APOLLO 17

7 - 19 DECEMBER 1972

an essay by

HAMISH LINDSAY

"And, as we leave the Moon at Taurus-Littrow,
we leave as we came and, God willing, as we shall return,
with peace and hope for all mankind.
God speed the crew of Apollo 17."

Eugene Cernan

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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 17 mission is based on the story in Hamish Lindsay's "Tracking Apollo to the Moon," and includes tables listing key activities and times, plus tracking times, duration, and handovers at Honeysuckle, Tidbinbilla and Parkes.

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 Daylight Time (AEDT, GMT +11), 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 17 CREW

Harrison H. Schmitt, Eugene A. Cernan, and Ronald E. Evans. Image: NASA/KSC

AS-512/CSM-114/LM-12/LRV3 J-3 mission NCG 742 742

PRIME CREW

Commander: Eugene A. Cernan
Command Module: Ronald E. Evans
Lunar Module Pilot: Harrison H. Schmitt

BACK-UP CREW

Commander: John W. Young
CM Pilot: Stuart A. Roosa
LM Pilot: Charles M. Duke Jr

SPACECRAFT

Command Module: **AMERICA** CSM-114
Lunar Module: **CHALLENGER** LM-12
Saturn V: SA-512

Note: The indented text in *italics* in this essay are excerpts from interviews by Hamish Lindsay with NASA astronauts and personnel, along with other comments, including air-to-ground conversations.

Mission Fact Box

Launch
Launch Complex – 39A, Cape Kennedy
Thursday, 7 December 1972
0033:00 US EST / 0533:00 UTC
[Thursday, 7 December 1972, 1633:00 AEDT]

Mission duration
12 days, 12 hours, 51 minutes, 59 seconds

Lunar orbit insertion
10 December 1972, 1953:55 UTC

Lunar orbital data
Lunar orbit (elliptical) – 315.6 x 107.7 kms
Lunar orbit (circular) – 122 x 100 kilometres
Orbits – 75 in 6 days 3 hours 48 minutes

Landing data
Landing site – Taurus–Littrow
20.18809°N, 30.77475°E
Landing – 11 December 1972, 1954:58 UTC

Extra Vehicular Activities (EVAs)
Total EVAs – 3 on lunar surface; 1 in space
First EVA – 7h 11m 53s
Second EVA – 7 h 36m 56s
Third EVA – 7h 15m 8s
Lunar rover distance: 35.7 kilometres
Samples collected: 110.52 kilograms
Cislunar EVA: 1h 5m 44s

Lunar Module ascent, docking and undocking
Launch – 14 December 1972, 2254:37 UTC
Docking – 15 December, 0110:15 UTC
Undocking – 15 December 1972, 0451:31 UTC

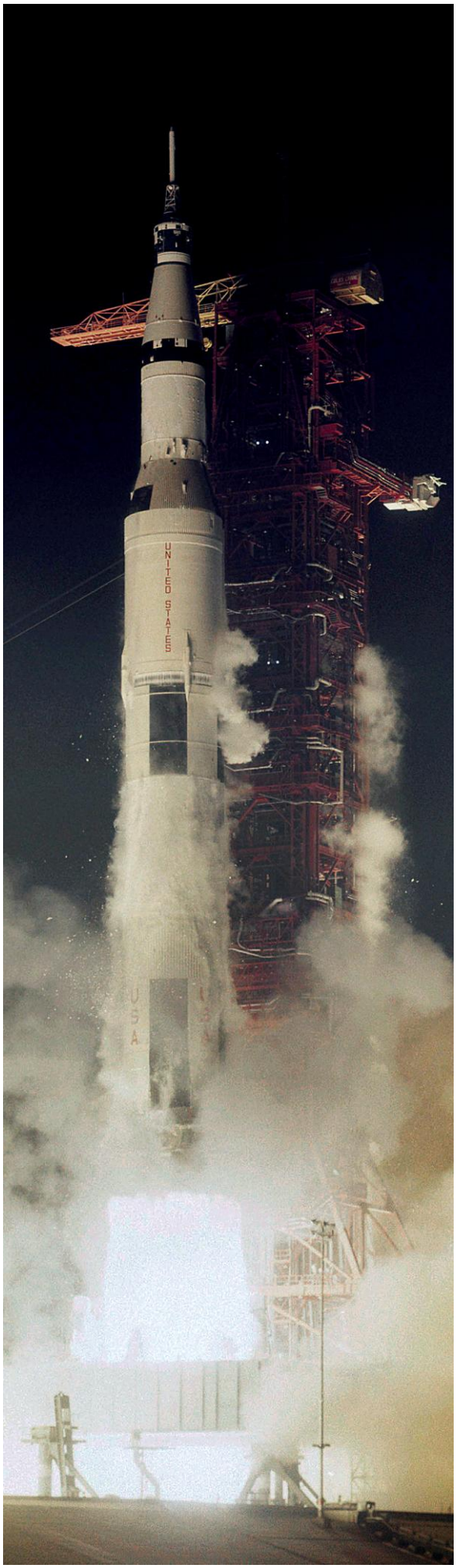
Lunar orbit departure
CSM – 16 December 1972, 2335:09 UTC

Splashdown
CM – 19 December 1972, 1924:59 UTC
South Pacific Ocean, 17.88°S 166.11°W
Recovery ship: USS Ticonderoga

ONLINE CONTENT – AUDIO, VIDEO, WEB

Click the icons or scan the QR code using your phone or tablet. **An internet connection is required.**

LISTEN WATCH WEBSITE	Click these icons for a direct link to the audio or video files, website or webpage content.
	Scan the QR icon with your phone or tablet for audio or video files, website or webpage content.



The Apollo 17 crew – Schmitt, Cernan, and Evans. Image: NASA/KSC

Apollo 17

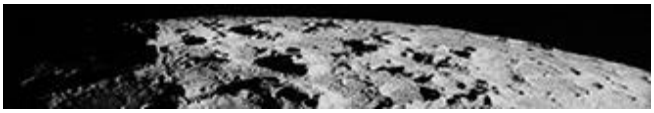
Originally this mission was planned as Apollo 18, when there were to be 20 Apollo missions. But with savage budgetary cutbacks prompted by lack of Congressional support and fear of another, perhaps fatal, Apollo 13, Apollo 18 was cancelled – along with Apollos 19 and 20 – and in September 1970 became Apollo 17 – the last Apollo mission to the Moon.

Deke Slayton, the Chief Astronaut, looking at the crew for this mission decided to choose the backup crew from Apollo 14, sticking to his system of rotating the crews. So, he submitted Gene Cernan, Ron Evans, and Joe Engle to NASA HQ for approval. It was rejected. With Apollos 18, 19, and 20 being cancelled, just about everyone of influence thought that a scientist should go on the last Apollo flight.

Prime candidate was geologist Harrison 'Jack' Schmitt, who had joined the Apollo team and began flight training in July 1965, and a year later moved into the astronauts' offices where he acted as an interface between the flight teams on one side and the geologists on the other. He also helped develop tools for lunar exploration and the ALSEP scientific package, as well as being involved in training the astronauts.

Schmitt's allocation as backup LM pilot on the Apollo 15 mission had put him in the Apollo 18 prime crew until Apollo 18 was cancelled. So, Slayton resubmitted his selection as Cernan, Commander, Evans as CM pilot and Schmitt as Lunar Module pilot, saying,

> *"I bit the bullet and dropped Joe Engle off and replaced him with Schmitt. I hated having to explain that to Joe, but he sort of realised it was out of my hands. He took it better than I would have."*



The Apollo 17 Crew – *Schmitt, Evans and Cernan.*

Commander
Eugene Andrew Cernan, U.S. Navy

A Commander in the US Navy, 38 year old Eugene Andrew Cernan was born on 14 March 1934. A native of Chicago, Illinois, his father was a Slovak and his mother a Czech. He grew up in the towns of Bellwood and Maywood. He attended the Proviso Township High School in Maywood, Illinois. In 1956 he graduated from Purdue University with a Bachelor of Science degree in Electrical Engineering and became a Naval Aviator flying jets. He received a Master of Science degree in Aeronautical Engineering from the Naval Postgraduate School in Monterey, California in 1963.

