, 1968

16 Pages

Apollo-8 set for moon orbit

CAPE KENNEDY, Monday (AAP-Reuters). — The Apollo-8 spacecraft continued to soar through space today on its way to a lunar orbit with the astronauts reporting all well.

Despite some sickness early in the voyage Air Force Colonel Frank Borman, Navy Captain James Lovell and Air Force Major William Anders were "in good shape" as they prepared for a 20-hour whirl around the moon.

If everything continues to go well, the astronauts will drop into lunar orbit early tomorrow to begin a historic 10-loop reconnaissance

miles from the earth, 49,045 miles from the moon and travelling at 2,474 miles an hour.

The speed is expected to drop to about 2,100mph under the drag of Earth's gravity and then accelerate up to 7,000mph when the Earth surrenders its influence on Apollo-8 to the pull of the moon in mid-afternoon.

The astronauts will begin the braking process at 9.58am (7.58pm AEST) and the craft will go into elliptical orbit, ranging from 69 to 196 miles above the lunar surface. At 2.22pm (12.22am AEST Wednesday) the engine will again be fired to bring the craft into a 69-mile circular orbit.

The most critical test will come



The Pueblo's Captain Bucher and US Navy Captain Vince Thomas leave the Press conference. — Radio picture.

Lieutenant F. R. Murphy, Army advance camp near

Grass in
ACT
'tinder
dry'

Grasslands in the eastern areas of the

'Week of ten for Pueblo c

Above: This is how Canberra residents read about the Apollo 8 Mission on the morning of Christmas Eve 1968.

An optimistic end to what had been a tumultuous year.

With thanks to Mike Dinn. Scans: Colin Mackellar.

Below left: The Canberra Times' front page also reported Mike Dinn's brief conversation with the Apollo 8 astronauts when there was a comms problem between Houston and Honeysuckle.

Doubtless Bernard Scrivener, the station's admin public relations officer — or Don Witten, visiting PAO from Goddard — would have alerted the newspaper to this local story.

AUSTRALIA'S VOICE, ENGLISH ACCENT

Mr M. J. Dinn, a 35-year-old Englishman, became yesterday afternoon the first man working at an Australian space station to speak to the crew of Apollo-8.

On an instruction from Flight Command, Houston, Mr Dinn, who is the assistant director at Honeysuckle Creek, told the astronauts that a "minor fault" had developed in a voice-controlled relay at the station.

This meant, Mr Dinn said last night, that if the crew had wanted to talk to Houston the ground-station would not have been able to transmit an immediate reply. His job was to tell them of this situation.

The fault was eradicated by switching to another relay.

About 40 technicians at the Honeysuckle Creek-Tidbinbilla complex began tracking the flight about 10.30am yesterday.

They worked for 12 hours, with the Carnarvon, WA, station in support at various times.

Listen to the Comms Break Exchange

Conversation regarding the communications break.

The exchange starts at 3m 15s.

Only Houston and the downlink are heard on this recording made at Honeysuckle Creek.

Sadly, Mike Dinn's uplink was not.



750kb mp3 file. Running time — 4m 15s





John Saxon (background) and Mike Dinn at the Operations Console, December 1968, and almost certainly during Apollo 8. Photo: Ron Hicks

At 61:58:06 GET (1249 AEST), about 1 hour 37 minutes after our AOS, Honeysuckle Creek had a rare mention on Net 1, the astronaut's communications loop with Mission Control.

Capcom Mattingly:

"Okay. And you can anticipate a handover between stations here on the hour, and you might get a slight glitch as we go through. I'll give you a call when we get back."

Borman: *"Thank you, Ken. What station are we going to be going to, Ken?"*

Mattingly:

"Okay. We'll be going to Honeysuckle."

Borman: *"Thank you."*

Borman wanted to do a urine dump but checked with Houston, as even such a minor liquid ejection caused the spacecraft to change its trajectory slightly, so Houston advised Borman to go ahead, but it would be the last *"gas station stop,"* or urine dump, before going into lunar orbit so as to minimise any trajectory perturbations.

Mattingly:

"Apollo 8, Houston through Honeysuckle."

Anders: *"Roger. Houston through Honeysuckle. We read you loud and clear."*

Mattingly: *"Okay. Good morning."*

Anders: *"Good morning."*

Mattingly: *"Thought you went to sleep."*

Anders: *"You got off over to Australia – you got over to Australia pretty fast."*

Mattingly:

"Rog ... that gas station call wake you up?"

Anders: *"Man, I've been all eyeballs and elbows here for the last several hours."*

Going behind the Moon and into Lunar Orbit

Then came the moment to go behind the Moon – and the decision to loop around the back and return, or to go into orbit around the Moon.

"Apollo 8 this is Houston," Capcom Jerry Carr called at 68:04:07 GET (1855 :07 AEST) *"at 68 hours 4 minutes you are Go for LOI."*

"Okay," replied Borman, "Apollo 8 is Go."

Carr, "Apollo 8 Houston, you're riding the best one we can find around."

Borman, "Say again."

Carr,
"You're riding the best bird we can find. Over."

Borman, "Roger. It's a good one."

Listen to the moments leading to LOS

068:57:06 GET - As recorded direct from the downlink at Honeysuckle which was prime.



140kb mp3 file. Running time – 1m 08s



Listen to the moments after LOS

068:57:06 GET - As recorded onboard Apollo 8 and downlinked at Honeysuckle.



140kb mp3 file. Running time – 1m 08s



At 68:57:16 GET (19:48:16 AEST), just as they were going behind the Moon's rim Carr called,

"Apollo 8 Houston. One minute to LOS. All systems go. Safe journey, guys."

"Thanks a lot, troops," Anders responded.

"We'll see you on the other side," Lovell added.

"Apollo 8, ten seconds to go. You're go all the way," Carr finished the conversation.

At 68:58:45 GET (0349:20 Houston USCST) time (early, early morning for the Americans, but 1949:20 AEST on Christmas Eve for us), Apollo 8 slipped behind the Moon's rim and all our signals dropped out. It was now a wait and hope and pray all went well with the burn to put them into lunar orbit.

Borman was so impressed with the exact predicted timing of LOS he wondered,

"That was great, wasn't it? I wonder if they turned the transmitter off?", but we hadn't.

Anders laughed, "Chris (Kraft) probably said, 'No matter what happens, turn it off.'"

Borman: "The greatest tension in the spacecraft was when we fired the rocket to slow us up, and when we fired the rockets to get us out of there."

Subconsciously I felt they would be all right, but was there something unexpected behind the Moon that was a threat to the astronauts or the spacecraft? Someone jokingly said, what about the mountain we didn't know about that was higher than the spacecraft they would smash into? What was certain was the whole fate of the mission and the astronauts now hung on the SPS motor.

Nobody had ever seen behind the Moon; up to this point we had only sent satellites round. So, we all waited, and waited for what seemed hours, but was really only 32 minutes. Behind the Moon the astronauts suddenly felt alone. The radio was quiet; there was no Houston, no Goldstone, Madrid or Honeysuckle to talk to; in fact, there was nobody to talk to – they were the first people in history to be completely isolated from Earth, unable to even see it. Lovell decided he felt no different – he was weightless before, he was weightless now – there was blackness outside the window before, there was the same blackness now. The black bulk of the Moon beside them was blotting out the Earth and stars on that side. Only now the radio was silent.

The astronauts looked at each other. Borman then broke into their thoughts with,

"So, are we go for this thing?"

"We're go as far as I am concerned," Lovell was checking his instruments.

"Go on this side," agreed Anders.

Borman at 69:00:23 GET (1951:23 AEST), *"Okay, 8 minutes,"* to the burn.

Lovell, trying to keep the tension down, *"Well, the main thing is to be cool."*

Borman quickly changed the subject, *"Gosh – it's cool!"*

Lovell, *"It's up to 80 (°F, 27°C) in the cockpit."*

Anders, *"No – I think, just when my clothes touch me it gets cold, huh?"*

Up to now the crew couldn't see anything out of the windows, as Borman said,

"On that horizon, boy, I can't see squat out there."

Anders, *"You want us to turn off your lights to check it?"*

But then a few moments later Lovell called out, *"Hey, I got the Moon."*

Anders, *"Do you?"*

Lovell, *"Right below us."*

Anders, *"It is below us."*

Lovell, *"Yes, and it's ..."*

Anders, *"Oh, my God!"*

Borman, thinking something was amiss, *"What's wrong?"*

Anders, overwhelmed by the sight, *"Look at that!"*

Lovell, *"Yes."*

Flying along with their heads down, the three astronauts were looking out the windows at shafts of bright sunlight splayed across the cratered lunar surface.

Anders,

"See it? Fan... fantastic – but you know, I still have trouble telling the holes from the bumps."

Commander Borman rallied his crew, *"All right, all right. Come on you're going to look at that for a long time. One minute. Come on Jim, let's watch it real good."*

Lovell typed the instructions into the computer and looked for the response. The code to say everything was Go, *"99:40"* appeared in the readout. Lovell took a deep breath and pressed the *"Proceed"* button.

At 69:08:20 GET (1959:20 AEST), 1,400 kilometres above the Moon, they felt the pressure on their backs as the spacecraft slowed in response to the 4 minute 6.9 second burn that put them into a 312.1 by 111.1 kilometre orbit around the Moon.

"Longest four minutes I've ever spent," murmured Lovell, and stuck his thumbs in the air at Borman.

They were now in lunar orbit after a Trans-Lunar Coast of 66 hours 16 minutes and 22 seconds.

Borman swung the spacecraft around to view the lunar surface, and the three astronauts were gob smacked to see the crater-pitted moonscape gliding past beneath. As far as the eye could see it was a plaster-like black and white lunar landscape of countless thousands of all types of craters, a tortured terrain of craters on craters on craters, craters obliterating craters, rising mountains of craters, deep valleys of craters, plus rilles, rifts, landslides and mares. For a brief moment the mission was forgotten as the men pressed their faces against the windows to soak up the sight.

When back in sight of the Earth the astronauts were hardly poetic in their descriptions.

Borman described the scene as: *"It looked like the burned-out ashes of a barbecue,"*

Lovell: *"It's like a sand pile my kids have been playing in for a long time. It's all beat up with no definition. Just a lot of bumps and holes,"* and

Anders: *"It looks whitish-grey, like dirty beach sand with lots of footprints in it."*

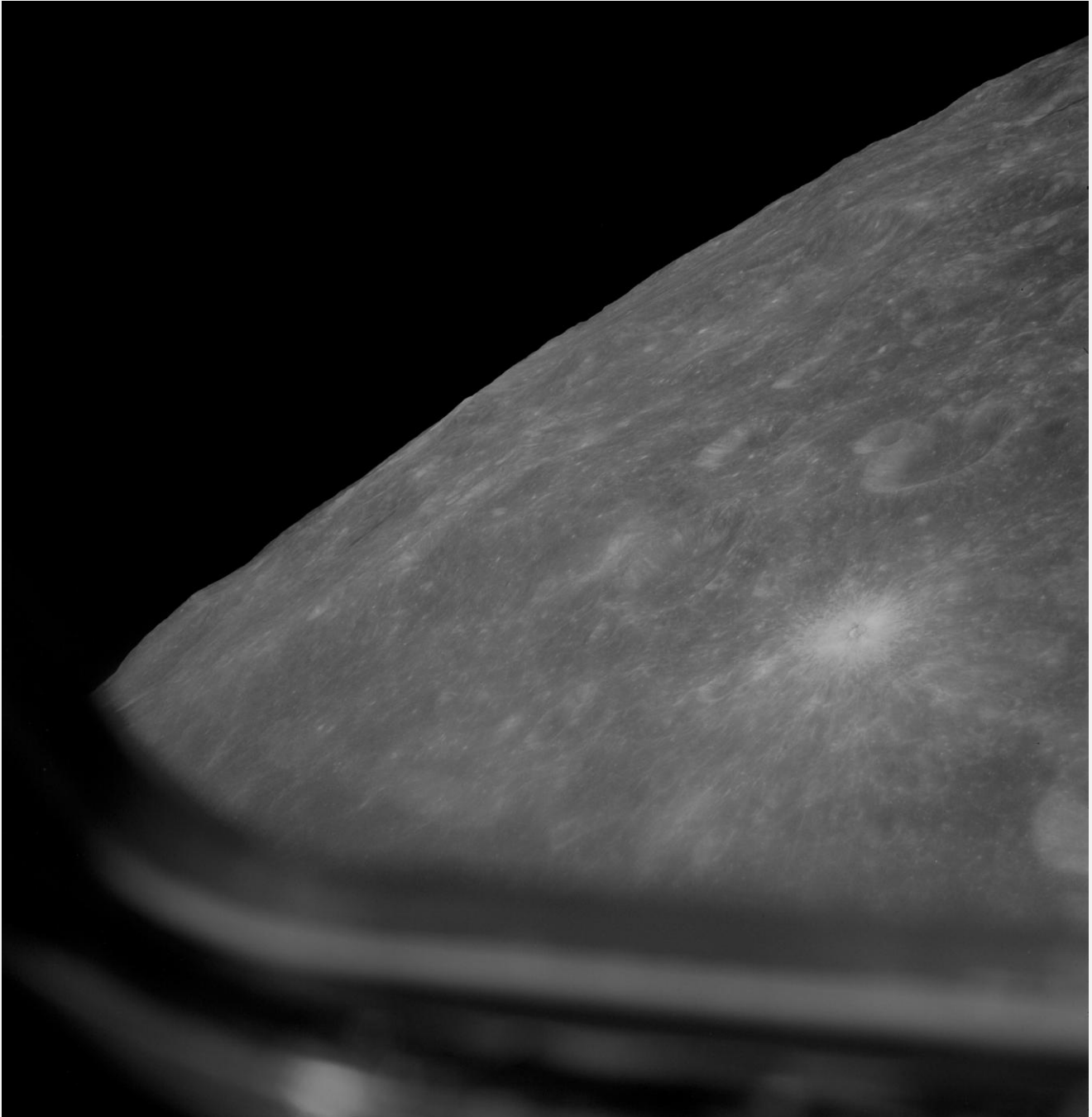
Listen to Apollo 8 go into orbit

069:05:05 GET - As recorded onboard Apollo 8 and downlinked at Honeysuckle.



1.1mb mp3 file. Running time – 1m 18s





Apollo 8 arrives in lunar orbit. Image: NASA

In Lunar Orbit

We had been given the exact time they should appear from behind the Moon for the first time, calculated by those brilliant boffins and their computers in the Trench at Mission Control. At Honeysuckle Creek, we were carrying the responsibility of being the Prime Station for this part of the mission.

In the USB area I could see our antenna focussed on the trailing edge of the crescent Moon on our boresight television, the crosshair sitting steadily on the rim – waiting. My APP (Antenna Position Programmer) steadily nudged the antenna along

to keep pace with the Moon. Just above the television screen was one of my large digital clock displays, silently flicking the seconds away, counting down to a monumental success or a tragic failure. Had they aborted the burn to give us an early acquisition and a direct ride home? If not, had the burn gone to plan and put them in the planned lunar orbit? Or had it failed?

I had a quick look around – everyone one was quiet, Alan Foster and the receiver operators were glued to their consoles, spring-loaded to grab the first signs of any signal from the spacecraft.



The 'kid's sand pile'. Image: NASA

When the AOS time of 69:32:35 GET Ground Elapsed Time, the time we always used, or 2024 AEST, appeared on our station clock displays we held our breath, but at that exact moment the signal hit our antenna and flooded through the station, kicking all the meters up (analogue meters in those days) and filled all our equipment with information about the spacecraft and what had happened while they were out of contact behind the Moon.

On the receivers Alan Foster remembered,

"I just made a normal acquisition as the came over the lunar horizon – it was a good signal, clean and sharp, no fading at all – one of the

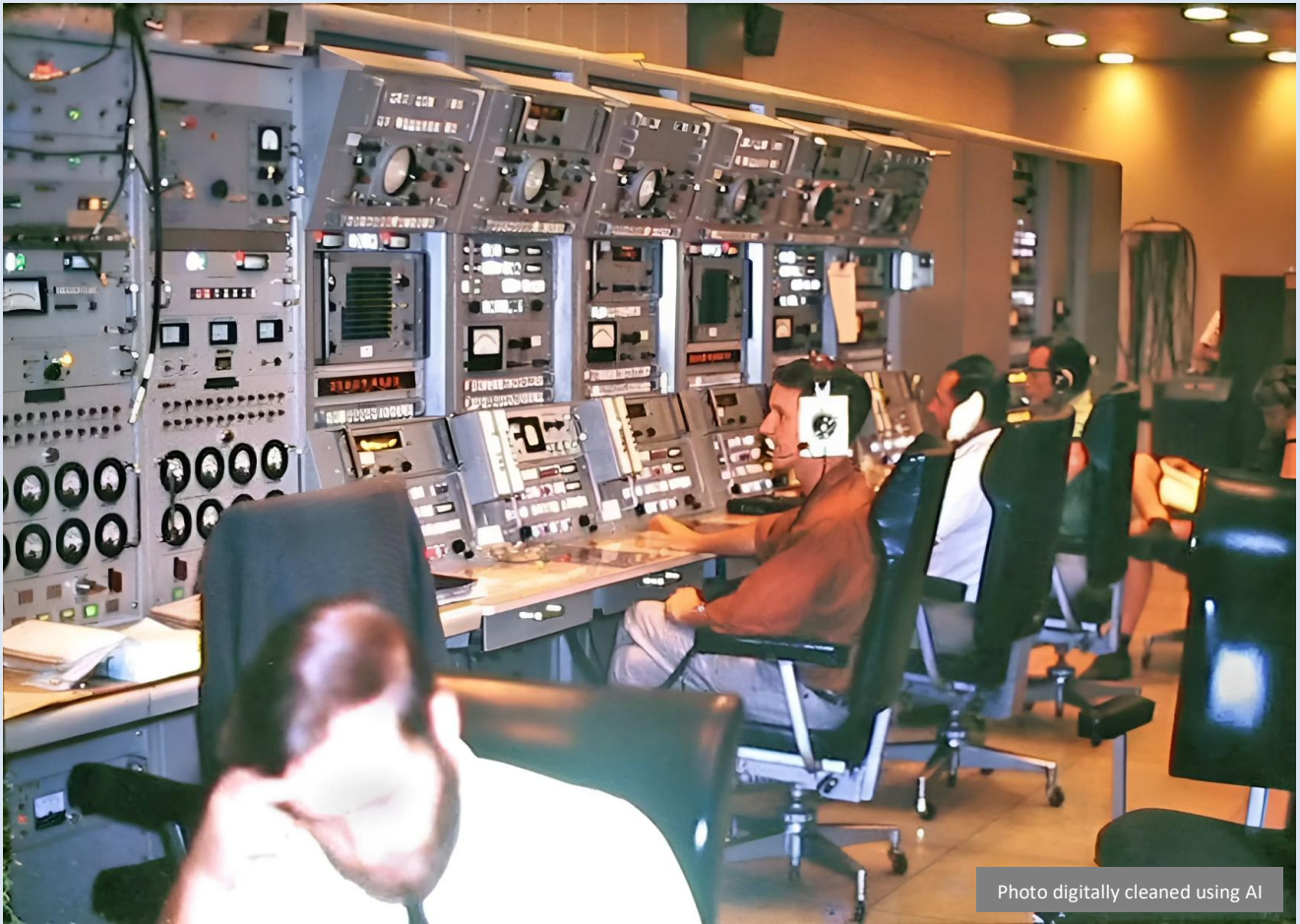


Alan Foster

easiest acquisitions I had ever done because there was no antenna searching around as we could see the crescent Moon on the boresight TV.

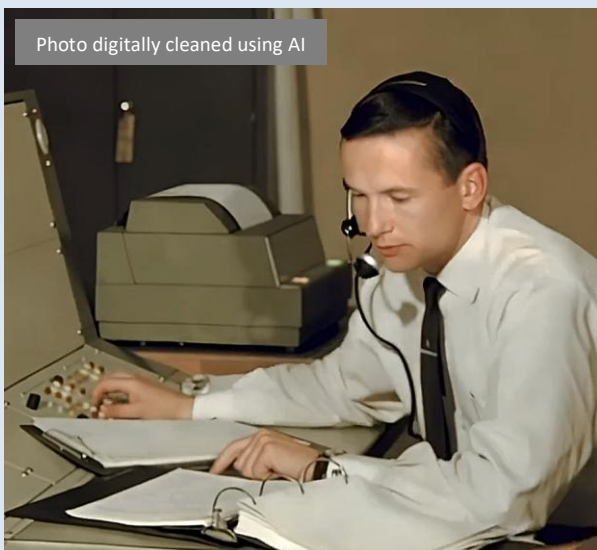
I was relieved, I can tell you. I have always remembered Network saying on the loop, 'That was a beautiful acquisition, Honeysuckle'."

Once the receivers were locked up we had no trouble acquiring the range, but down at the back of the station there was a lot of tension as there was telemetry data but no voice.



The Honeyuckle Creek USB area during Apollo 8. Photo: Ron Hicks.

Hamish Lindsay (over-exposed) is in the foreground, at the USB 1 ("SB1") desk. Behind him are Rod Lindrea, and Graham Fraser. Alan Foster is at the console farthest from the camera. Peter Cohn (Ranging) is on the far right.



John Saxon

Operations Supervisor John Saxon:

"Because we weren't tracking the LM we had all our equipment configured onto the CM. There was a planned mode and an unplanned, or back-up mode.

We decided we should cover the back-up mode just as carefully as the prime mode.

Unfortunately, there were so many ways to configure this – we ended up locking up all the telemetry and sending it back to Houston all right – but there was a degree of confusion about where the voice was actually coming from.

I remember hearing the Public Affairs loop saying we have data but no voice, and here I was frantically pushing buttons trying to find where they had put this voice, and Kevin Gallegos (on SDDS, Demodulator) was pushing buttons as well – and no doubt Houston was also pushing buttons. I had my fingers poised ready to call the astronauts and tell them that we did have communications with Houston, but somehow we can't get you through.

We managed to sort it out in the end – I was very close to being the first guy to speak to someone in Lunar orbit.

Our problems with voice during that first Lunar AOS had worried me for almost 50 years. But recently (August 2018) we gained access to the CSM on-board voice recorder tapes. And it's now apparent that the CSM HGA was not properly locked on to our signals so the ground signal level (and in particular the voice sub-carrier levels) were really low, making it almost impossible for Kevin Gallegos to establish if the voice was on a sub-carrier or not. I feel better now!"

Meanwhile on board the spacecraft at 69:33:56 GET (2024:56 AEST) the astronauts were getting ready to receive Honeysuckle Creek's signal.

Borman, *"Are we on the High Gain (antenna) Jim? Bill?"*

Anders, *"Give me a verb 64, Frank."*

Verb 64 was the computer's instruction to control the High Gain antenna to acquire the station's signal.

HSK MISSION – DAY 4

Tuesday, 24 December 1968
Times: AEST (HSK local time)

EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 1	1:24:04	2023:35 2147:39

Back on Earth, the public affairs commentator in Houston, Texas, John McLeaish, announced with suppressed excitement,

"We've got it! We've got it!! Apollo 8 now in lunar orbit."

There was a relieved cheer from the Flight Controllers in Mission Control while Bob Gilruth and Chris Kraft, the two leaders, were choked up with emotion as they shook hands.

Capcom Carr began repeatedly calling the spacecraft with no answer, *"Apollo 8, Houston."*

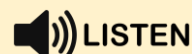
Carr: *"Apollo 8 Houston, Over."*

Lovell tried calling Houston: *"Houston, Apollo 8."*

Borman: *"Verb 64. I don't think we ..."*

Listen to PAO John McLeaish

069:33:46 GET – PAO John McLeaish describes the moment.

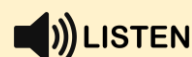


180kb mp3 file. Running time – 0m 39s



Listen to Capcom Jerry Carr

069:33:19 GET – Capcom Jerry Carr calls Apollo 8 and Jim Lovell answers.



228kb mp3 file. Running time – 0m 55s



Borman,
"Give them the whole burn report there Jim."

Lovell thinks Houston can't hear him: *"I think I'm talking to myself."*

Borman: *"Why don't you get a Roger for the (recorder) dump then?"*

Anders:
"Okay, that's ... Let me go into High Gain."

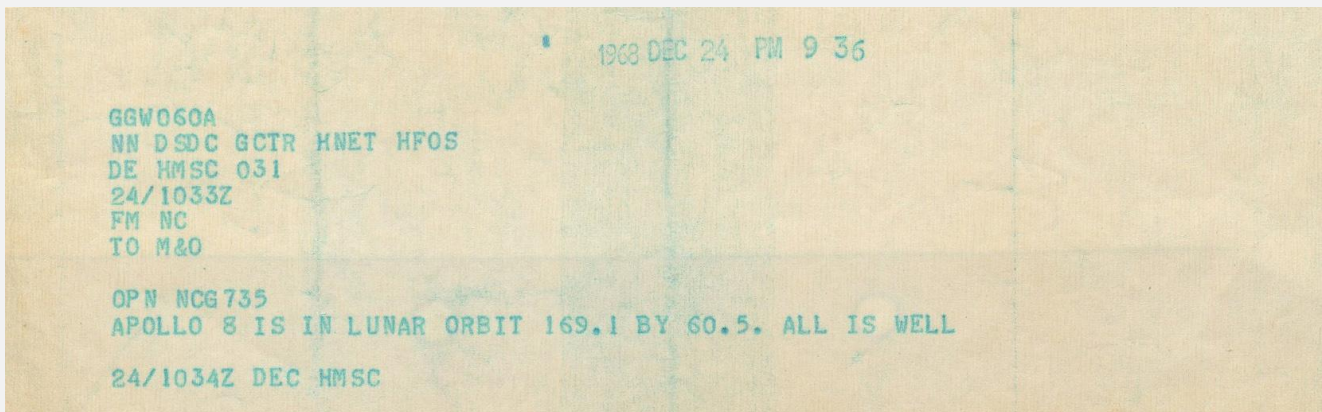
Borman: *"Can you get them, Bill?"*

Anders: *"We got them."*

Borman: *"Houston, Apollo 8. How do you read? How do you read Apollo 8, Houston?"*

Anders: *"They've got a ground problem."*

Borman: *"Houston, Apollo 8 ... I hear they are reading us now."*



"Apollo 8 is in lunar orbit. 169.1 by 60.5. All is well."

TWX received at Guam. Preserved and scanned by Brian Riehle.

Carr in Mission Control:

"Apollo 8, Houston, Over."

Lovell: *"Go ahead Houston, this is Apollo 8. Burn complete. Our orbit is 169 by 60.5."*

Borman:

"Are we hooked on with the High Gain?"

Lovell: *"Yes, Sir."*

Carr: *"Apollo 8, Houston. Over."*

Lovell:

"They came through that time didn't they?"

Borman: *"Yes."*

Carr: *"Apollo 8. Apollo 8, This is Houston. Over."*

Lovell: *"Okay."*

Borman: *"Roger Houston. We read you loud and clear. How do you read us?"*

Carr: *"Apollo 8. This is Houston. Reading you loud and clear now and verify your evaporator water control panel switch to the Auto position. Over."*

With clear communications established, a discussion began on the status of the cooling radiator as the temperatures were higher than expected. As its evaporator had dried out they switched to the secondary system.

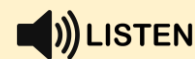
When we heard astronaut Lovell's prosaic voice answering Mission Control in Houston,

"Go ahead Houston, this is Apollo 8."

We all knew everything was all right. They were safely in a 312 x 111.1 kilometre Lunar orbit – at least for the moment.

Listen to Jerry Carr ask Jim Lovell

069:51:04 GET – Jerry Carr asks *"What does the ol' Moon look like from 60 miles?"*



344kb mp3 file. Running time – 2m 45s



At 70:03:31 GET (2054:31 AEST) the astronauts were still mulling over the accurate predicted time of the signal LOS.

Carr: *"Apollo 8 Houston. MSFN tracking is comparing very well with your on board nav."*

Borman:

"Roger. Houston, for your information we lost radio contact at the exact second you predicted."

Carr: *"We concur."*

Borman: *"Are you sure you didn't turn off the transmitters at that time?"*

"Honest injun', we didn't," Capcom Jerry Carr was indignant.

Just before eating breakfast, they flew into darkness in the shadow of the Moon and Jerry Carr asked the astronauts if they could see

Listen to Frank Borman and Jerry Carr

070:03:17 GET – Jerry Carr tells Borman
“Honest injun, we didn’t.”



124kb mp3 file. Running time – 0m 54s



Earthshine, that is, the light reflecting from Earth shining on the dark face of the Moon.

Carr: *“Apollo 8, Houston. Any words on Earthshine? Over.”*

Anders: *“Earthshine is about as expected, Houston. Not as much detail, of course, as in the sunlight but you can see the light craters quite distinctly, and you can see the albedo contacts quite distinctly. And, also, there’s a good three-dimensional view of the rims of the larger craters.”*

Listen to Bill Anders reporting

070:09:13 GET – Bill Anders reports
“Earthshine is about as expected.”