After logging more than 5,000 hours flying time, 4,800 in jets, with over 200 aircraft carrier landings, Cernan was selected among the third group of 14 astronauts on 14 October 1963. He was trained as a backup pilot for Gemini 9 with Tom Stafford, but when the prime crew of Elliot See and Charles Bassett were killed in an aircraft crash on 28 February 1966, they became the prime crew, and Cernan chalked up a record for walking around the world in America's second spacewalk, logging 2 hours and 7 minutes outside the spacecraft. He was backup pilot for Gemini 12 and backup LM pilot for Apollo 7. Before he was assigned to Apollo 17, he flew to the Moon as the LM pilot in Snoopy with Tom Stafford in Apollo 10, reaching within 14,300 metres of the surface of the Moon, almost following the same trajectory as Armstrong and Aldrin took two months later. Cernan was assigned to the Apollo 14 backup crew as Commander with Ron Evans as CM pilot and Joe Engle as LM pilot. He is the only Apollo astronaut to have trained as both a LM pilot and Commander.

Among his awards are two NASA Distinguished Service medals; the NASA Exceptional Service medal and the Johnson Space Center Superior Achievement Award; two Navy Distinguished Service medals, the Navy Distinguished Flying Cross; induction into the US Space Hall of Fame as well as the Slovak World Recognition Award and Slovak Presidential Medal of Honour.

He retired from the Navy and NASA in 1976 and went into private business.

One evening in a Houston restaurant during the Gemini Program, rocket genius Wernher von Braun was talking to a group of rookie astronauts and suddenly fixed his gaze on one of them and said, *"You are going to need mobility on the lunar surface. We will provide a car."* The idea seemed so farfetched at the time, as they were still trying to learn how to handle a spacecraft in Earth orbit, that the rookie never thought it would happen, and simply couldn't imagine driving a vehicle around the Moon's surface. But it did happen, and that rookie astronaut did drive a car around the lunar surface fast enough to hold the speed record of 18 kilometres per hour. That rookie astronaut was Gene Cernan.

Commander
Ronald Ellwin Evans, Jr., U.S. Navy
Also, a Commander in the US Navy, 39 year old Ronald Ellwin Evans, Jr. was born in St Francis, Kansas, on 10 November 1933. He was an Eagle Scout, a maths whiz and an all-round athlete. He graduated from Highland Park High School in Topeka, Kansas, before obtaining his Bachelor of Science degree in Electrical Engineering from the University of Kansas in 1956, and a Master of Science degree in Aeronautical Engineering from the US Naval Postgraduate School in 1964.

Evans and Cernan studied together at the Navy's Postgraduate School at Monterey, California, when Cernan learned that NASA had accepted him, and Evans was told he had been rejected. Evans remembered, *"That night Gene and I went out and got totally sloshed."*

Evans flew 100 carrier missions in the South China Sea from the carrier USS Ticonderoga before being selected by NASA as one of 19 pilot/astronauts on 4 April 1966. He served as a member of the Support crew for Apollo 7 and 11 flights, and as backup CM pilot for Apollo 14.

He was presented with the Navy Distinguished Service Medal and the NASA Distinguished Service medal in 1973; the Johnson Space Center Superior Achievement Award in 1970 and Kansan of the year award 1972. To these can be added 8 Air Medals; the Viet Nam Service Medal; the Navy Commendation Medal with combat distinguishing service in 1966 and the University of Kansas Distinguished Service Citation in 1973.

Evans was one of the 19 astronauts selected by NASA in April 1966 and served as the astronaut support crews for the Apollo 7 and 11 flights and back up CM Pilot for Apollo 14. He holds the record of more time in lunar orbit than anyone else.

After the Apollo 17 mission he was backup CM Pilot for the Apollo-Soyuz (ASTP) mission.

He retired from NASA in March 1977 to become a coal industry executive and died in Scottsdale, Arizona, aged 56, on 7 April 1990 of a heart attack.

Doctor
Harrison Hagan 'Jack' Schmitt
Dr. Harrison Hagan 'Jack' Schmitt PhD., aged 37 years, was born on 3 July 1935 in Santa Rita, New Mexico. He attended Western High School, Silver City, New Mexico, in his spare time visiting mining camps, Indian Reservations and went on rock hunting forays into the deserts of the southwest. He earned a Bachelor of Science degree from the California Institute of Technology in 1957. He studied at the University of Oslo in Norway during 1957/1958 and received his Ph.D. in geology from Harvard University in 1964.

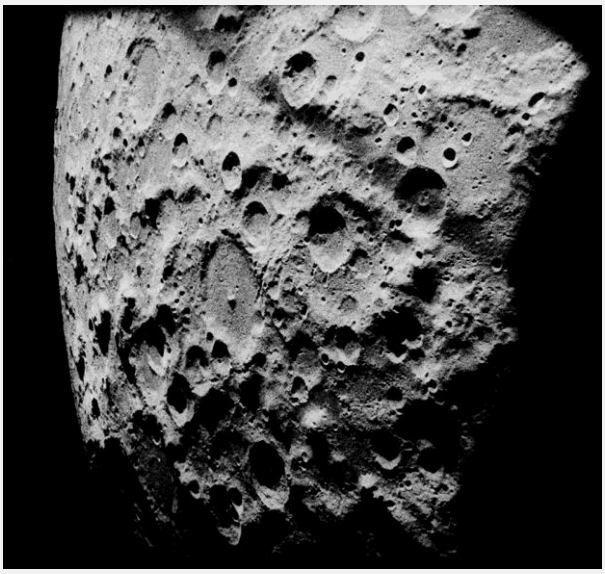
He ranked second in his class of 50 at Air Force flight school and logged more than 2,100 hours flying time, 1,600 in jet aircraft. Schmitt was selected as a scientist/astronaut by NASA in June 1965. He is the only astronaut to have walked on the Moon who wasn't a member of the US armed services.

In July 1973 Schmitt was appointed as one of the first Sherman Fairchild Distinguished Scholars at the California Institute of Technology, extended to July 1975.

In August of 1975, Dr. Schmitt resigned his post with NASA to run for the United States Senate in his home state of New Mexico. He was elected on 2nd November 1976, defeating the incumbent Joseph Montoya 57% to 42% of the votes cast. He served for one term, becoming a ranking Republican member of the Science, Technology, and Space Subcommittee.

As well as being a consultant, corporate director, freelance writer and speaker on space, science, technology and public policy, in 1994 he was appointed an Adjunct Professor of Engineering at the University of Wisconsin.

See a list of Dr Harrison Schmitt's awards at the end of this document.



Questions about the Moon

Before they left Cernan announced he wasn't going to let Schmitt do all the geological work, *"I'm too proud an individual to let that happen because I figure I am just as good a geologist on the Moon as Jack, and if he didn't feel he was just as good a pilot as I am, I'd be disappointed."* They worked a lot together during their training and he felt they were a good team. Cernan never hesitated to disagree with Schmitt when they differed in opinions, feeling they complemented each other with their backgrounds.

With the last Apollo mission about to go, scientists still had many questions to be answered. The magazine Aviation Week & Space Technology of 21 February 1972 list some of them:

1. Had the Moon's interior been molten once but thermally inactive for billions of years?
2. How were the great lunar basins formed?
3. What event between 3.2 and 3.5 billion years ago triggered the cratering phase of the Moon's history?
4. Were cones noticed during the Apollo 15 mission cinder cones of volcanic origin, or just of a similar appearance?
5. Is there is evidence of water on the Moon?
6. What is the explanation for the differences in ages of samples taken from different areas of the Moon?

Site Selection

With Apollo 17 the last manned flight to the lunar surface for the foreseeable future, the choice of where to land and explore was critical to the geologists. Lava upwelling was understood, which had flooded most of the basins over the ensuing half billion years, but the main objective now was to find evidence of later volcanism. There were three final candidates, Taurus-Littrow, Alphonsus, a 111 kilometre crater that appears to have volcanoes in its floor, and Gassendi, a 93 kilometre crater with a central peak. Jack Schmitt had proposed a landing on the far side using communications satellites, which had actually been costed, but was vetoed on the grounds of expense.