84kb mp3 file. Running time – 0m 34s



Just before eating breakfast, they flew into darkness in the shadow of the Moon and Jerry Carr asked the astronauts if they could see Earthshine, that is, the light reflecting from Earth shining on the dark face of the Moon.

Listen to the Lunar Revolution 1 Pass

069:32:10 GET – Apollo 8 Lunar Revolution 1 as recorded direct from the downlink at Honeysuckle Creek.

Note the lack of Quindar tones in these recordings. These tones, sent by the Capcom to put his voice to line at the tracking stations, were filtered out of the uplink and usually not heard by the astronauts. On this tape, Bernard Scrivener at Honeysuckle Creek announces “occultation” at the end of the pass.



18.4mb mp3 file. Running time – 1h 19m 31s



In Houston excitement spread through the computer centre as the real-time measurements they were getting from our ranging systems at the tracking stations gave them the precise, accurate measurements of the spacecraft’s real orbit around the Moon they needed for all the upcoming Apollo missions – their maths models were now corrected with live data.

Also, for the first time, the crater-scarred surface of the Moon appeared on the 3 by 6 metre screen stretched across the front of the control room. Up to then it had always been the lands and seas of the Earth as the spacecraft orbited the planet.





Looking at Apollo 8 as it was looking at us. Photo: Hamish Lindsay. Scanned by Colin Mackellar.

Hamish Lindsay writes:

"Back on Earth, in the darkness of the Australian bush at Honeysuckle Creek, I felt I should get a photograph of this historic moment of us tracking Apollo 8 in lunar orbit and set up my Linhof camera to record the moment.

I had to wait for a gap as some clouds drifted across the face of the Moon. As it was night and there were only the antenna floodlights, it had to be a long tripod exposure for the 100 ASA Kodacolor 4 x 5 inch sheet film, but the result, shown here, was successful, and recorded the historic moment."

Taken at around 9:00pm AEST on Christmas Eve, as the Moon heads towards the western horizon, and Apollo 8 is in its first lunar orbit.

Note the tops of the flagpoles near the Honeysuckle Operations Building and microwave link tower just visible in the darkness at lower left.

HSK MISSION – DAY 5

Wednesday, 25 December 1968

Times: AEST (HSK local time)

EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 2	1:25:08	2230:00 2355:08

Listen to Start of Revolution 2

071:41:00 GET – Starting at AOS on Rev. 2 and Madrid is now prime, the TV camera is already on, and Capcom is Jerry Carr. During Apollo 8, microwave links had not yet been set up to allow Honeysuckle Creek to send its TV to Houston.



588kb mp3 file. Running time – 0m 34s



The first pass in lunar orbit ended with LOS at 70:56:35 GET (2147:35 AEST) as they went behind the Moon for the second time, and after 42 minutes they reappeared at 71:39:00 GET (2230:00 AEST) in orbit 2, busy transmitting television pictures of the lunar surface passing below the spacecraft. This was their third television broadcast. Madrid was the prime station tracking now.

Anders: *“Houston, this is Apollo 8 with the TV going. Over.”*

Carr: *“Apollo 8, this is Houston. Reading you loud and clear. We see your TV. It’s a little bit ... a little bit clearer.”*

The opening scenes were of the lunar surface,

Carr: *“We are beginning to pick up a few craters very dimly. The whole thing is pretty bright.”*

Anders: *“Roger. There’s not much definition up here either out on the horizon. I’ll shift to the rendezvous window.”*

After Anders moved to the rendezvous window, which wasn’t so fogged up, Carr responded with,

“Looks like we’ve got a real good picture now.”

Lovell: *“Say, Bill, how would you describe the colour of the Moon from here?”*

Anders: *“The colour of the Moon looks, ah, a very whiteish grey, like dirty beach sand, and with lots of footprints in it.”*

Lovell:

“Don’t these new craters look like pick-axes striking concrete creating a lot of fine haze dust.”

After 12 minutes of television transmission, mainly showing and discussing various craters passing by below Borman terminated the transmission with,

“This is Apollo 8. We are going to terminate our program for this pass and get on with preparations for LOI-2 (second burn to circularise their orbit) if you say we’re GO.”

Carr: *“Apollo 8, this is Houston. Roger.”*

Borman:

“Okay. Signing off until ninth rev. Apollo 8.”

Just before our midnight, at 73:04:08 GET (2355:08 AEST) the spacecraft disappeared behind the Moon again, though we weren’t tracking it.

HSK MISSION – DAY 5

Wednesday, 25 December 1968

Times: AEST (HSK local time)

EVENT	Overall Track Duration	AOS/LOS
Lunar orbits 3-10 / TEC Day 1	9:35:15	1231:30 2206:45

At 73:35:06.6 GET (0026:06 AEST) there was a second SPS engine burn of 9.6 seconds to circularise the orbit to 112.4 by 110.6 kilometres.





Photo digitally cleaned using AI

Above: As most Australians slept, awaiting the dawn of Christmas Day, NASA Public Affairs Officer Don Witten took this photo of Station Director Tom Reid at the Operations Console. Ops Supervisor Ken Lee is partially visible. The time display reveals this photo was taken on Day of Year 359, 24 December 1968, at 16:58 UTC – i.e. Christmas Day, Wednesday, 25 December, at 2:58am Australian Eastern Standard Time.

Photos by Don Witten. Preserved by Hamish Lindsay. Scan and image processing by Colin Mackellar.

Below: This photo, taken at the same time, gives a slightly different view of the Operations Console.



Photo digitally cleaned using AI

HSK MISSION – DAY 5

Wednesday, 25 December 1968

Times: AEST (HSK local time)

EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 3	1:11:58	0040:25 0152:23

At 73:49:25 GET (0040:25 AEST), the Manned Space Flight Network saw Apollo 8's signal again in their third orbit.

At 74:44:51 (0135:51 AEST) Borman checked to see if Rod Rose was in Mission Control. Rose was Chairman of the Planning and Analysis Division of Flight Operations, responsible for producing the Mission Flight Plans.

Borman: *"I said is Rod Rose around?"*

Collins: *"Stand by one Frank. We'll look for him."*

Collins came back with: *"Rod Rose is sitting up in the viewing room – he can hear what you say."*

Borman:

"I wonder if he is ready for experiment P-1?"

Collins: *"He says thumbs up on P-1."*

Borman: *"Roger. Rod and I got together, and I was going to record a little – say a little prayer for the church service tonight. And I wonder ... I guess that's what we are ready on?"*

Collins: *"Apollo 8, Houston. Go ahead, Frank, with your message."*

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."

Collins: *"Amen."*

Borman: *"I was supposed to lay-read tonight, and I couldn't quite make it."*

Experiment P-1 was a code for a planned Bible reading arranged with Borman's St. Christopher's Episcopal Church near Seabrook, Texas, Rose being a fellow member, and in on the secret.

The third orbit ended at 75:01:23 GET (0152:23 AEST) with LOS behind the Moon's rim, heading around to begin their fourth orbit.

HSK MISSION – DAY 5

Wednesday, 25 December 1968

Times: AEST (HSK local time)

EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 4	1:12:41	0238:18 0350:59

AOS in the fourth orbit was at 75:47:18 GET (0238:18 AEST)

One of the mission's sublime moments was the sight of the Earth rising above the lunar horizon – Earthrise!

Although the vista of the Earth rising over the lunar horizon had been experienced in the first three orbits, the astronauts were too busy with the lunar surface to see it with their windows looking down. This time Borman had been keeping the spacecraft pointing down to look at the Moon's surface but had to roll it around for a navigation sighting by Lovell.

As the lunar horizon hove into view, Anders was startled to see a glowing blue and white ball swim into view – the Earth.

At 75:47:30 GET (0238:30 AEST) an astonished Anders blurted out,

"Oh, my God – look at that picture over there; here's the Earth coming up ... wow, is that pretty."

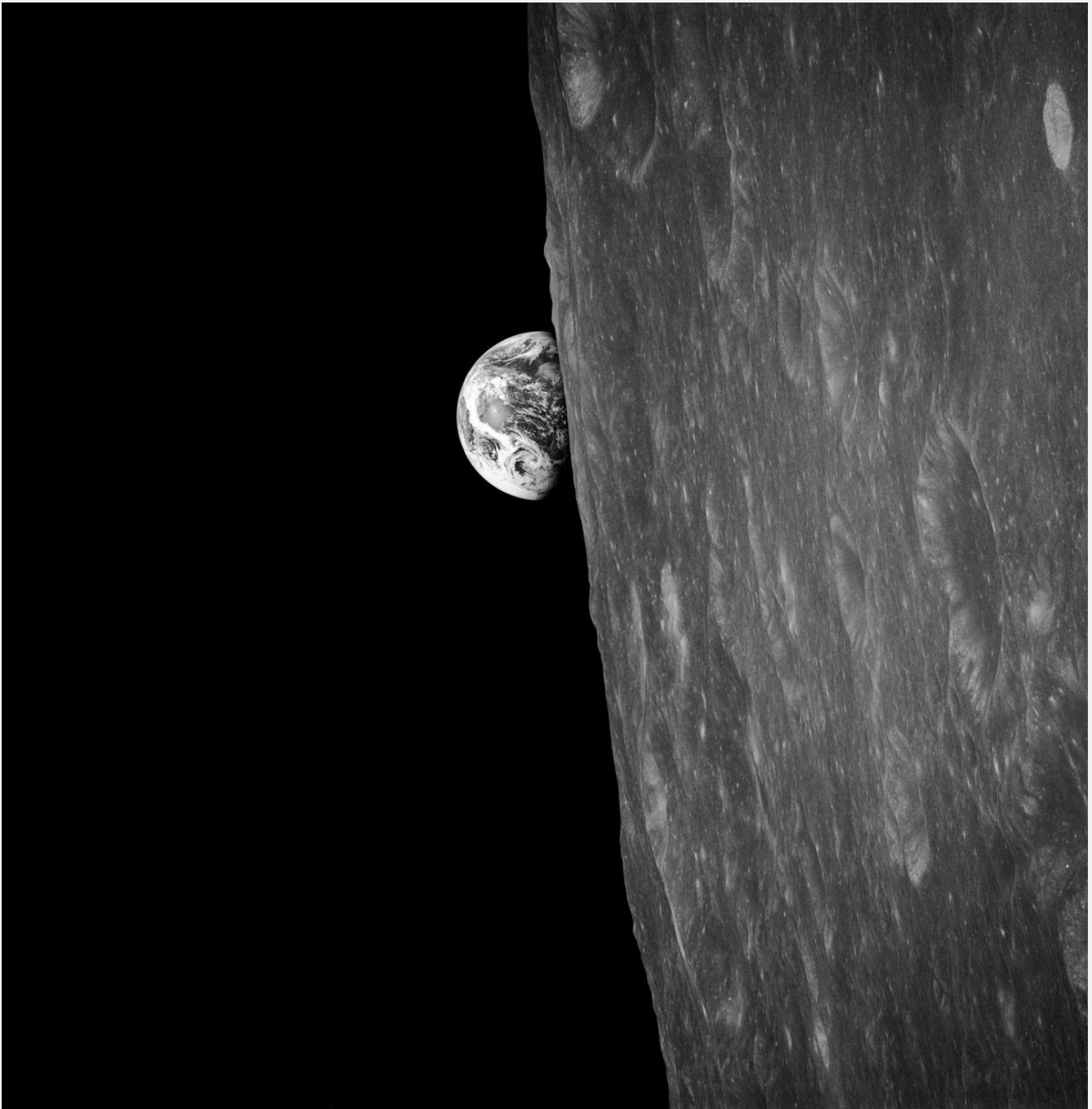
Borman joked:

"Hey – don't take that – it's not scheduled."

Anders laughed: *"You got a colour film, Jim? ... Hand me that roll of colour – quick – will you."*

While waiting, Anders took a black and white photograph at 75:47:44 GET (0238:44 AEST) showing the Earth just appearing from behind the Moon.

Lovell: *"Oh, man, that's great!"*



The first black and white picture of the famous Earthrise scene. Image: NASA

Anders: *"Hurry ... quick..."*

Borman: *"Gee!"*

Lovell: *"It's down here!"*

Anders: *"Just grab me a colour ... hurry up."*

Borman: *"Got one?"*

Anders: *"Yeah, I'm looking for one."*

Lovell quoted the film magazine identification:
"C-368."

Anders: *"Anything ... quick!"*

Lovell: *"Here."*

Anders: *"... well, I think we missed it."*

As the spacecraft was rolling, the Earth disappeared from window #5 and now could be seen in windows #4 and #3.

Lovell: *"Hey – I got it right here!"*

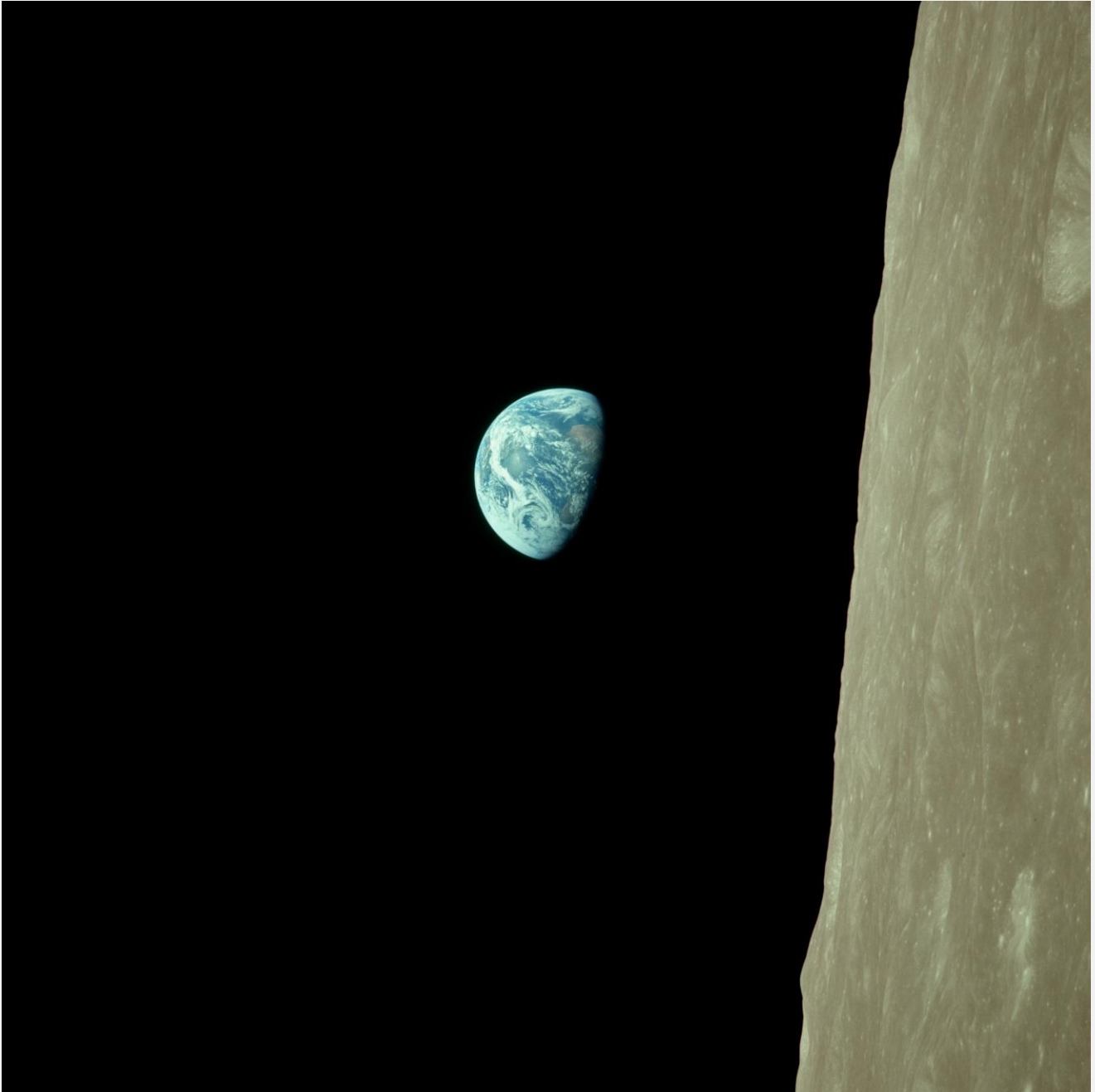
Anders: *"Let ... let me get it out this window. It's a lot clearer."*

The first colour frame was taken at 75:48:39 GET (0239:39 AEST).

Lovell: *"I got it framed ... it's very clear right here – You got it?"*

Anders: *"Yep."*

Borman: *"Well, take several of them."*



Bill Anders took this colour picture of the Earth rising above the Moon a few moments later. Image: NASA

This is the picture that first showed Earthlings their fragile but beautiful planet alone in the Cosmos and changed their perception of their place in the Universe for the rest of time.

Lovell:

"Take several of them. Here, give it to me."

Anders: *"Wait a minute....let's get the right setting. Here ... now... just calm down. Calm down, Lovell."*

Lovell:

"Well, I got it ri ... oh, that's a beautiful shot!"

The second frame, with a minor exposure change, was taken 30 seconds later.

As the Earth climbed above the horizon into the jet black sky they gazed in silence, spellbound at

the wondrous sight. The resulting colour picture, to become one of the most famous images ever recorded, was the first time the people of Earth really became aware of how fragile and insignificant our planet suddenly looked in the infinite cosmos.

I used to wonder which way was 'up' in the spacecraft. Pictures usually show the lunar horizon across the bottom of the frame, but actually the lunar horizon should be on the right side to me, lunar north being 'up.' One day I asked Dave Scott (Apollo 15) which way was up to the

astronauts in the spacecraft, and his answer was it was always straight above their instrument panel, whatever was happening outside. I feel that the pictures of the Earth with the lunar surface should have the horizon on the right side if they are orbiting clockwise around the Moon's equator to give a more natural alignment to the scene.

Looking from the Moon back to the Earth suspended in the absolute black, infinite void of space, the astronauts now saw the whole planet Earth as "home". In fact, a running joke among the Apollo 8 crew was that looking at the Earth from space the question arises, "Is it inhabited? Is there life on Earth?"

This acquisition through Madrid while the astronauts were taking their historic pictures had some spacecraft omni antenna problems and the lines were very noisy, so they handed the uplink over to Goldstone.

Collins:

"We have been having a little antenna problem on the ground here. We are reading you now with a lot of noise in the background. How me?"

Borman: *"Loud and clear, Michael."*

Collins: *"Roger, Frank. We are still trying to get a little better comm. here ... stand by; you are unreadable."*

So, on the ground at Honeysuckle Creek, we did not share those exciting moments of Earthrise as it happened.

LOS for the fourth orbit was at 76:59:59 GET (0350:59 AEST) with Anders frantically busy taking endless photographs, Lovell at the navigation station and Borman keeping an eye on the spacecraft and eating his lunch.

Collins: *"Have a good back side. See you next time around."*

HSK MISSION – DAY 5		
Wednesday, 25 December 1968		
Times: AEST (HSK local time)		
EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 5	1:12:54	0437:02 0549:56

AOS from behind the Moon was at 77:45:50 GET (0437:02 AEST), the topics under discussion during the pass were navigational, engineering and the lunar surface features, and some general news items were read to them.

Just before LOS the crew reflected on what they had seen (onboard conversation):

Anders: *"It doesn't seem like we've hardly been here that long, does it?"*

Lovell: *"It seems like I've been here forever."*

Anders: *"You know it really isn't all that ... anywhere near as interesting as I thought it was going to be. It's all beat up."*

Lovell, *"The things that I saw that were interesting were the new craters."*

Anders, *"Yes, but they're not the ones that people are really interested in – some of them they are."*

MSFN LOS was at 78:58:44 GET (05:49:56 AEST) with a weary Borman already asleep.

HSK MISSION – DAY 5		
Wednesday, 25 December 1968		
Times: AEST (HSK local time)		
EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 6	1:11:24	0632:12 0748:36

AOS was at 79:46:00 GET (0637:12 AEST) for their sixth orbit, but communications were poor due to relying on the omni antennas, and it was a few minutes before dialog was established.

During the sixth orbit, before rounding the corner to see Earth, they saw another sunrise at 79:09:22 GET (0600:34 AEST). (Onboard.)

Lovell: *"Oh boy, I may see the Sun. I'd better be careful, too. Hey, there is – there's a – here's a glow – you can see the Sun come around a little bit."*

Anders: *"Is that right?"*

Lovell: *"Yes, I can see the Sun come up before it comes up ... like a Zodiacal light, a little bit, maybe."*

Anders: *"Rim brightening, they call it."*

Lovell: "Yes, you sure can ... oh boy!"

Anders: "Can you describe it?"

Lovell: "Yes, it's a real bright glow right in one spot, and it fans out all over the horizon. And I'm just trying to move my eye away, because the Sun's going to peek over here any second now, and it's getting brighter and brighter, and it's get ... it's an even light."

Anders: "Bright spots fan out over horizon?"

Lovell: "Yes, yes ... then it fans up into the air; it's an even light, then all of a sudden it ... the Sun is peeking out right now ... whooo!"

Borman woke up at around 80:12:00 GET, just before they went behind the Moon again at 80:57:24 GET (0748:36 (AEST))

HSK MISSION – DAY 5		
Wednesday, 25 December 1968		
Times: AEST (HSK local time)		
EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 7	1:12:49	0834:17 0947:06

At 81:43:05 GET (0834:17 AEST) the MSFN had AOS with Capcom Collins greeting the boys with, Roger, Frank. Good morning. Welcome back.

In a comfortable cabin temperature of 25°C Borman was flying the spacecraft, Lovell was conducting auto optic exercises, and Anders was trying to eat between identifying landmarks and more photography.

By now Lovell and Anders were getting very tired and at 82:42:01 GET (0933:13 AEST) Borman announced he was terminating all experiments,

"We're scrubbing everything. We'll – I'll stay up and point – keep the spacecraft vertical and take some automatic pictures, but I want Jim and Bill to get some rest."

Collins: "Roger. Understand."

Ten minutes later Borman called down: "Lovell is snoring already."

Collins: "Yeah. We can hear him down here."

LOS was at 82:55:54 GET (0947:06 AEST) and, after they were out of contact with Earth, Borman had to urge Anders to go to sleep,

"I want you to go to bed. Come on now. You've been up all the time – it's in the Flight Plan, God dammit. Go to bed. To hell with the other stuff! We'll bust our ass for it."

HSK MISSION – DAY 5		
Wednesday, 25 December 1968		
Times: AEST (HSK local time)		
EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 8	1:11:22	1033:17 1145:12

Honeysuckle Creek begins tracking once the Moon rises above the surrounding hills – some minutes after nominal Moonrise at 10:34am AEST and tracks through to LOS at 11:45am.

OS was at 83:42:05 GET (1033:17 AEST) with Lovell and Anders asleep, while Borman was keeping watch and speaking to Houston,

"Well, Jim and Bill are both resting now. I had about 3 or 4 hours earlier today."

With a shift change in Mission Control, Michael Collins handed over the Capcom position to Ken Mattingly,

"Okay we have finished looking at all your systems and you have a GO for another rev."

Borman: "I understand we're go for rev 9?"

Mattingly: "That's affirmative, Eight."

Borman: "How's the weather down there, Ken?"

Mattingly: "It's really beautiful – loud and clear – and just right in temperature."

Borman: "How about the recovery area?"

Mattingly: "That's looking real good. They told us there's a beautiful Moon out there."

Borman: "Now, I was just saying that there's a beautiful Earth out there."

Mattingly: "It depends upon your point of view."

They ducked behind the Moon again at 84:54:00 GET (1145:12 AEST) and as they sailed along the back of it the crew began to think about the big television show they were going to set up for, as Borman said,

"We've got to do it up right, because there will be more people listening to this than ever listened to any other single person in history."

They were also thinking about the SPS burn and coming home during the tenth orbit.

Borman again, *“And we’ll put it all in one place and get the whole damn thing shipshape, because now she’s going to take us home.... let’s only have the stuff out we’re going to need to operate for the burn. Here’s some stuff stuck up here. There’s cameras floating about all over the place. Jim, fix me one of those.”*

The crew began stowing their equipment away, with the recorder recording comments like,

“Jim, where did you get this camera bracket out of?” and *“Huh! Where does that go?”* and *“I don’t know, how does this store, Bill? Together or separately?”*

HSK MISSION – DAY 5		
Wednesday, 25 December 1968		
Times: AEST (HSK local time)		
EVENT	MSFN Track Duration	AOS/LOS
Lunar orbit 9	1:12:30	1231:30 1344:00

On Christmas morning, an Australian News Press Release was sent to the media proudly announcing that television pictures of the Moon had just been received at Honeysuckle Creek and Tidbinbilla tracking stations as the spacecraft was passing over the Sea of Crises as it began its ninth orbit.

At 85:40:30 GET (1231:30 AEST) the Moon had risen above our horizon at Honeysuckle Creek, and we had our AOS as the spacecraft came around the Moon’s rim. With Goldstone in California, the prime station, we were ready for the big television moment.

The fourth television transmission began at 85:42:51 GET (1233:51 AEST), with Anders querying,

“How’s the picture look, Houston?”, hoping he had set up a good picture.

Mattingly: *“Loud and clear.”*

Lovell: *“Welcome from the Moon, Houston.”*

Anders: *“Houston, you’re seeing a view of the Earth taken below the lunar horizon. We’re*

going to follow the track until the terminator, where we will turn the spacecraft and give you a view of the long shadowed terrain at the terminator, which should come in quite well in the TV.”

Borman: *“It certainly would not appear to be a very inviting place to work. Jim, what have you thought most about?”*

Lovell: *“Well, Frank, my thoughts are very similar. The vast loneliness up here of the Moon is awe inspiring, and makes you realise just what you have back there on Earth. The Earth from here is a grand oasis in the big vastness of space.”*

Borman: *“Bill, what do you think?”*

Anders: *“I think the thing that impressed me the most were the lunar sunrises and sunsets. These in particular bring out the stark nature of the terrain, and the long shadows really bring out the relief that is here and hard to see at this very bright surface that we’re going over right now. The sky up here is also rather forbidding, foreboding expanse of blackness, with no stars visible when you’re flying over the Moon in daylight.”*

As Apollo 8 approached lunar sunrise, passing over endless mares and craters, the shadows on the moon beneath shortened, the astronauts celebrated Christmas by taking turns reading from the Bible at 86:06:56 GET (1257:56 AEST, during our lunch time). Anders opened the Bible reading sequence with,

“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 ...”

Off air, Lovell said, *“You got it, Frank?”*

Borman, *“No – it’s your ...”*



Above: Mike Dinn preserved this Polaroid of the slow scan TV monitor at Honeysuckle Creek during the 4th TV transmission of lunar revolution 9. This was taken a few seconds before Anders began reading from Genesis.

Polaroid's preserved by Mike Dinn and scanned by Colin Mackellar.

Below: This Polaroid was taken as Jim Lovell began reading his portion of the Genesis reading.



Lovell quickly picked up the reading,

" ... 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."

Off air Borman said, *"Can you hold this camera?"*

Anders, *"You want to pass it over here, Jim?"*

Borman, *"No, it's perfect right where it is."*

Anders, *"Okay."*

Borman finished the quote,

" ... And God said, 'Let the waters under the Heavens be gathered together into 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 the 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."

Television screens around the world blacked out when Anders switched the camera off at 86:09:46 GET (1300:46 AEST), ending a 26 minute 55 second broadcast.

An estimated one billion people in 64 countries heard the live reading, and delayed broadcasts reached another 30 countries.

Anders, off air: *"That's it!"*

Borman: *"Don't say any more."*

Anders:

"I just turned it off. You want it on again?"

Borman: *"No leave it off. Great. Great."*

Lovell: *"Off? Camera's off."*

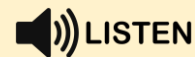
Anders: *"Yes."*

Borman: *"Hey! How can you beat that? Geez, we just went into the terminator right in time."*

Listen to the Genesis Reading

086:06:25 GET – The Genesis reading – as recorded at Honeysuckle Creek. In order: Bill Anders, Jim Lovell and Frank Borman.

The slight echo is possibly due to the audio being recorded off the downlink at Honeysuckle and simultaneously from Goldstone via Net 1.



588kb mp3 file. Running time – 0m 34s



Watch the Genesis Reading

The accompanying TV went to the world via Goldstone, who would have been tracking two-way at this point.

Though seen at Honeysuckle, no links to send the TV to the outside world would be set up for another six months.



24.0mb mp4 file. Running time – 3m 23s



Lovell: *"Okay, let's get the spacecraft back in even keel again."*

Borman: *"Houston, how do you read? Apollo 8."*

Borman, off air:

"Don't tell me they didn't hear us?"