Gassendi was dropped as NASA thought it was potentially too hazardous for operational reasons and Taurus-Littrow was favoured by the geologists for the geologic variety of the valley and the possibility of collecting dark soil and lavas dug out by lunar impacts. The valley is covered by a dark, fine-grained mantle that has no large blocks or boulders, and is pock marked by small, dark halo craters thought to be volcanic vents near the landing site. It looked as though the south eastern rim of Serenitatis would provide both ancient and young lurain.

It was Al Worden, the CM Pilot from Apollo 15, who set the seal on Taurus-Littrow. While orbiting the Moon he had seen the dark halo craters that looked like cinder cones scattered over the region's brighter surfaces, particularly Shorty Crater. Many of the geologists believed these were cinder cones, and streaks on the Massifs suggested they were volcanic vents. A landslide on South Massif promised to bring the mountain's material within collecting range. The selectors examined a variety of sites along the eastern arc, where it was flooded by the dark mantle. It is also near one of the largest known Mascons. Intensive studies of specially enlarged Apollo 15 photographs from orbit were conducted before the site was finally chosen and announced to the public during February 1972, before Apollo 16 set forth. It was also hoped that rocks both older and younger than previous missions would be found.

Major objectives of the mission were to observe and sample:

1. The highlands
2. The dark mantle
3. The sub-floor material

Flanked by mountains of 2000 metres plus on either side, the Taurus-Littrow valley is an open fracture through the eastern rim of the Mare Serenitatis basin. This mare was probably created

by a large object, a planetesimal, travelling at nearly 11,000 kilometres per hour, colliding with the Moon some 3.9 billion years ago. The collision fractured rocks to a depth of nearly 25 kilometres and brought material to the lunar surface, scattering debris around the rim. Later volcanic eruptions filled the basin with lava, some flowing into the Taurus-Littrow valley floor. As lava cools quickly, to fill this basin enormous amounts of lava must have erupted quickly. The slopes of the two big mountains range from 20º to 30º, too steep for a vehicle or walking astronaut to negotiate. It was hoped that sampling large boulders that had rolled down the slopes would give the astronauts material from high up the mountain. Some of these boulder tracks were up to 2 kilometres long.

The Taurus-Littrow site is named for the Taurus Mountains and Littrow Crater located in the mountainous region south east of the Serenitatis basin. It is named after the constellation Taurus (the Bull) and the Austrian astronomer and mathematician Joseph Johann von Littrow (1781-1840).

Surface Scientific Experiments

To broaden the lunar database, seven new surface experiments not used on previous missions were deployed:

Surface Gravimeter – to measure lunar tidal deformations caused by gravitational pull of the Sun and Earth, and to confirm the existence of gravity waves.

Ejecta and meteorite experiment – to determine the mass, velocity and frequency of meteorites striking the Moon and the nature of the ejecta produced.

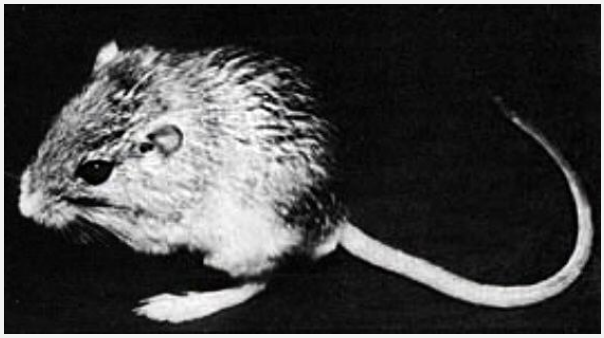
Seismic Profiling experiment – to acquire data on the physical properties of the material just beneath the lunar surface and to monitor moonquakes and meteorite impacts.

Atmospheric Composition experiment – to obtain data on the composition of the lunar atmosphere at the surface.

Traverse Gravimeter – to make a relative survey of the gravitational field at the landing site.

Surface Electrical Properties experiment – To determine any layering in the lunar surface; to search for highly reflective surfaces which would indicate the presence of subsurface water; and to measure electrical properties of lunar material on the Moon.

Neutron probe – to measure and capture rate of low energy cosmic ray secondary neutrons in relation to the depth of the lunar surface.



A Pocket Mouse
Five mice flew on Apollo 17, named
Fe, Fi, Fo, Fum and Phooey.

Mice for Companions

The only new biological experiment on this mission was five pocket mice from the Californian desert secreted in a special canister in the Command Module. They were used to determine if heavy ionising cosmic ray particles could injure nerve cells in the brain and eye. Small, at 8.5 grams each, these mice require no water. Each mouse was sealed in a 33.8 long by 17.8 centimetre wide tube with a supply of seeds for food and had a cosmic ray detector implanted under the scalp. The seeds contain enough water for the mice to survive. The astronauts had no part in the experiment.

Four mice survived the journey, and a total of 80 cosmic particles were registered in the detectors of the five mice, 9 of which did not pass through the heads. The absence of demonstrable lesions in the brain and eyes left unresolved the degree of vulnerability of the brain tissue to this source of radiation.

Solar Flares

Solar flares, or storms, are quite common, but usually not strong enough to be a hazard to astronauts in space. Flares powerful enough to be a danger to astronauts can occur twice a decade. It is interesting to note that in August 1972, half way in time between Apollo 16 and 17, a solar

The Apollo 17 Saturn V on pad 39-A at dusk on November 22, 1972. Image: NASA/KSC

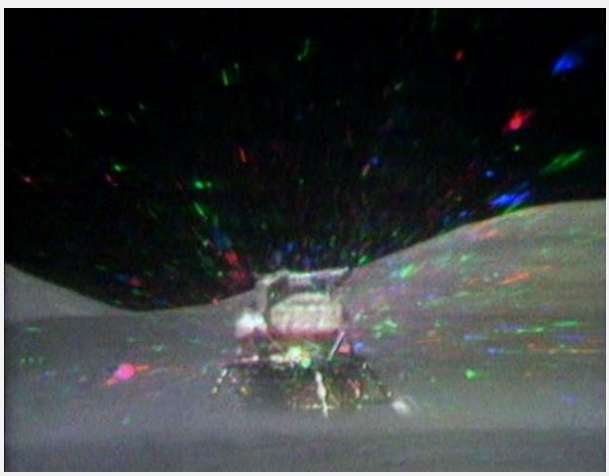
flare occurred which would have been strong enough to give the astronauts a radiation dose high enough to cause nausea, vomiting and diarrhoea, with the possibility of death if not treated in time. We were lucky!

Videoing the LM launch

Commenting on the planned video of the lunar liftoff using the Rover TV camera controlled by Ed Fendell (Captain Video) in Mission Control, Houston, Cernan wrote,

"I had worked with Ed Fendell for the Apollo 17 lift-off to get it exactly right for a long tracking shot. At lift-off, the action was perfect, but soon the image of the ascending capsule drifted out at the top of the frame. Ed was furious that, after all the calculations, we missed the mark. It was discovered later that the crew had parked the Rover closer to the LM than was prescribed by mission plan, and the vertical tilting of the camera was too slow.

Whenever I see a clip of that lift-off I note, as the stage nears the top of frame, a cut to a film shot of the stage ready to dock with the command module. And I still think, 'Darn, we could have followed that final lift-off until it was but a dot of light winking out as it headed for the mother ship.'"