Borman to Houston: *"Are we off the air now?"*



Apollo 8 sunset – peering into the depths of ancient craters. Image: NASA

Mattingly:

“That’s affirmative, Apollo 8, you are.”

Borman: *“Did you read everything that we had to say there?”*

Mattingly: *“Loud and clear. Thank you for a real good show.”*

Borman: *“Okay. Now, Ken, we’d like to get all squared away for TEI here.”*

Outside, darkness enveloped the spacecraft as it rushed on into the lunar night. On Earth millions had gathered around their Christmas trees and listened to this ethereal reading from above the forbidding lunar surface.

We lost the spacecraft’s signal at 86:53:00 GET (1344:00 AEST) as it went behind the Moon for the second last time.

Tom Sheehan, Head of Mission Control’s Track group we knew as ‘Houston Track’, said,

“Hardly anyone left Mission Control for the very long lunar orbits. There was a universal feeling of awe and fulfilment. All too soon it was time for TEI and the trip home.”



Photo digitally cleaned using AI



NASA Public Affairs Officer Don Witten with a special Slow Scan Television monitor set up in Station Director Tom Reid's office. He is examining some of his Polaroids showing the slow scan TV picture.

Photo: Don Witten. Image restoration: Colin Mackellar.

HSK MISSION – DAY 5

Wednesday, 25 December 1968

Times: AEST (HSK local time)

EVENT	Track Duration	AOS/LOS
Lunar orbit 10 ³	1:12:45	1429:15 1542:00
³ Honeysuckle Creek tracking.		

AOS for Orbit 10 at Honeysuckle Creek was at 87:38:15 GET (1429:15 AEST).

This being the last pass before they went behind the Moon for the TEI burn, everybody was busy checking and double checking all the figures and equipment status. Mattingly read up all the final information for the burn. Lovell swung himself from the lower equipment bay where he had been checking out navigation figures and settled in his couch. The other two were already seated. They began going through the checklist.

At 88:51:00 GET (1542:00 AEST), just as they went around the corner for the last time, there was a conversation about Australia on the spacecraft recorder:

Anders: *"Look at the Earth."*

Borman: *"Yes."*

Lovell: *"Setting?"*

Anders: *"We're down in Carnarvon."*

Lovell: *"Huh?"*

Anders:

"Yes, we're down in Honeysuckle – that was Australia. You don't see that very often, do you?"

The TEI Burn and they were coming home

Honeysuckle Creek tracking.

As the crew prepared for the burn behind the Moon, Anders commented,

"Boy – it's blacker than pitch out there."

Borman (onboard): *"Yes, I know it."*

Lovell: *"Yes, I watched the Sun – I watched that star rise, and I could just see the black horizon and the Moon fade away and the star come up."*

Anders: *"Do you see anything hanging around that could come down?"*

Lovell: *"I hope not."*

Borman: *"Tell you one thing these flights are good for – an old fatty like me. I bet I have lost a lot of weight. I didn't eat much those first two days and I didn't ... didn't even get much to eat today."*

The mission critical SPS motor burn to bring them home was fired at 89:19:16.6 GET (1610:16 AEST) with a TEI burn time of 3 minutes 23.7 seconds at an altitude of 111.5 kilometres above the Moon. Their speed increased by 4,435.5 kilometres per hour to 9,702 kilometres per hour.

The clock in Mission Control counted down to the burn while another clock was showing 9 minutes 23 seconds to reacquisition of the spacecraft signal.

In all the tracking stations and Mission Control everyone went quiet. This was the last unknown.

"Swallow the frights one at a time as they appear in the Flight Plan," astronaut Michael Collins once said.

George Low, the man responsible for this crazy trip to the Moon, sat hunched in the VIP lounge in Mission Control. He admitted this was his most feared moment.

Chris Kraft, the Director of Flight Operations in Mission Control in Houston, who knew more than anybody about the missions, said to me later, *"If you weren't shaking at that point you didn't understand the problems."*

So again, Honeysuckle Creek was the action station as we hung in suspense waiting for them to come from behind the Moon. If the SPS engine hadn't fired, or fired incorrectly, they would be doomed to die when their consumables would run out within a week. They would then be condemned to circle the lonely reaches of the Moon. There was no rescue mission standing by, or anybody around to help them.

Last Lunar AOS

Aware this was another big Apollo 8 moment, I had set the computer controlling the Honeysuckle Creek antenna, so the dish pointed steadily at the Moon's rim where the spacecraft was expected to appear.



Photo digitally cleaned using AI

The Honeyuckle Creek Operations Console during Apollo 8. Mike Dinn (seated) and Ian Grant appear in this photo by NASA PAO, Don Witten.

Gorton sends space greeting

CANBERRA, Wed. — A message from the Prime Minister (Mr. Gorton) will be beamed to the three men in the Apollo 8 spacecraft.

Mr. Gorton's message was sent this afternoon from Canberra to the Apollo headquarters in Houston, Texas.

Mr. Gorton's message said: "We have all been following the progress of the Apollo 8 mission

with tremendous excitement and interest.

"On this memorable Christmas Day as the Australian stations provide the vital link between the spacecraft and earth I am delighted to know that the spacecraft has completed its lunar orbit program and has commenced its return to earth.

"On behalf of the people of Australia I send to Frank Borman, Jim Lovell and Bill Anders our heartiest congratulations, warmest greetings and best wishes.

"May God bless them and their wives and families.

"I am sure their efforts and sacrifices will be rewarded by their joyous reunions on return to earth.

"We wish them all a happy Christmas."

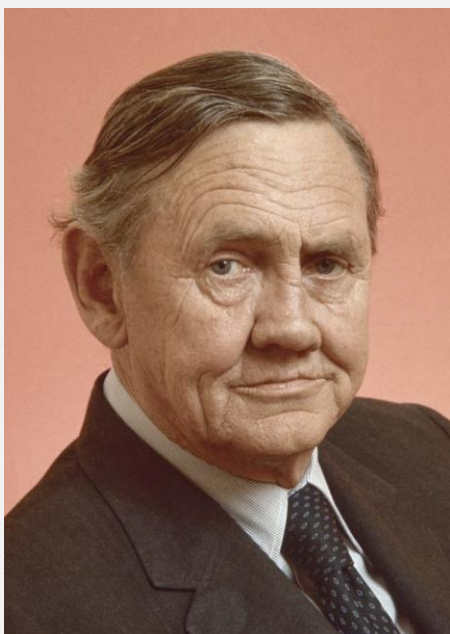
Mr. Gorton sent his message only minutes after the spacecraft had reappeared from behind the moon after its final orbit.

He also sent congratulations and personal greeting to the four Australian tracking stations taking part in the project.

It seems that someone at Honeysuckle – perhaps Bernard Scrivener - suggested to the Prime Minister's office that any such request should go to Houston.

This news report, published in Sydney's Daily Telegraph newspaper the next day, 26 December, was apparently written in the hope that the Prime Minister's message would be sent to the spacecraft.

Preserved and scanned by Colin Mackellar.



Prime Minister.
John Gorton.

Photo credit:
Australian
Information Service -
National Archives
of Australia
Item No. 203052031

And, right on time at 89:28:39 GET (16:19:39 AEST) the signal from Apollo 8 arrived at our antenna and the station came alive with operators calling out their readings.

"Apollo 8 ... Houston," called Capcom Ken Mattingly into the ether.

"Apollo 8 ... Houston," he called again, listening to the hash coming down the line.

"Apollo 8 ... Houston."

Everyone on the loops around the world were straining to hear a voice. Nearly a hundred seconds of hash had ticked by, then...

"Roger. Please be informed there is a Santa Claus," we heard Lovell's voice say and knew they were heading safely for home.

Mattingly: *"That's affirmative. You're the best ones to know."*

Borman: *"You get the sensation that you're climbing, Ken."*

Mattingly: *"Rog."*

The voice circuit was a bit noisy, and there was no telemetry data, but that was soon corrected when the spacecraft aligned its High Gain antenna and our signal strength increased.

Trans Earth Coast (TEC)

Twenty hours, ten minutes and thirteen seconds after entering lunar orbit and 10 times around the Moon, it was Christmas day and it was all on again for the ride home – they had to have a rocket burn to bring them back to Earth, and it had to happen out of contact behind the Moon.

It was 1625 in the afternoon on Christmas Day at Honeysuckle Creek. Apollo 8 was a success, and our Moon landing missions could go ahead – well, that was providing they re-entered safely, but there were no unknowns there. We could now enjoy a late but happy Christmas.

Australian Prime Minister John Gorton called the station requesting to speak to the astronauts but was politely declined. Then he wanted to send a message, but that was also turned down.

At 89:54:06 GET (1645:06 AEST) the Chief of Flight Crew Operations, Deke Slayton, came on the loop,

"Good morning, Apollo 8. Deke here. I just would like to wish you all a very Merry Christmas on behalf of everyone in the Control Center, and I'm sure everyone around the world. None of us ever expect to have a better Christmas present than this one. Hope you get a good night's sleep from here on and enjoy your Christmas dinner tomorrow; and look forward to seeing you in Hawaii on the twenty-eighth."

Borman: *"Okay, Leader. We'll see you there. That was a very, very nice ride, that last one – this engine is the smoothest one."*

Slayton: *"Yeah, we gathered that. Outstanding job all the way round."*

Borman: *"Thank everybody on the ground for us. It's pretty clear we wouldn't be anywhere if we didn't have them doing it for helping us out here."*

Slayton: *"We concur with that."*

Lovell: *"I concur too."*

Cheekily Anders added: *"Even Mr Kraft does something right once in a while."*

Slayton: *"He got tired of waiting for you to talk and went home."*

In Mission Control the big display maps showed the Earth again and a 1.8 metre high, cheerfully decorated Christmas tree was brought into the front of the Control Center.

At 89:59:18 GET (1650:18 AEST) Mattingly called,

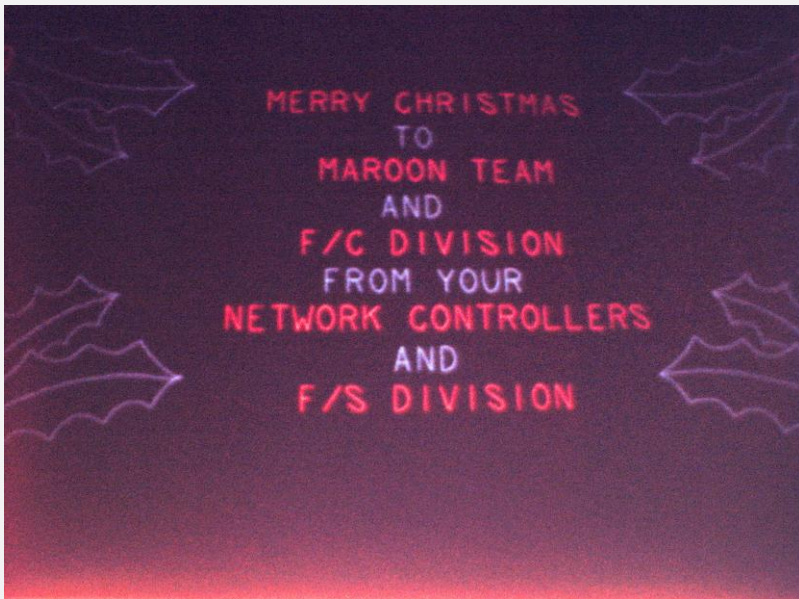
"And we've got a couple of words for you. Jack's (Schmitt, Apollo 17 scientist astronaut) been watching you since LOI, and he has a few words he wants to give you."

Borman: *"Go ahead."*

Schmitt: *"Typhoid Jack here. We've got some good words here that originated at the Cape (Canaveral) with a bunch of friends of yours. And it's sort of in a paraphrase of a poem that you are probably familiar with. Do you read me Apollo 8?"*

Borman: *"You're loud and clear, Jack."*

Schmitt, *"Okay,*



The Christmas greeting to Cliff Charlesworth's Maroon Team of Flight Controllers was displayed on one of the screens at the front of the Mission Operations Control Room (MOCR).

Image from 16mm NASA footage supplied by Stephen Slater. Enhancement by Colin Mackellar.



The Christmas tree is decorated.

Image from 16mm NASA footage supplied by Stephen Slater. Enhancement of very dark footage by Colin Mackellar.



The Christmas tree stands between the consoles and the display screens at the front of the MOCR.

Image from 16mm NASA footage supplied by Stephen Slater. Enhancement of very dark footage by Colin Mackellar.

*"T'was the night before Christmas, and way out in space
The Apollo 8 crew had just won the Moon race;
The headsets were hung by the consoles with care,
In hopes that Chris Kraft soon would be there;
Frank Borman was nestled all snug in his bed,
While visions of REFSMMATS danced in his head;
And Anders in his couch, and Jim Lovell in the bay,
Were racking their brains over a computer display....*

*When out of the DSKY there arose such a clatter,
Frank sprang from his bed to see what was the matter.
Away to the sextant he flew like a flash,
To make sure they weren't going to crash.
The light on the breast of the moon's jagged crust
Gave a lustre of green cheese to the grey lunar dust.
When what to his wondering eyes should appear
But a Burma Shave sign saying: 'Kilroy was here!'*

*But Frank was no fool, he knew pretty quick
That they had been first... this must be a trick.
More rapid than rockets his curses they came,
He turned to his crewmen and called them a name;
Now Lovell! Now Anders! Now don't think I'd fall
For that old joke you've written up on the wall!*

*They spoke not a word, but grinning like elves,
And laughed at their joke in spite of themselves.
Frank sprang to his couch, to the ship gave a thrust,
And away they all flew past the grey lunar dust.
But we heard them exclaim, ere they flew 'round the moon:
Merry Christmas to Earth; We'll be back there real soon!*

Great job, Gang!"

DSKY is the computer keyboard and REFSMMAT is Reference to Stable Member Matrix or a mathematical means of determining angles using the stars as a reference.

Borman: *"Thank you very much. That was a very good poem, but in order to win the race you have to end up on the carrier."*

Schmitt: *"We'll see you there."*

With the spacecraft cruising quietly back to Earth, the crew were very tired and at 91:11:59 GET (1802:59 AEST) Borman called down,

"We all only got about 2 hours sleep today, max, Ken. We're going now – Bill's going to stay up awhile, and Jim and I are going to sack out, and we're going to try to rotate short sleep cycles till we can get back to the normal one."

Mattingly:

"Roger, sounds like a good idea."

Once, for a moment there was a flurry of excitement when the spacecraft signal dropped out, and Houston switched antennas but there was still no voice from Apollo 8. Then it was discovered Anders had inadvertently unplugged his headset.

Capcom Carr:

"We lost data on you for 15 minutes and voice comm for about 45 and were beginning to get a little twitchy."

With Apollo 8 on its way home, and Borman and Lovell asleep, so ended our Christmas Day at work for 1968.

Listen to the Poem

089:59:00 GET – Read by Harrison Schmitt – affectionately referred to as 'Typhoid Jack' after he fell ill just before the mission. The crew initially, but incorrectly, suspected they had caught whatever he had. Ken Mattingly is Capcom at the beginning of this segment.



512kb mp3 file. Running time – 2m 53s



Watch the reading of the Poem

Here is the same audio synchronised with short segments of silent 16mm film which were taken as the poem was read.



52.58mb mp4 file.
Run time – 2m 44s



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PAGE ONE OF TWO
OPN HCG735

MISSION BRIEFING MESSAGE AS OF 90:00:00 GET
ALL PLANNED LUNAR ORBIT ACTIVITIES, WITH THE EXCEPTION OF ORBIT
8 AND 9 NAVIGATION AND PHOTOGRAPHIC EXERCISES, WERE COMPLETED
AS PLANNED. THE LATTER WERE SCRUBBED TO ALLOW THE CMP AND LMP
TO REST PRIOR TO TEI. HOWEVER, AN EXTENDED TV PASS WAS SUBSTITUTED
DURING ORBIT 9.

THE TV PICTURE, AFTER SWITCHING FROM THE EARTH TO THE LUNAR
LANDSCAPE, WAS INITIALLY SOMEWHAT WASHED OUT. THIS WAS BECAUSE
OF THE FILTERS ON THE CAMERA. THE QUALITY OF THE PICTURE IMPROVED
GREATLY AS THE TERMINATOR WAS APPROACHED, AND WAS OF EXCELLENT
QUALITY AT SIGN OFF.

TEI WAS ACCOMPLISHED AS SCHEDULED. FOR THOSE WHO ARE INTERESTED
IN NUMBERS, HERE IS THE DATA:

GET IGNITION 89:19:15, CUTOFF 89:22:39 VELOCITY CHANGE APPROX
3522 FPS TOTAL BURN TIME 3 MIN 24 SEC.

THERE WAS SOME INITIAL DIFFICULTY IN ACQUIRING TELEMETRY AFTER
TEI, EVEN THOUGH THE HI GAIN ANTENNA WAS IN USE. SIGNAL STRENGTHS
WERE REPORTED AS VERY LOW (MINUS 135 DBM AT HSK AND MINUS 145
DBM AT CRO). THE CREW WAS REQUESTED TO GO TO WIDE BEAM AND

PAGE TWO OF TWO HMSC 25/0837Z

ATTEMPT MANUAL REACQUISITION. SIGNAL STRENGTH PICKED UP TO MINUS
120 DBM AT HSK AND THE ANTENNA WAS SWITCHED BACK TO NARROW BEAM.
THE DSE WAS DUMPED AS BRIEFED AGAIN AND AGAIN (AND AGAIN) AND
WAS WELL EXECUTED. AT THIS TIME HSK IS SENDING BIOMED AND FM/FM
FORMAT PLAYBACKS, AND CRO IS SENDING DUMP DATA. GWM IS SENDING DSE
VOICE PLAYBACK. IN ALL SEVEN SIMULTANEOUS PLAYBACKS ARE BEING
EXECUTED.

A QUICK LOOK AT POST BURN TRACKING INDICATES THAT A MIDCOURSE
CORRECTION OF 2 FEET PER SECOND AT TEI PLUS 3 HOURS WOULD PUT
SPLASH ON THE TARGET LINE. 4 FPS AT THAT TIME WOULD PUT US ON THE
NOMINAL TARGET. (LANDING POINT/POINT CONTROL IS NOT REQUIRED.)
I REPEAT, THIS IS BASED ON A QUICK LOOK.

THE SURGEON REPORTS THAT THE CMDR'S HEART RATE REACHED A PEAK OF
150, COMPARED TO PEAKS OF 130 DURING LAUNCH AND LOI.

AS OF 100:47:47 GET, THE SPACECRAFT WILL BE 175,528 NAUTICAL
MILES FROM THE EARTH, WITH AN EARTH REFERENCED VELOCITY OF 4,176
FPS. BASED ON THIS THE SPACECRAFT WILL REENTER AT 146:50:49 GET.
SPLASH WILL BE AT 147:04:59 GET. WEATHER AT BOTH THE MIDPACIFIC
LINE AND THE ATLANTIC OCEAN LINE IS CURRENTLY GOOD, AND IS EXPECTED
TO REMAIN SO. THE MCC HAS ASSUMED RESPONSIBILITY FOR COMMANDING
ANTENNA SWITCHES. PASSIVE THERMAL CONTROL WAS INITIATED AT 91:15:00.
THE CREW IS TIRED AND WILL BE USING SHORT REST PERIODS TO CATCH UP
AND GET BACK ON SCHEDULE. ONE CREWMAN WILL BE AWAKE.
THAT IS ABOUT THE EXTENT OF THE MISSION NEWS. WELL DONE TO ALL
THUS FAR. KEEP UP THE SAME KIND OF SUPPORT THE REST OF THE WAY.

25/0845Z DEC HMSC

This TWX (Network message) was sent from HMSC - Houston Manned Spacecraft Center,
to the Network on Christmas Day at 0845GMT. Preserved by Bruce Withey.

While such messages were routine, they served to encourage the troops at the various facilities.
The addresses at the top include: DSCC - All supporting Apollo facilities; DSSW - All NASCOM switching
centres; GCEN - Goddard operations; HMOC - Houston Operations, Flight controllers(?);
HNET - Houston Network, IST; etc. With thanks to John Saxon.

HSK MISSION – DAY 6

Thursday, 26 December 1968

Times: AEST (HSK local time)

EVENT	Track Duration	AOS/LOS
TEC - Day 2	10:10:34	1210:35 2221:09

At 98:05:28 GET (0056:28 AEST) there was a short discussion about Santa Claus:

Lovell: *“How was your Christmas, Jerry?”*

Carr: *“Real good, Jim. Santa Claus struck last night before I came here on shift, and I guess we*

will finish off the unwrapping this morning when I get back.”

Lovell: *“Right. He was looking for a chimney here, but he didn’t see any.”*

Carr laughed: *“You could have left the hatch unlocked for him.”*

Lovell: *“I’ll think about that one.”*

Carr: *“Think real hard, Jim. EECOM says he could have slid down the steam duct.”*

Lovell: *“Sounds good. About that time Bill would have been boiling water.”*



Australia from Apollo 8 in this photograph of the Earth taken during Trans Earth Coast. Image: NASA
Carnarvon has clear skies, while the storm that brought snow to Honeysuckle Creek on Christmas Day is still swirling around south-eastern New South Wales. This is an excerpt from a much larger image.

While most of us were resting, at 100:47:47 GET (0338:47 AEST) Apollo 8 cruised quietly back through the equigravisphere, where the Moon's and Earth's gravity zero out and the spacecraft slowed up before gaining velocity to plunge back to Earth. At that point the spacecraft's velocity was 5,309.7 kilometres per hour relative to the Moon, and 4,505.4 kilometres per hour relative to the Earth.

A fifth television broadcast began at 104:24:04 GET (0715:04 AEST) with Borman calling, Mike, we're ready when you are.

Collins: *"Yes, we're ready, Frank. We're all squared away and eagerly standing by. You got your make-up on?"*

Borman: *"Okay. That's right. That's Jim Lovell. What we thought we'd do today was just show you a little bit about life inside Apollo 8. We've shown you the scenes of the Moon, the scenes of the Earth, and we thought we'd invite you into our home. It's been our home at least for four days as you can see on the instrument panel. We mark off each day on the instrument panel. We're four down, and we're working on the fifth day. Of course, we're all looking forward to the landing on Friday.*

Down here in the parts of the spacecraft that we call the Lower Equipment Bay, we have the President's adviser on physical fitness, Captain Jim Lovell, about to undergo an exercise program that we do every day. You notice that he floats around very freely. He just bumped his head on the optics, used for our navigating. He's working with an exercise device that's designed to keep the muscles in shape.

Now another very important function of our spacecraft is the computer, and I thought you might be interested in seeing what we have here, the displays that give us all the information about our burn, about navigating, and about the velocity that we use during entry and retro-fire on earth-orbital missions. You can see it's controlled by a DSKY, or similar to a typewriter keyboard, and the things that go in and out of that are absolutely miraculous. It's done a fantastic job for us, and Jim Lovell has done an excellent job operating it.

Now another very important thing, whether you're in space or the ground, is eating, and I've asked Bill Anders to show you how we eat up here in the flight. Pardon the picture while we move around here and change cameras.

The food that we use is all dehydrated; it comes pre-packaged in vacuum-sealed bags. You notice that all Bill has to do to keep it in one place is let go of it. Except for the air currents in the spacecraft, it would stay perfectly still. He gets out his handy, dandy scissors and cuts the bag. The food is varied, generally pretty good. If that doesn't sound like a rousing endorsement, it isn't, but nevertheless, it's pretty good food. You can see that Bill is very clever. He does things swiftly. Actually, those food bags are stuck together because they've been vacuum packed in plastic."

Lovell:

"What do we have today, Bill, for dinner?"

Anders: *"Well, here we have some cocoa; should be good. I'll be adding about 5 ounces (141.8 grams) of hot water to that. These are little sugar cookies, some orange juice, corn chowder, chicken and gravy, and a little napkin to wipe your hands when you're done. I'll prepare some orange juice here."*

Borman: *"Okay. You can see that he's taking his scissors and cutting the plastic end off a little nozzle that he's going to insert the water gun into. The water gun dispenses a half-ounce burst of water per click. Here we go; Bill has it in now, and the water is going in. I hope that you all had better Christmas dinners today than us, but nevertheless, we thought you might be interested in how we eat."*

Collins:

"Looks like a happy home you've got up there."

Borman: *"Ordinarily, we let these drinks settle for 5 or 10 minutes, but Bill's going to drink it right now. Then, to get on with the program, he cuts open another flap, and you'll see a little tube comes out..."*

Lovell: *"This is not a commercial."*

Borman: *"...and he drinks his delicious orange drink. Maybe I should say he drinks his orange*

drink. He's usually not that fast. Bill is really in a hurry today. Well, that's what we eat.

Now another very important part of the spacecraft is the navigation station or the optics panel. And we – just a minute; Bill wants to say something ...”

Anders: “That’s good, but not quite as good as good old California orange juice.”

Borman: “Bill’s from Florida. Okay, now if you will let me have the camera, Jim, I’ll show the people where you do most of your work.”

Lovell: “I can clean up some of Bill’s food around here and have it away – Down in this area is called the LEB or the Lower Equipment Bay, and we have our optics positioning equipment right here. We do all our navigation down here by sighting on stars and on horizons of either the Moon or the Earth. And this is where we find out exactly where we are in space, what direction, and how fast we are travelling. And our computer, as Frank has mentioned, takes information and tells us how to manoeuvre to get home safely. I work with the scanning telescope and the sextant, and occasionally, if I get too busy, I just sort of float out of sight and go up into the tunnel which is the tunnel to the hatch of the Lunar Module which we don’t have onboard, of course.”

Borman: “Now, that’s about all we have for today. I ... each and every one of us, wish each and every one of you a very Merry Christmas. And I guess we’ll see you tomorrow. We’ll be landing early Friday morning. Merry Christmas from Apollo 8.”

Collins: “Merry Christmas from the ground, Apollo 8, and thank you very much for the guided tour. We really enjoyed it.”

A follow up comment from Lovell

“It appears that we did a grave injustice to the food people. Just after our TV show, Santa Claus brought us a TV dinner each, which was delicious, turkey and gravy, cranberry sauce, grape punch; outstanding.”

Collins: “Roger, Jim. Glad to hear it. Now we’re down here eating cold coffee and bologna sandwiches.”

The return journey was quiet except for one moment. At 105:58:19 GET (0917 AEST on 26 December) Michael Collins was sitting relaxed in the Capcom’s chair in Mission Control when he heard Lovell call,

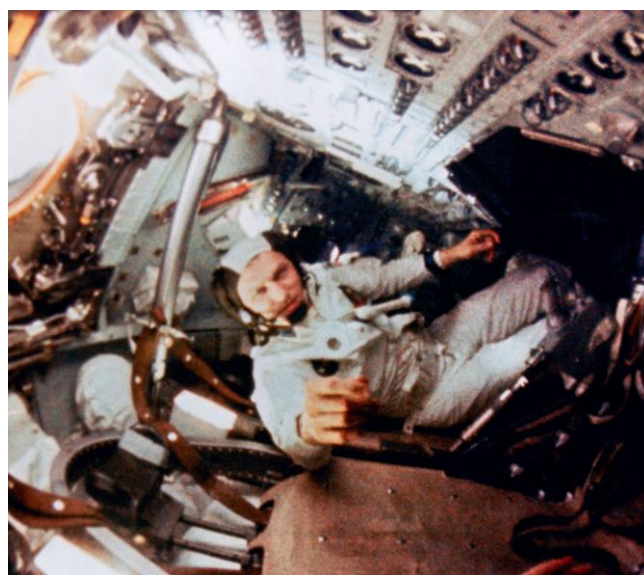
“Whoa, whoa, whoa!”