LM ascent stage launch. Image: NASA – Rover TV

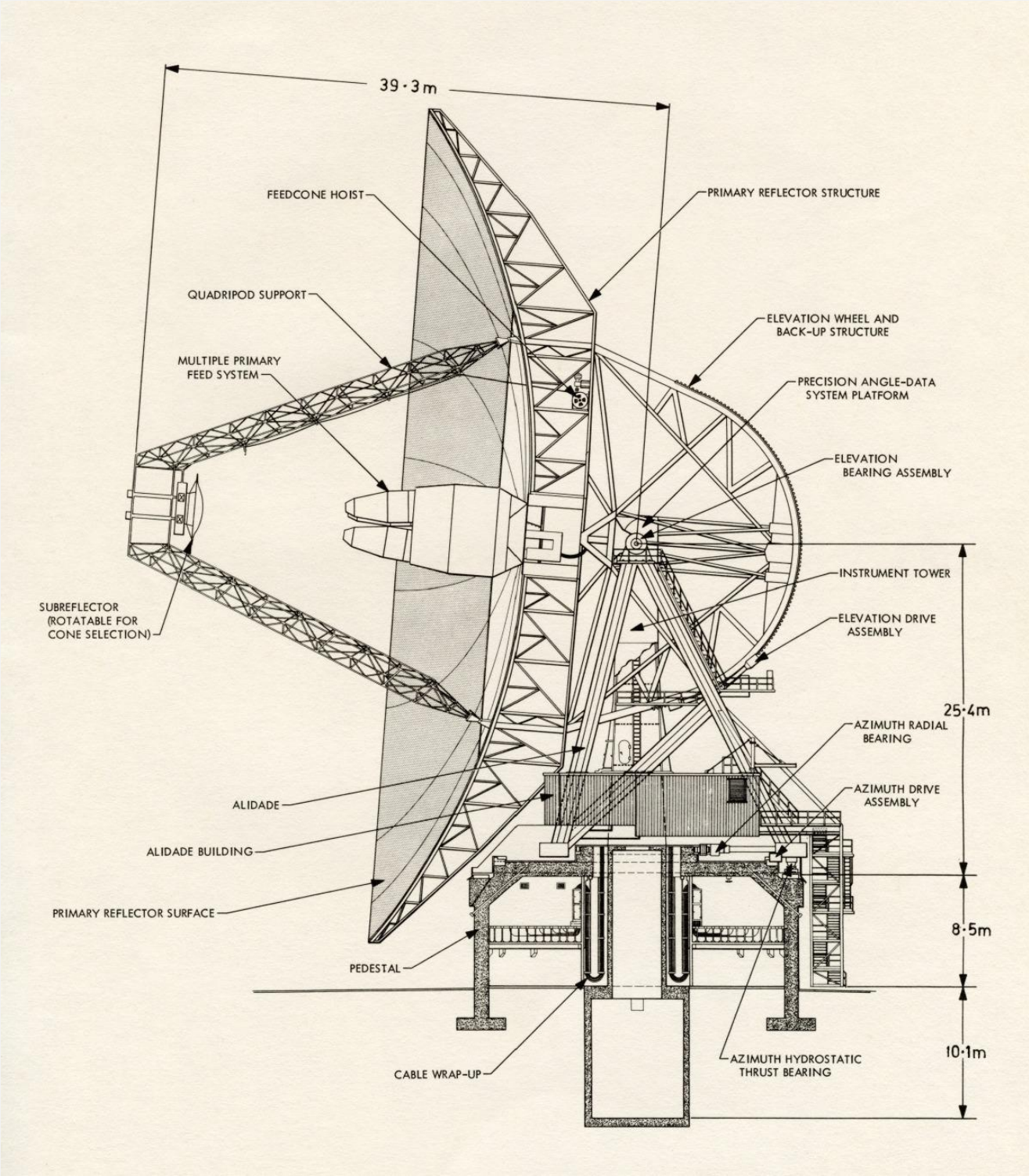


Diagram of Deep Space Station 43 in its 64-metre (210 foot) configuration.

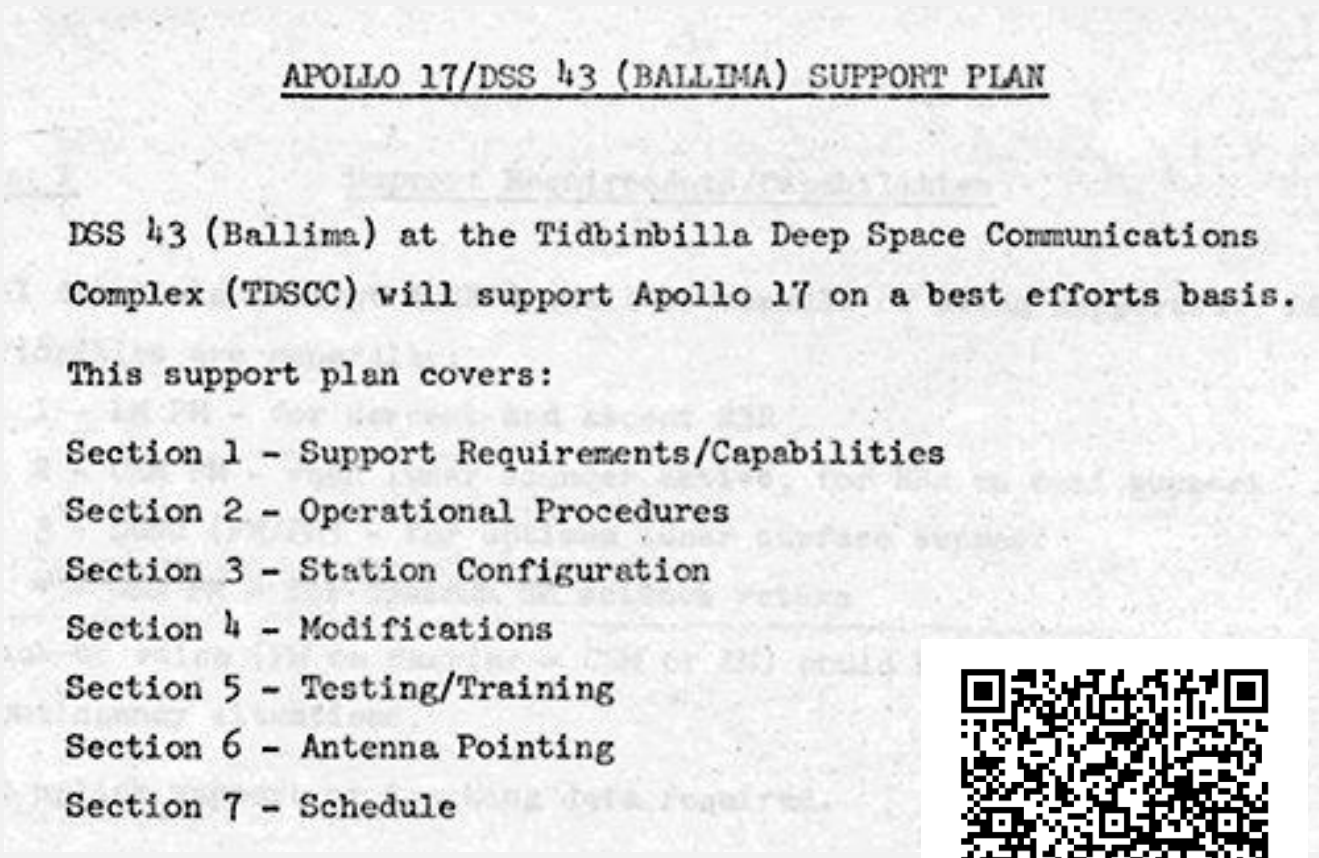
Deep Space Station 43
- a new 64-metre dish antenna at Tidbinbilla

Over at the Tidbinbilla Deep Space Communications Complex near Canberra, Australia, a new 64-metre Az/El dish antenna (named *Ballima*) was being completed.

Deputy Station Director Mike Dinn had the idea of it supporting the Apollo 17 mission. He explains,

"It was decided that I would go to the Jet Propulsion Laboratory (JPL) during the calendar year 1972 to facilitate and coordinate the new 64 metre antenna DSS 43. I was attached to a systems section at JPL for a year.

Along the way, Tom Reid, Station Director at Tidbinbilla, and I determined that there was a good chance that DSS 43 could be finished, or finished enough to support Apollo 17, and we



APOLLO 17/DSS 43 (BALLIMA) SUPPORT PLAN

DSS 43 (Ballima) at the Tidbinbilla Deep Space Communications Complex (TDSCC) will support Apollo 17 on a best efforts basis.

This support plan covers:

Section 1 - Support Requirements/Capabilities
Section 2 - Operational Procedures
Section 3 - Station Configuration
Section 4 - Modifications
Section 5 - Testing/Training
Section 6 - Antenna Pointing
Section 7 - Schedule

Above: The DSS-43 Support Plan for Apollo 17. With thanks to Mike Dinn.