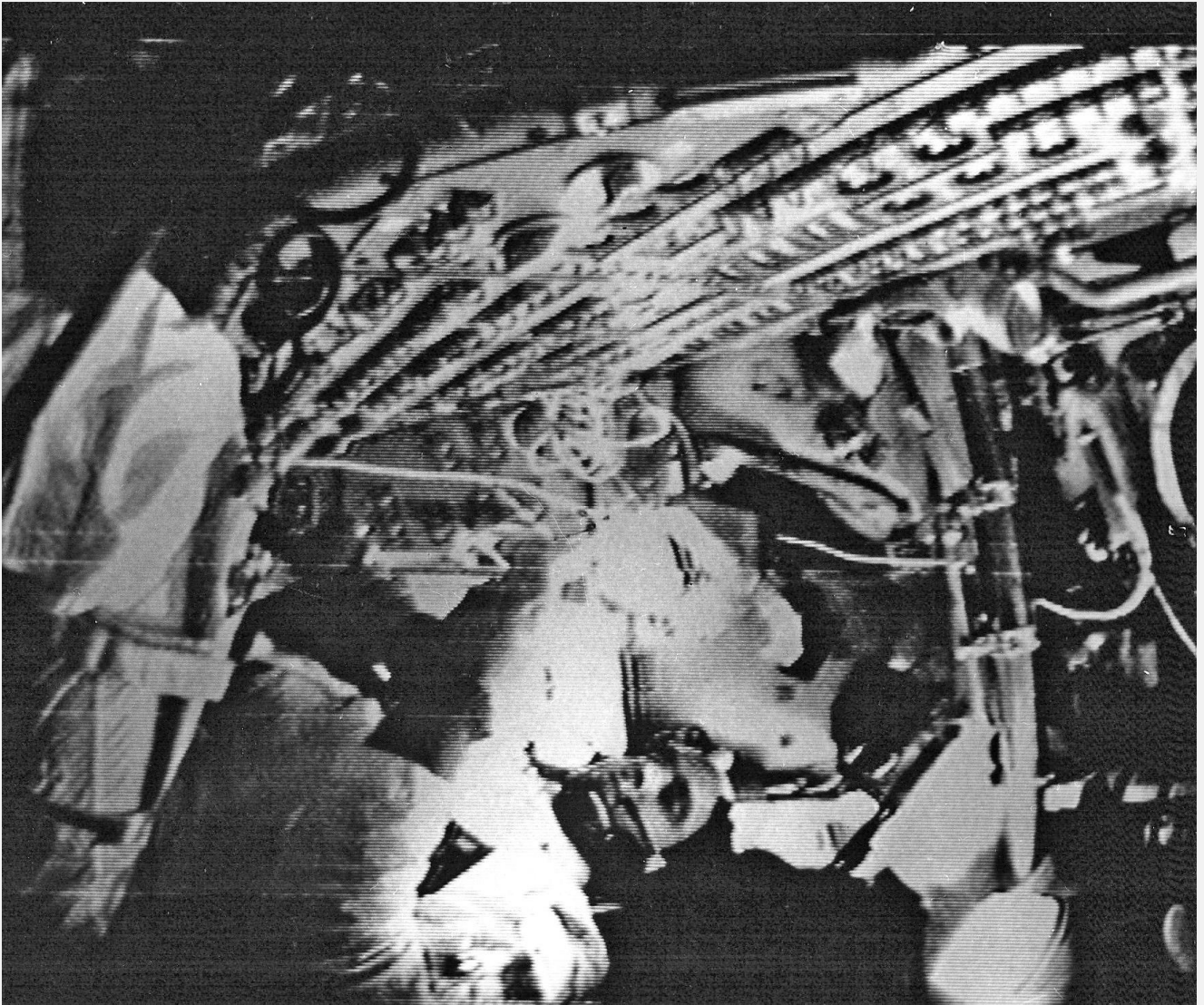
“Okay, whoa, whoa. Standing by,” he replied, wondering what was coming next.

Lovell had accidentally erased all the navigational data from their computer. The IMU (Inertial Measuring Unit) which Borman had insisted they leave running the whole trip so they would not have to do a tedious manual realignment, suddenly did not know which way was up. It reconfigured back to the beginning of the mission and thought it was back on the launch pad, so the attitude computer began firing the thrusters to realign the spacecraft to the new ‘up.’ Anders noticed with alarm that the eight ball indicator was moving more than it should and tried to counteract the movement, but the spacecraft only corrected his instruction. He wondered if they had a stuck thruster. When he figured the thrusters were okay, he let the spacecraft stabilise to what it thought was ‘up’ on the launch pad. This condition couldn’t continue because during re-entry the spacecraft’s heatshield wouldn’t be properly aligned to face the direction of travel.

Lovell had to reset the IMU manually by aligning the spacecraft to the stars Rigel and Sirius and transfer the settings to the computer.

During the quiet periods Houston played a lot of Herb Alpert’s Tijuana Brass on the uplink from Honeysuckle Creek to the astronauts.





Apollo 8 Television. Preserved by Don Witten. Probably taken at Goldstone.

This photo of the slow scan TV monitor, just over six minutes into Apollo 8's 5th television broadcast, shows how good the slow scan picture was. Bill Anders is demonstrating how to prepare a meal.

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#
GGW022A
NN DSOB DSSW GWAB HNET      1968 DEC 26 PM 3 06
DE HMSC 006
26/0359Z
SUB COR HMCP

OPN
APOLLO 8 STATUS REPORT FOR RELEASE BY STADIRS & DOD PERSONNEL.
THE APOLLO 8 CREW PERFORMED A SMALL MID-COURSE CORRECTIVE BURN
TODAY. THEN, A FEW MINUTES LATER THEY TOOK HUNDREDS OF MILLIONS
OF TELEVISION VIEWERS ON A TOUR OF THEIR SPACECRAFT. MRS. BILL
ANDERS, WATCHING THE TV TRANSMISSION FROM MISSION CONTROL IN HOUSTON
WATCHED HER HUSBAND EAT HIS CHRISTMAS DINNER 165,000 MILES FROM
EARTH.
ON-BOARD SYSTEMS CONTINUED TO PERFORM IN A COMPLETELY TROUBLE-FREE
WAY.
DEC. 25, 1968 5:30 P.M. CST

26/0404Z DEC HMSC
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TWX - 0359Z 26 December 1968. Report of a TV show on the way home.

Preserved and scanned by Brian Riehle.

HSK MISSION – DAY 7

Friday, 27 December 1968

Times: AEST (HSK local time)

EVENT	Track Duration	AOS/LOS
TEC – Day 3	--:--:--	----:-- ----:--

When we picked up Apollo 8 for the last time there was a peculiar twist due to the Earth turning under the slowing spacecraft.

We lost Apollo 8 in the west with a handover to Carnarvon who then handed over to Madrid who handed over to Guam for the final minutes of flight and the fall to Earth.

The final television show began with a rehearsal at 127:45:33 GET (0636:33 AEST) with the Earth 182,164.6 kilometres away. By now they were speeding up and were travelling at a speed exceeding 6,583 kilometres per hour.

The show began at 128:00:00 GET (0651:00 AEST) with the Earth showing South America:

Lovell: "At the tip of South America there is a great swirl of clouds there. It looks like a great storm. I wonder if you can see it?"

Carr: "Roger, we see a large swirl just south of the terminator."

Lovell: "And then up to the left hand side, or towards the north, we can see the light waters around the West Indies, and we can actually see Florida. I'm looking through Bill's monocular, and I can see the various land masses, South America and the central part and southern part of the United States."

Anders: "As I look down on the Earth here from so far out in space, I think I must have the feeling that the travellers in the old sailing ships used to have: going on a very long voyage away from home, and now we're headed back, and I have



AWA Technician Tom Lysaght at the Receiver/Exciters at Carnarvon USB during Apollo 8.
Photo 8526 from the Tidbinbilla archives. Scan by Colin Mackellar.

that feeling of being proud of the trip, but still – still happy to be going back home and back to our home port. And that’s – that’s what you’re seeing right here.”

Borman ended the six minute show with,

“This is Frank Borman. We’ve enjoyed the television shows, and we’d like you to stay tuned in, in the future, because there’ll be flights and rendezvous and Earth orbit; and then, of course, there’ll be television from the lunar surface itself in the not too far distant future. So, until then, I guess this is the Apollo 8 crew signing off, and we’ll see you back on that good Earth very soon.”

Carr: *“Roger, Frank, adios.”*

Shortly after the television broadcast Frank Borman announced,

“I say we are starting to stow the spacecraft and get all squared away and then be eating and sleeping. We’ll all be thinking about entry from now on.”

HSK MISSION – DAY 8		
Saturday, 28 December 1968		
Times: AEST (HSK local time)		
EVENT	Track Duration	AOS/LOS
Splashdown	--:--:--	----:-- ----:--

While the tracking stations were busy following the spacecraft in the darkness below, the astronauts were getting ready for their spectacular re-entry. They had cast off the Service Module (SM) at 46:28:48 GET (0119:48 AEST) and were settling in their couches preparing for a rough ride.

Borman (onboard): *“Well, men, we’re getting close.”*

Anders: *“There’s no turning back now.”*

Lovell: *“Old Mother Earth has us.”*

“It’s getting a little hazy out there,” Bill Anders spoke thoughtfully as he saw a strange glow outside the window, *“Every time you fire a thruster.”*

Their first thought was sunrise, but it was the spacecraft entering the initial wisps of the Earth’s atmosphere at 39,744.7 kilometres per hour and

a glowing ionised plasma began to wrap itself around the Command Module as it dipped into the thickening air at 146:46:13 GET (0137:13 AEST).

Borman: *“That’s the airglow we are starting to get – that’s what it is, gentlemen ... God damn, this is going to be a real ride – hang on!”*

Moments later the communications blackout began. The spacecraft then skimmed out of the atmosphere to cool off for a few moments, before plunging back for the final descent to the ocean below. They were still weightless.

Borman was watching his instrument panel,

“Got it – O five G – Hang on.”

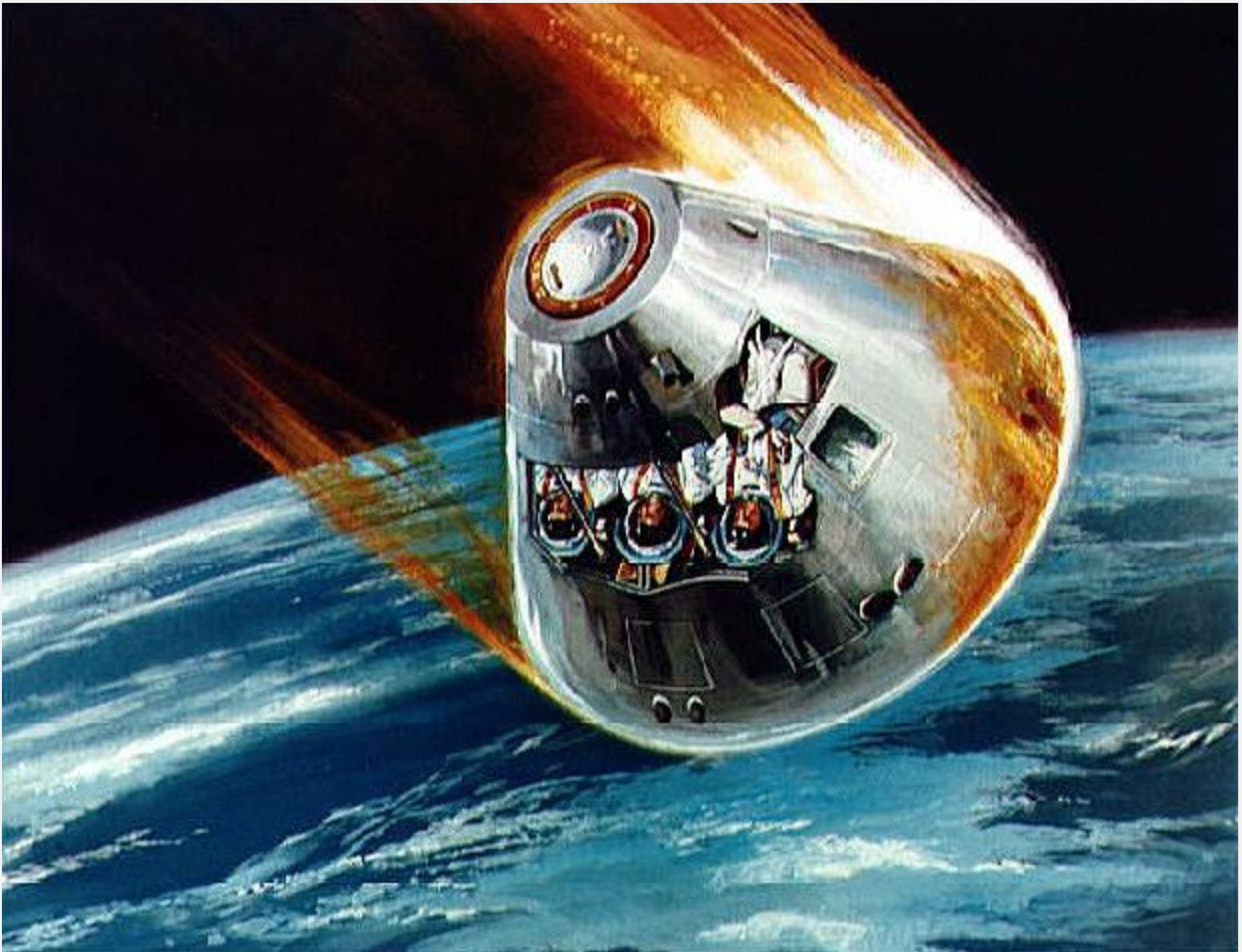
They were now biting into the atmosphere, and the G forces were climbing rapidly until they were groaning with the unaccustomed weight of 6.8 g’s feeling like a ton of bricks pressing on them. A white neon-like light filled the cabin, bathing them in an eerie glow. Outside the window they could see small flaming objects whipping past, mixed with some quite large chunks of burning material. Hurtling through the air at 1,098 kilometres per hour, the heat shield was shedding its honeycombed epoxy at a temperature of 5,000 degrees C, while inside the cabin the astronauts were feeling a comfortable room temperature.

Travelling at 39,635 kilometres per hour it had to enter the Earth’s atmosphere at an angle of 6.5 degrees from the local horizon, with a safe corridor only 42 kilometres wide, this only allowed an error of 1 degree either way.

At 9,000 metres, around the height of Mount Everest, the parachute canister cover blew off, and three small drogues popped out to whip madly in the slipstream. A loud hiss told the astronauts the air vent had opened to allow fresh air to enter the cabin and equalise the pressures.

At 146:55:39 GET (0146:38 AEST) at a height of 3,000 metres, the three main parachutes burst out to slow the spacecraft to about 30 kilometres per hour, and the first voyage to the Moon was over as Apollo 8 now drifted steadily down to the sea.

The return was a triumph for the trajectory boys – in the pre-dawn darkness 1,800 kilometres south west of Hawaii Apollo 8 flew right over the



North American Rockwell Artist's impression of the CM during re-entry. Image: NASA/Rockwell
Travelling at 39,635 kilometres per hour it had to enter the Earth's atmosphere at an angle of 6.5° from the local horizon, with a safe corridor only 42 kilometres wide, this only allowed an error of 1° either way.



Apollo 8 Re-enters the Earth's atmosphere. Image: NASA/ARIA
This image was taken from a KC-135 (using the ALOTS pod from an ARIA) along the re-entry corridor. The bright object at top is either the Command Module or the Service Module.



The Apollo 8 Command Module descends under main parachutes. Image: NASA

recovery aircraft carrier Yorktown and landed a mere 4.2 kilometres beyond at 147:00:42 GET (0151:42 AEST). The weather was good with 1.8 metre waves from the east south east and a 19 knot breeze from the north east.

A Pan-Am commercial jet flying to Sydney was witness to the fiery re-entry of the Command Module. The return journey had taken 57 hours 23 minutes and 32 seconds.

The whole Apollo 8 mission took 147 hours and 42 seconds to cover a distance of 933,419.1 kilometres.

John Saxon: "In Apollo 8 at Honeysuckle Creek, we were the prime station in view when they first disappeared behind the Moon, and when they appeared from behind the Moon. We were also the prime station when they entered the Earth's atmosphere."

At Mission Control the trajectory specialists and computer whizz kids were ecstatic as they now had accurate measurements of the real orbit

around the Moon and their math models were all corrected with live data.

In the MSFN Post Mission Report the tracking network results were excellent. Operator errors were minimal, with only one station reporting four errors. Two recurring equipment failures were reported, one involved a printed circuit board and the other pen failures on chart recorders. There were no Telemetry or Command losses during the Trans Lunar Coast, Lunar Orbit, and Trans earth Coast at HSK. The only computer problems were in the 29-point Acq messages with checksum errors, garbled messages, line errors and late arrival of messages on station.

After the successful return to Earth of Apollo 8, as a gesture of thanks for our disrupted Christmas the American Ambassador in Australia, Mr Edward Crook, threw a big party at the American Embassy in Canberra for all the station staff and their families on Saturday 8 February 1969.



A jubilant Apollo 8 crew on the USS Yorktown. Image: NASA
Frank Borman speaks into the microphone while William Anders and James Lovell watch.

After Apollo 8, Borman decided to resign from the astronaut corps,

"I thought I had carried my end of the bargain. I'd contributed as much as I could. I wasn't a pro on the LM ... I would not have gone to the Moon after the first one (Apollo 11). To me it wasn't worth it."

When asked did he look up at the Moon differently to the rest of us, he answered,

"Sometimes I do. I try to. I try to feel like everybody thinks I should, which is awe, 'I can't believe I was really there.' But most often I find I just revel in the beautiful Moon."

With a successful Apollo 8 now behind us, all the Apollo team's energies were directed to getting onto the Moon's surface.

But first the LM had to be checked out in Earth orbit. That was to be our next Apollo mission.

Chris Kraft, *"From Apollo 8 we really knew what we were doing. It was the boldest decision we made in the whole space program – period."*

Flight Director Glynn Lunney probably summed it up best with,

"Apollo 8 was the decision which opened the gate and let us slide down the hill to the Apollo 11 landing."

Essay by Hamish Lindsay

Hamish's personal interview with Chris Kraft.

Images, illustrations and captions by Hamish Lindsay, Colin Mackellar, and Glen Nagle.

The Apollo 8 mission patch for the online version was recreated by Syd Buxton.

Unless noted, the Audio files were recorded at Honeysuckle by Station Admin officer Bernard Scrivener.

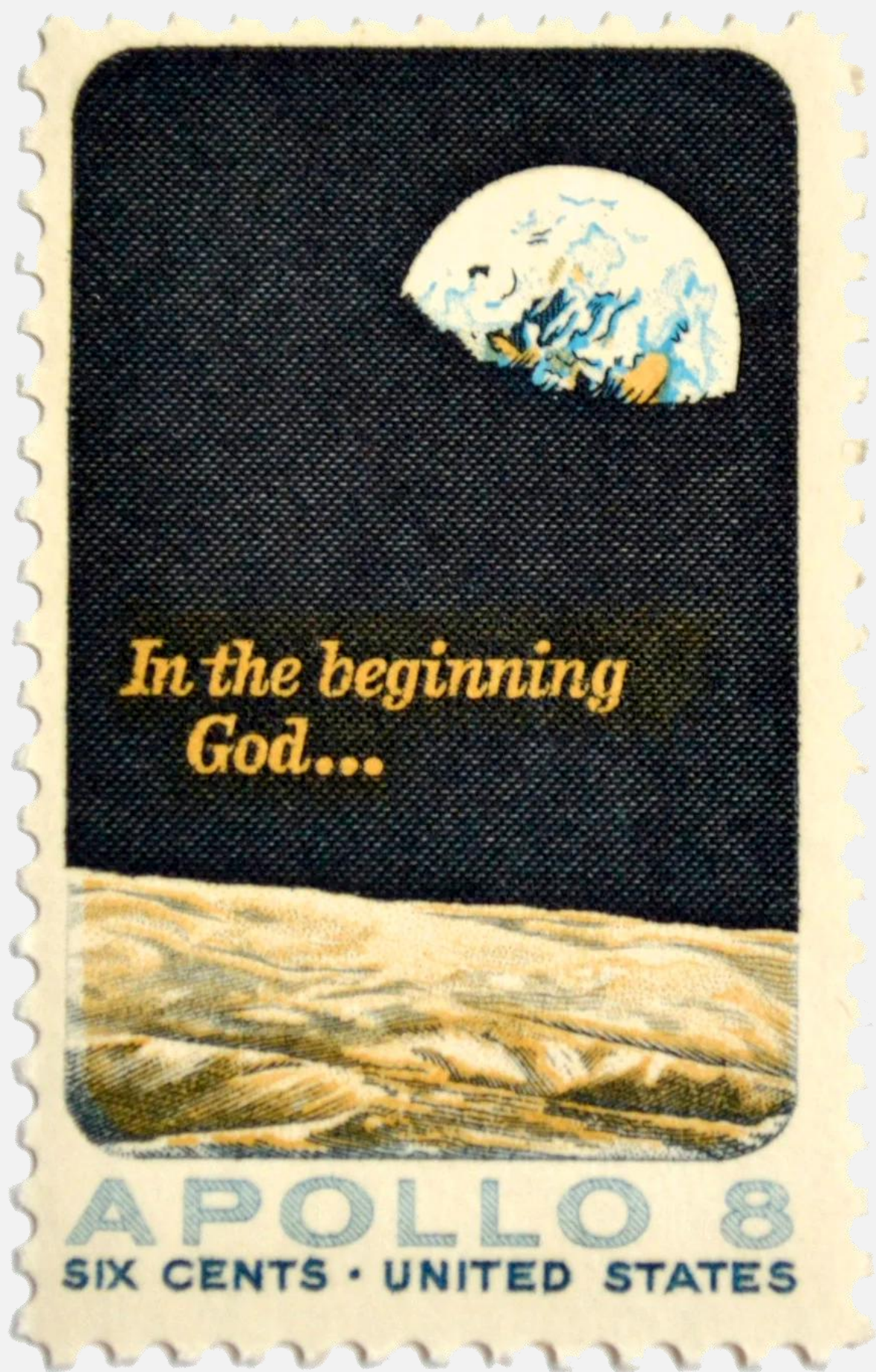
With thanks to Mrs Rosemary Scrivener and Hamish Lindsay for preserving these tapes.

Digitised by Mike Dinn or Colin Mackellar, and processed, edited and annotated by Colin Mackellar.

PDF formatted by Glen Nagle.

PDF formatted by Glen Nagle.

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Apollo 8 postage stamp. Source: Hamish Lindsay

This US postage stamp was released to commemorate the Apollo 8 mission.

ACRONYMS

Official acronyms used in this text:

AEST	Australian Eastern Standard Time
ACN	Ascension Island Tracking Station <i>- in the south east Atlantic Ocean</i>
Acq	Acquisition – <i>of spacecraft signal</i>
ALSJ	The Apollo Lunar Surface Journal <i>- every word spoken on the Moon</i>
ALSEP	Apollo Lunar Scientific Experiments Package <i>- equipment left behind by the astronauts to measure physical characteristics of the Moon</i>
AOS	Acquisition of Signal <i>- from the spacecraft (downlink)</i>
APP	Antenna Position Programmer <i>- computer controlling the antenna</i>
Capcom	Capsule Communicator <i>- the voice of Mission Control, always an astronaut</i>
CRO	Carnarvon Tracking Station <i>- Western Australia</i>
CM	Command Module
CSM	Command and Service Module
DOWNLINK	Receive - <i>signal sent from the spacecraft back to tracking stations on Earth</i>
DSKY	<i>Guidance computer keypad</i>
DSS	Deep Space (tracking) Station
GDS	Goldstone Tracking Station <i>- in California, USA</i>
GET	Mission Ground Elapsed Time <i>- time in hours/minutes/seconds from the moment of launch</i>
GWM	Guam Tracking Station <i>- northwest Pacific Ocean</i>
HSK	Honeysuckle Creek Tracking Station, <i>Canberra, Australia</i>
HSKX	Canberra Deep Space Communication Complex <i>- Tidbinbilla, also called the Wing</i>
IU	Instrumentation Unit <i>- electronic system part of the Saturn IVB rocket</i>
JPL	Jet Propulsion Laboratory <i>- Pasadena, California, USA</i>
LM	Lunar Module
LOI	Lunar Orbit Insertion
LOS	Loss of Signal - <i>from the spacecraft</i>

ACRONYMS

Official acronyms used in this text:

LOX	Liquid Oxygen
MAD	Madrid Tracking Station <i>- Robledo de Chavela, Spain</i>
MOCR	Mission Operations Control Room <i>- Houston, Texas, USA</i>
MESA	Modular Equipment Stowage Assembly - <i>part of the LM</i>
MSFN	Manned Space Flight Network <i>- worldwide network of tracking stations for human spaceflight</i>
NASA	National Aeronautics and Space Administration
NET-1	<i>Phone line between Mission Control, Capcom and astronauts in their spacecraft</i>
OMNI	Omni-directional antennas <i>- multiple antennas around the spacecraft</i>
PGNS	Primary Guidance and Navigation System
PSI	Pounds per square inch - <i>pressure</i>
PTC	Passive Thermal Control <i>- spinning the spacecraft to even temperatures around it</i>
RCS	CSM Reaction Control System <i>- controlling spacecraft attitude</i>
REFSMMAT	Reference to Stable Member Matrix <i>- a mathematical means of determining navigation angles using the stars as a reference</i>
S-IC	Saturn IC - <i>first stage of the Saturn V booster rocket</i>
S-IVB	Saturn IVB - <i>third and final stage of the Saturn V launch rocket</i>
SAS	Space Adaption Syndrome <i>- space sickness</i>
SPS	Service Propulsion System <i>- Service Module rocket motor</i>
SRT	Site Readiness Test <i>- tracking station equipment tests before each group of passes</i>
STADAN	Satellite Tracking and Data Acquisition Network
STDN	Satellite Tracking Data Network

ACRONYMS

Official acronyms used in this text:

TEC	Trans Earth Coast <i>- the voyage back to Earth</i>
TEI	Trans Earth Injection <i>- the rocket motor burn to send Apollo back to Earth</i>
TLC	Trans Lunar Coast <i>- the voyage out to the Moon</i>
TLI	Trans Lunar Injection <i>- the rocket motor burn to send Apollo off to the Moon</i>
VAB	Vehicular Assembly Building <i>- located at the Kennedy Space Center, Florida USA</i>
UPLINK	Transmit - <i>signal sent from the tracking station up to the spacecraft</i>
USCDT	US Central Daylight Saving Time <i>- also spacecraft time</i>
USEDT	US Eastern Daylight Saving Time
UT/UTC	Coordinated Universal Time <i>- aka Universal Time, or Greenwich Mean Time (GMT)</i>

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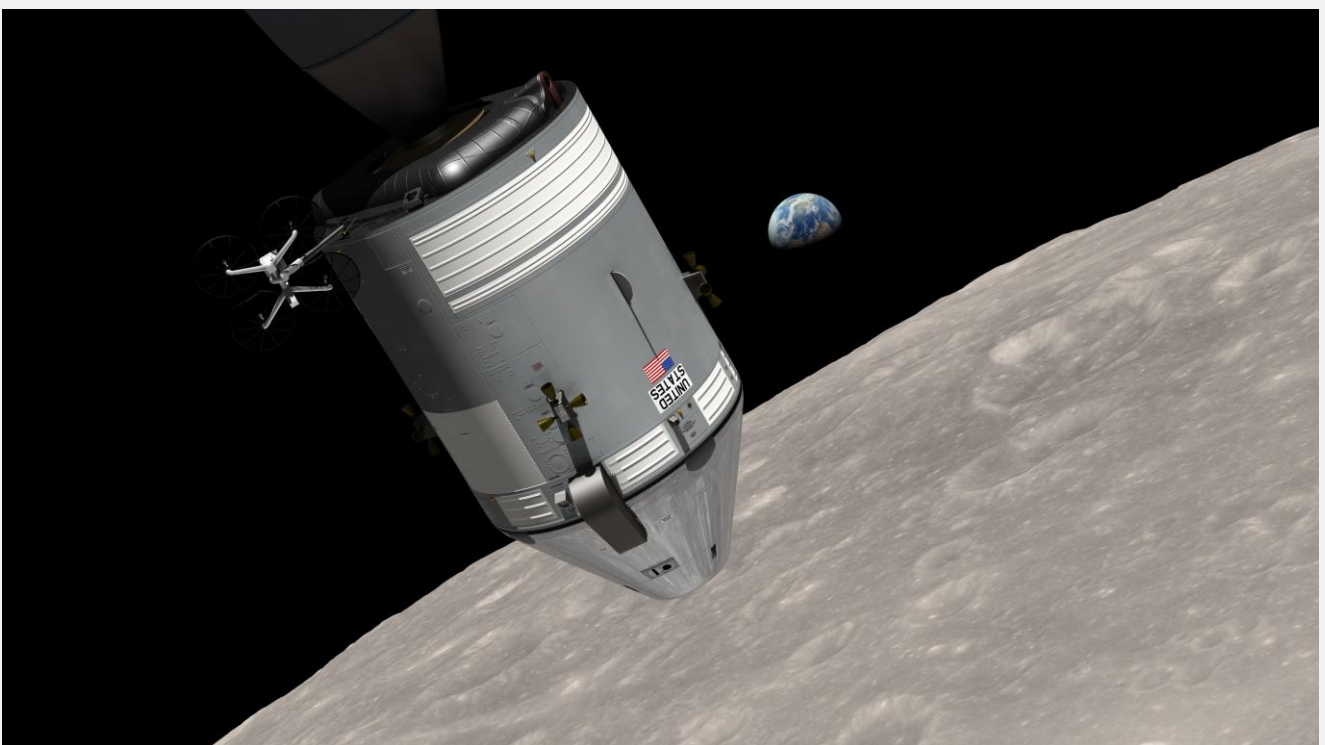
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Quotations used with permission.





ABOUT THE AUTHOR

Hamish Lindsay worked at the Muchea, Carnarvon, Honeysuckle Creek space tracking stations between 1963 and 1981.

He has written many essays on the history of human spaceflight and is the author of the book *Tracking Apollo to the Moon*.