WEBSITE
A 3.5MB PDF file.

both thought it would be a good target for everyone concerned. I also saw it as an opportunity to work back in manned flight, which I left after Apollo 13. So, I worked with Goddard and Houston, and with Tom Reid and Tidbinbilla and JPL to facilitate the support of Apollo 17 by DSS 43 on a best effort basis. I had a couple of meetings at Goddard, then I got to Houston for a couple of meetings with people like Tom Sheehan. It also gave me an excuse to be at Houston for the launch of Apollo 17. I wrote the support plan for that particular activity."

Tidbinbilla management decided that the new 64-metre antenna would only track the Command and Service Module (CSM).

Mission Call Signs and Patch

Apollo 17 was the last Apollo mission to the moon, so the spacecraft were named with appropriate dignity, the Command Module America as a tribute to the mission and the American public. The Lunar Module was called Challenger because of what the future held for America.

The patch for Apollo 17 was also full of symbolism.

Cernan explained the significance of the design to me:

"We felt certainly that Apollo 17, in spite of the fact that it's the last flight in the Apollo Program, it's really not the end, but rather the beginning. It's sort of a conclusion of the culmination of what we consider man's greatest achievement, certainly in our lifetime. And, looking into the future, these achievements and the potential of them have literally no bounds. So, we have a bust of the god Apollo on our patch. He represents not just Apollo and the Apollo program, but we feel that he represents mankind himself.

He represents knowledge and wisdom; Apollo is looking out into the future. He is not looking behind. And he's not simply looking at the moon – someplace that mankind has been – and in a sense has a goal that mankind has accomplished. But he is looking beyond the moon and into the future.

The Apollo 17 Saturn V stack and mobile launch platform rolling out of the VAB. Image: NASA/KSC

Schmitt, Evans and Cernan at the base of their Saturn V launch vehicle. Image: NASA/KSC

DESTINATION MOON!

Apollo 17 on the launch pad at Launch Complex 39A at the Kennedy Space Center.
Image: NASA/JSC

We have along with him, up in the corner of our patch, a golden moon, sort of representing a golden era of spaceflight that we are bringing to a close now.

Superimposed upon this moon, alongside the bust of Apollo, alongside mankind, we're a little bit parochial: we have a very contemporary American eagle whose wings are coloured with blue and red stripes of our flag. And we have three white stars indented into the top of this eagle's wings.

The significance there is to remind us – not just in this country, and as I say, parochially speaking – the rest of the world, that the achievements that have happened in the past decade were not by accident. America brought us to where we are today and the United States of America is going to lead us into the achievements and accomplishments of the future."

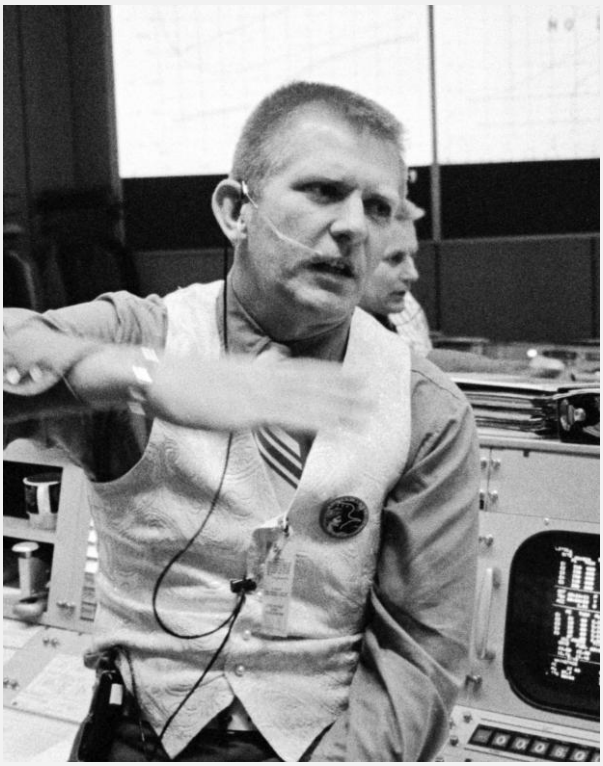
A normal Apollo mission plan would have ended in a landing on the moon during a solar eclipse, putting the spacecraft in shadow for up to nine hours. The engineers felt that some of the spacecraft systems might not survive such a long cold period, so to arrive at the target in sunlight with the sun at the right angle, planned for 13.3° above the lunar horizon, Apollo 17 was scheduled to have the first night launch. To be conditioned for the upcoming night work the astronauts stayed up through the preceding nights.

Other differences were the Trans Lunar Injection (TLI) rocket burn over the Atlantic Ocean instead of the Pacific; two descent orbit insertion manoeuvres instead of one; and a southerly rather than a northerly track on re-entry into the Earth's atmosphere.

Cernan had experienced the fantastic thrill of a Saturn V lift-off before in Apollo 10, so he advised Schmitt and Evans,

"Soak up the experience because we're going to shake, rattle and roll. I want you to enjoy this, enjoy every second before it's gone. This will be one of the most breathtaking experiences you've ever had, and we won't be back this way again."

After trying to explain what they were about to experience, Cernan realised that they would never understand what he was telling them until they experienced it for themselves.



Gene Kranz. Image: NASA/JSC

Flight Director Gene Kranz, on duty for the launch, saw this crew as the most relaxed of all the Apollo crews, probably because being the last mission and the end of the Apollo program, some of the strict protocol was relaxed, and also there had been no crises leading up to the launch. Listening to the conversation from the astronauts as they went about their tasks on the Moon bears this observation out.

The Australian Government's Minister for Supply, Mr (later Sir) Victor Garland (**pictured below**), said before the mission in a news release,

"I am certain that all Australians will follow with interest the achievements of this mission which marks the end of perhaps the greatest scientific and technological program in history, and one in which many Australians have played a dedicated part."

HSK MISSION DAY 1
THURSDAY, 7 DECEMBER 1972
LAUNCH

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Launch	00:00:00	1633:00

Note: Apollo 17 was the only night launch of the Apollo program

The Launch

The astronauts climbed out of their beds at noon and tucked away the usual steak and eggs before facing the final briefings and procedures. The weather was looking doubtful with a cold front sweeping in from the west, passing over the Florida panhandle. Thick clouds threatened thunderstorms.

As he approached the Launch Umbilical Tower (LUT) Cernan was very aware that this was a special event he was responsible for – they were going to be the last men to go to the Moon for a long time. He had done this trip before in Apollo 10, when everybody's mood was very different. Approaching the elevator, he looked up at the giant rocket, towering 116 metres above him in the dark; in his words, it *"… sparkled like a jewel rampant against the night sky, centre stage and draped in spotlights."* Frosty ice and mysterious wisps of vapour clung to the sides, shimmering in the spotlights. Isolated from the world in his space suit and helmet he couldn't talk to or hear anyone, the only sound was the steady hiss of the oxygen from his portable life-support system. Crossing the narrow walkway to the White Room over the Command Module hatch he felt this was different to Apollo 10, it was a new sensation with the surrounding darkness pierced by the brilliant spotlights. This time he was going to walk on the Moon' surface.

As he buckled up in the left seat and plugged in he was connected back to the outside world. Farewell taps on his helmet, shaking gloved hands before the hatch closed; the White Room slid away, and he began to go through the pre-flight check list.

Meanwhile over in Mission Control in Houston Duty Flight Director Gene Kranz noted that the launch countdown was a nightmare to him during the last hour when Mission Control suffered a series of power glitches and the display systems failed and controllers considered having to relocate to adjacent emergency working consoles. Luckily the problems were fixed by T-7 minutes.

The countdown progressed until,

"This is Apollo Launch Control, we're holding at the 30 second mark,"…

There was a hold at 2 minutes 47 seconds before the scheduled launch, when the Terminal Countdown Sequencer failed to issue the S-IVB LOX tank pressurization command due to a defective diode in a printed circuit board. As a result, an automatic hold command was issued at T-30 seconds, which lasted 1 hour 5 minutes 11 seconds. The countdown was recycled to T-22 minutes but was held again at T-8 minutes to resolve the sequencer corrective action. This hold lasted 1 hour 13 minutes 19 seconds. Ron Evans drifted off into sleep while they waited, snoring gently. The countdown was then picked up at T-8 minutes and proceeded smoothly to launch. The delays totalled 2 hours 40 minutes.

The planned launch window was 2153 on 7 December to 0131 on 8 December Florida times to take advantage of a sun elevation angle on the lunar surface of 13.3°.

At the launch site the threatening weather cleared, though flickers of lightning could be seen away in the distance. The temperature was 21ºC; the relative humidity was high at 93%; a light breeze was blowing at 8 knots from the north. Stratocumulus clouds with a base of 2,600 feet covered 20 percent of the sky and high above them cirrus clouds covered 50 percent.

Watched by an estimated 700,000 spectators, the mighty Saturn V was lit for the second last time (the last time was to launch Skylab 1) at 33 minutes after midnight local time, 00:00:00 GET (1633 AEDT) on Thursday 7 December 1972. It was a brilliant spectacle.

Above: Apollo 17 lifts off the pad in the only night-time Saturn V launch.
Images: NASA/KSC
Below: The Saturn V is about to clear the tower.

Listen to the Launch

Recorded by Colin Mackellar from Voice of America radio and local ABC Radio sources.

LISTEN

4.1 mp3 file. Running time – 11m 06s

With an intensity equal to the sun, the dazzling glare from the streaming wake of the giant rocket lit up the night sky and was seen as far away as Cuba and North Carolina, over 800 kilometres away. Clouds of white vapour boiled and writhed in the spotlights as the rockets spewed out their gases …

"Two... one... zero... we have a lift off. We have a lift off and it's lighting the area; it's just like daylight here at the Kennedy Space Centre as the Saturn V is moving off the pad. It has now cleared the tower."

When the powerful five F-1 engines of the S-1C first stage fired, the astronauts could not see the stupendous spectacle they made as they speared up into the black sky above, their cockpit and suits glowing a lurid red from the rocket's glare reflecting off the nearby stratocumulus clouds through the Commander's window.

Cernan, *"Roll is complete. We are pitching."*

Evans, as the acceleration shoved him hard into his couch, *"Wow…woozle!"*

Schmitt,
"Thirty seconds. We're going up. Man, oh, man."

A roll manoeuvre was initiated at +13 seconds to put the vehicle on a flight azimuth of 91.503° east of north. The escape tower, normally blasted off without much of a spectacle in the bright daylight, departed in a blinding flash of fire, *"akin to the birth of a comet,"* wrote Cernan.

Astronaut Gordon Fullerton saw the launch and told the crew later as Capcom,

"There was one advantage gained by delaying the launch the 2 hours and 40 minutes that you did. By that time there were very few clouds around at all. I lost you visually probably oh, about four to five minutes into the second stage, as best I can remember. Part of the problem was the brightness of the plume during the first stage – it kind of burned a spot in my eye so then I had reduced efficiency at looking for a small point of light from there on out."

Schmitt found the 4gs on the way up was difficult,

"A Saturn V launch is something I wish everybody could experience. First there was extremely heavy vibration and acceleration, then at 2 minutes and 45 seconds you're at four times gravity – 4gs. It makes you feel very, very heavy – your arm now weighs four times what it normally weighs so you can imagine lying on your back and reaching up to touch the panel in front of you takes a fair amount of effort – mainly because you're not used to doing it. It's not that you can't do it, it's just that you're not used to it."

As they cleared the clouds hugging the planet, Cernan tried to see any stars but found that the cabin lights dulled his night vision.

Apollo 17 entered a 167.2 by 166.7 kilometre Earth orbit at 00:11:52 GET (1644:52 AEDT). A speed of 28,094.6 kilometres per hour gave a period of 87.8 minutes to orbit the Earth. Approaching the African coast the crew were treated to a spectacular sunrise.

Evans: *"See those big thunderheads on the horizon?"*

Schmitt: *"Yes."*

Cernan: *"Look at the size of those things!"*

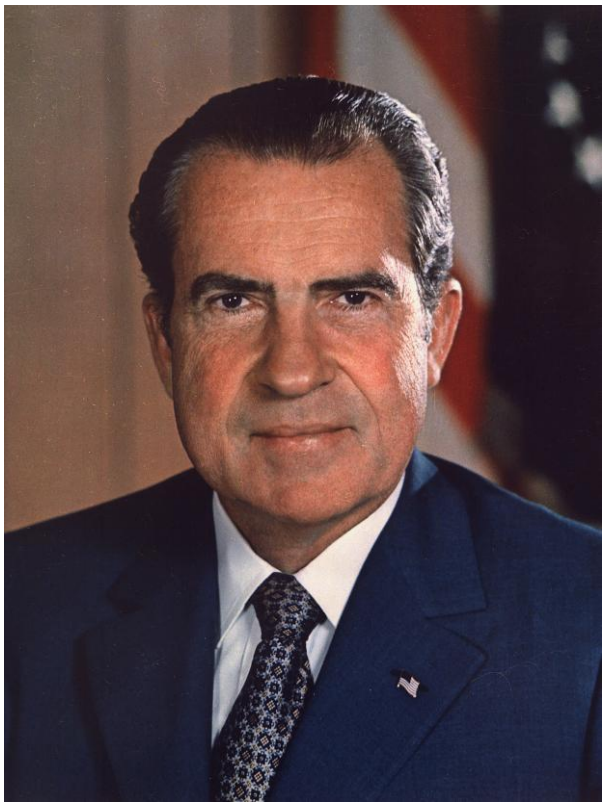
Evans: *"Isn't that beautiful."*

Timelapse photo of the Saturn V's departure. Image: NASA photo 72-HC-894.
Research: J.L. Pickering, via the Apollo Image Archive.

Houston received a personal message to the crew of Apollo 17 from the President of the United States:

"As you set forth on the final Apollo expedition to the Moon I want to have my personal best wishes for a successful mission and safe return. I am sure your voyage, your scientific exploration, will be the crowning achievement in a program which has expanded man's horizons, brought great credit to your country and lifted the spirits of people all over the world. God speed to you all."

Signed Richard Nixon



At 52 minutes 20 seconds (1725:20 AEDT) into the mission the spacecraft rose over Carnarvon's horizon and conversation flowed again.

Capcom Robert Overmyer in Mission Control:

"Okay, and on page 2-17 of the Launch checklist you're going to want to delete all reference to Honeysuckle AOS (acquisition of spacecraft signal) and LOS (loss of signal) and delete all reference to Canary's AOS and LOS."

Schmitt: *"Wilco."*

Schmitt,
"Oh, we were paying attention to a sunset that was the biggest …"

Cernan interrupted, *"Sunrise."*

Schmitt, *"… or sunrise or something that we saw. It was the biggest rainbow I have ever seen."*

As they came to the end of the Carnarvon track, Cernan said,

"We're looking at the deserts of Australia right now, and, again, everything's good on board."

Schmitt later explained his 'rainbow' to a puzzled Capcom. It was the colours across the eastern horizon,

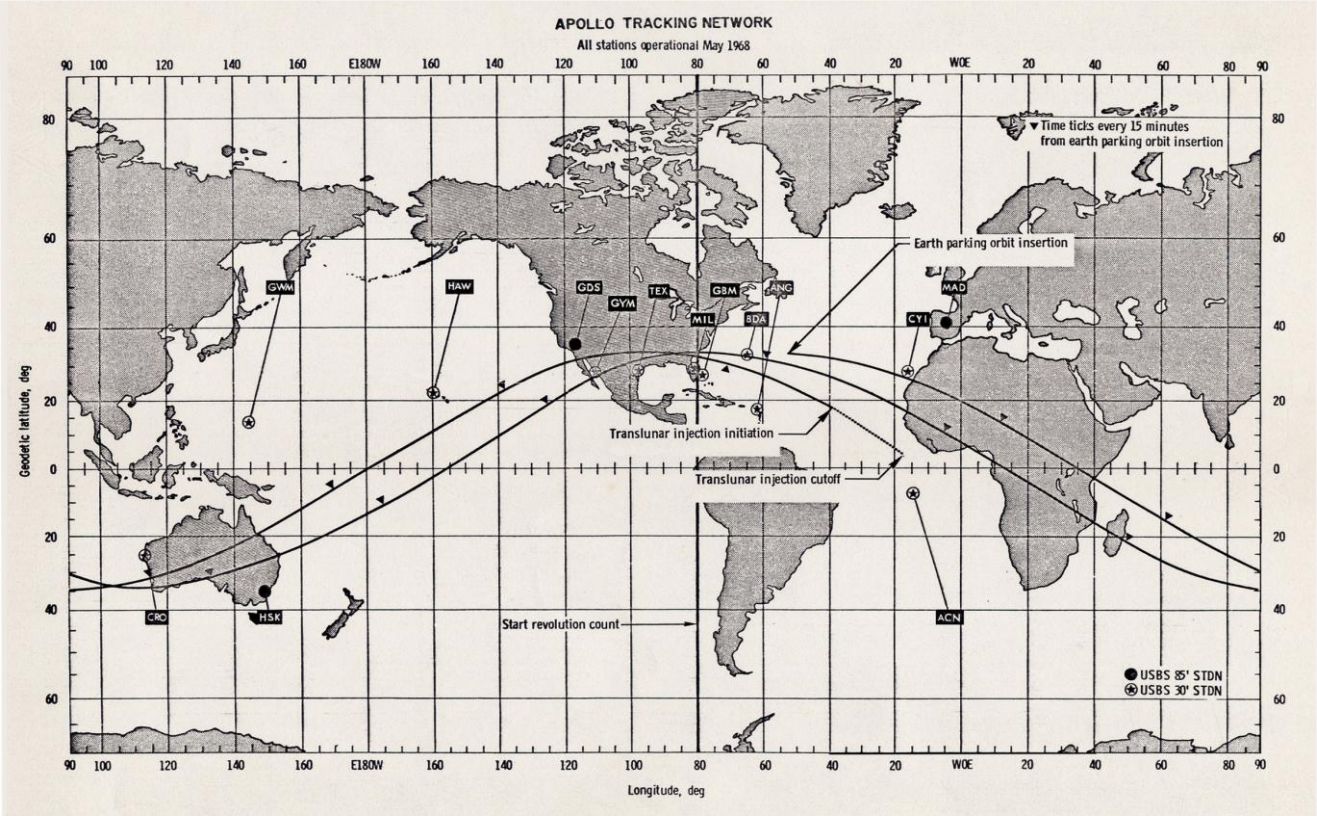
"It had a banded colour appearance that varied as you approached sunrise. There was a grey-blue upper layer that merged or graded into a brilliant blue intermediate zone that was just above the cloud levels. And within the clouds you got an orange to yellow band, getting more yellow as the Sun rose."

At Honeysuckle Creek we did not see the two Earth orbits as originally planned because of the late lift-off requiring a launch azimuth of 91.503°. Apollo 17 was the first spacecraft to break out of Earth orbit and head for the moon from over the Atlantic instead of the Pacific because the Saturn IVB rocket was not quite powerful enough under the conditions to push the spacecraft to escape velocity from the Pacific.

The crew and spacecraft were all ready for TLI (Trans Lunar Injection) by the time they arrived over Goldstone, California, on the first orbit.

By 1808 AEDT they were passing Houston and approaching Florida for the first time and trying to pick out landmarks in the darkness below.

Schmitt: *"Bob, I'm not sure exactly where we are, but I'm looking out to an awful lot of lights on the horizon out there at 12 o'clock, and an awful lot of lightning in the clouds out there."*



Apollo 17's Groundtrack leading up to TLI. Scanned and processed by Hamish Lindsay.

Lunar Module 'Challenger' sitting in her nest. Image: NASA

Overmyer, *"Roger. We show you just about over the middle of the Gulf. Looking ahead, you're probably seeing the very southern tip of Florida there."*

Cernan: *"It looks like almost the entire Florida Peninsula has got lights. Got lightning on it somewhere."*

At 2:25:15 GET (1858:15 AEDT) Carnarvon locked on to Apollo 17 for their second pass and the final figures for the TLI were passed up. During the second orbit over Hawaii tracking station Mission Control in Houston gave the message for Apollo 17 to GO for the Moon.

Overmyer: *"Guys, I've got the word you wanted to hear. You are GO for TLI – you're GO for the Moon."*

Cernan: *"Okay, Robert. I understand. America and Challenger with their SIVB are Go for TLI."*

Overmyer: *"That's affirmative."*

Cernan, *"You're a sweet talker."*

Tracking for the TLI burn was through an ARIA aircraft flying over the Atlantic, before Ascension Island picked them up. The TLI burn itself occurred at 03:12:36.60 GET (1945:36 AEDT) at an altitude of 179.6 kilometres with a 5 minute 51.04 second Saturn IVB burn, which boosted their speed to

39,014.1 kilometres per hour. Their two Earth orbits had lasted a total of 3 hours 6 minutes 45 seconds. This manoeuvre shortened the trans lunar coast period by 2 hours 40 minutes to compensate for the launch delay to ensure the lighting conditions on the Moon would still conform to the original Flight Plan.

Cernan: *"We started the burn in darkness and flew right on through a sunrise during the TLI burn. We shut down in daylight. It was pretty spectacular."*

The CSM separation from the SIVB began at 03:42:36.60 GET (2015:27 AEDT), with Evans in the driving seat. The LM was transposed and re-docked 14½ minutes later. The LM was pressurised, the entry hatch removed and an inspection revealed that latches 7, 9 and 10 were not locked. All were manually set and the docked spacecraft were ejected from the Saturn IVB at 7:25:02 GET (2118:02 AEDT).

As they parted company Schmitt exclaimed, *"Hey…there's the booster!"*

Overmyer, *"Roger. Bet you never saw the SLA panels on the simulator."*

Cernan, *"No, but we got the booster and is she pretty. Challenger's just sitting in her nest."*

As Evans piloted the CSM around to dock with the LM, Cernan commented,

"I can't tell you too much, Bob, from the centre seat, other than Captain America is very intent on getting Challenger at the moment."

Overmyer, *"Roger, I can believe that."*

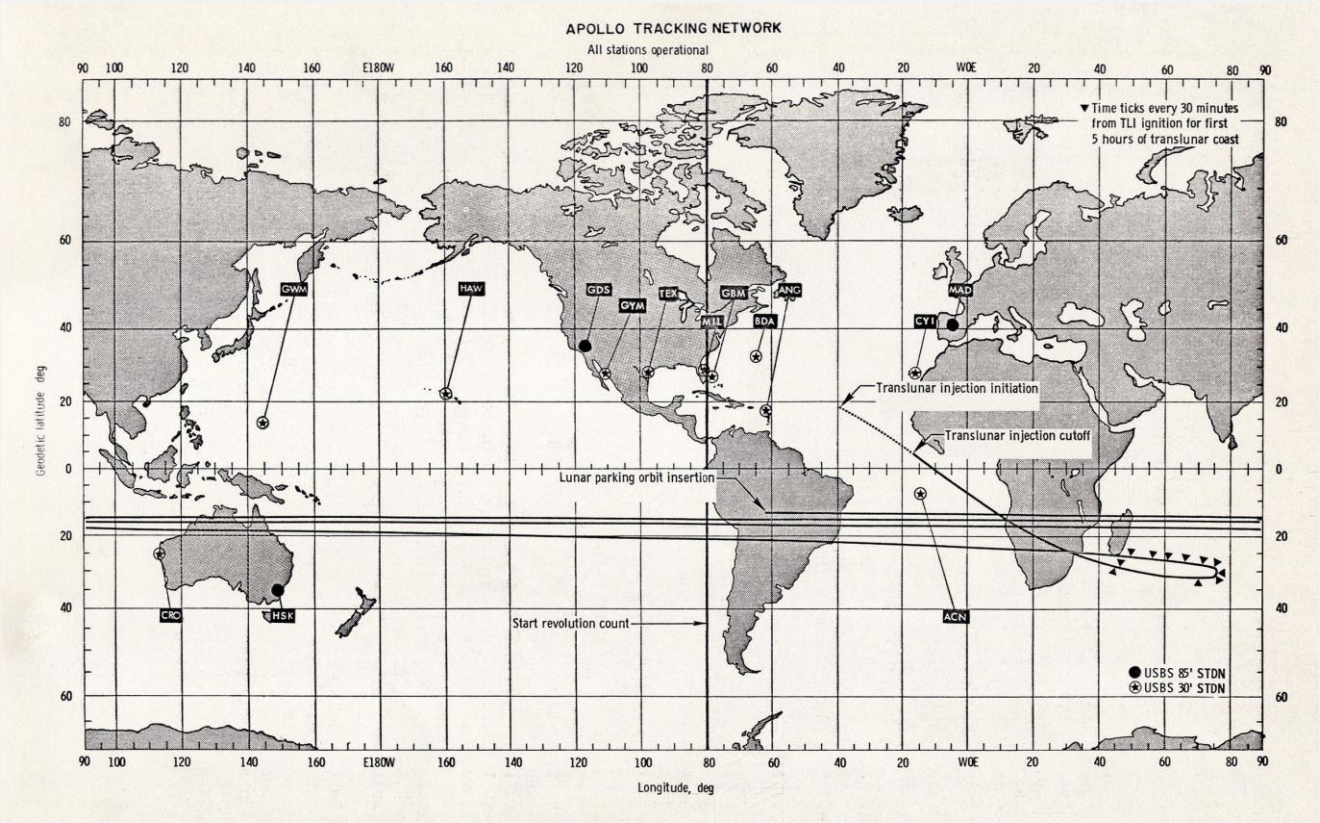
Evans, *"I'm coming in a bit slow, but we've got plenty of time... Now she's coming in."*

Schmitt, *"Rover looks in good shape, so far."*

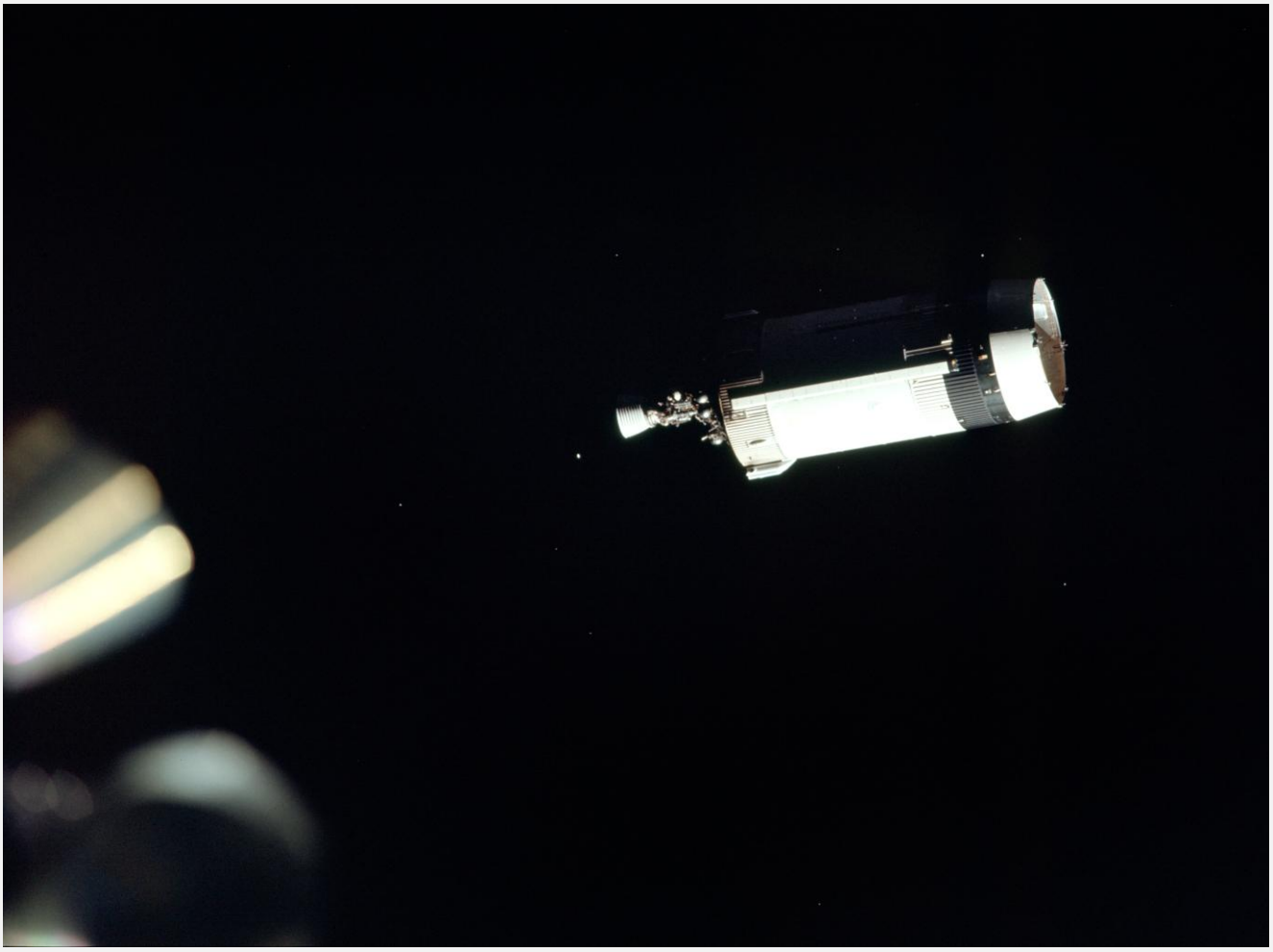
Cernan, *"Capture, Houston."*

The LM was transposed and re-docked 14½ minutes later. The LM was pressurised, the entry hatch removed and an inspection revealed that the handles for latches 7, 9 and 10 were not locked. All were manually set and the docked spacecraft were ejected from the Saturn IVB at 4:45:02 GET (2118:02 AEDT).

With a successful LM docking and separation from the Saturn IVB at 6:37:10 GET (2030:10 AEDT), they were ready for their trip to the Moon and began coasting away from their home planet.



Apollo 17 Trans Lunar Coast groundtrack. Note the time ticks every 30 minutes as Apollo 17 climbs above the Indian Ocean after its TLI burn off the west coast of Africa. Scanned and processed by Hamish Lindsay.



The Saturn IV Booster – S-IVB. Image: NASA

Cernan, *"I can't see the S-IVB – it's gone."*

Evans, *"Look at that."*

Schmitt, *"Yes, Madagascar and Africa. Got to be… Hey there's Antarctica; it's all full of snow. You want to look?"*

Cernan, *"Yeah."*

Schmitt, *"Yes,"* then seeing the S-IVB, *"Oh, there it goes, there. Looks kind of empty down there without the LM."*

At 05:03:01 GET (2136:01 AEDT) a 79.9 second separation burn was executed to make sure the CSM would not collide with the S-IVB, and the crew could begin to relax, getting out of their suits.

At 40,000 kilometres from Earth, while the crew were waxing eloquent descriptions of their views of the Earth, concentrating on Africa and Antarctica, Overmyer informed them,

"Gene, looking at our plot board you're directly over the southern tip of Africa but shortly you're going to start going backwards and head back across the Atlantic. That ought to be some sort of a first. You crossed the Atlantic twice, going from west to east, and now you're going to cross it going from east to west, all in a very short span of time."

Cernan, *"Yes… I guess that does sound like a first."*

Schmitt was intrigued with the weather patterns he could see on the retreating planet below him. It was an unusually clear day on Earth. While Cernan and Evans were getting out of their suits, Schmitt, a keen amateur meteorologist, happily announced detailed weather reports for an hour. He even tried predictions.

It prompted Capcom Gordon Fullerton to comment: *"You're a regular human weather satellite!"* Cernan called him the Dr Rock weather channel.

The famous ‘Blue Marble’ photo was taken by Harrison Schmitt not long after Transposition, Docking and Extraction. Several similar photos were taken, but this one is most often seen. Image: NASA

Schmitt, in space for the first time, found he was unable to communicate his feelings to Houston and said,

"Bob, you always wish that you had a poet aboard one of these missions, so he could describe things that we're seeing and looking at and feeling in terms that might transmit at least part of that feeling to everybody in the world. Unfortunately, that's not the case, but ... I certainly hope that someday, in the not too distant future, the guy can fly who can express these things."

At 5:30:00 GET (2202:59 AEDT) Gene Kranz's White Team of flight controllers handed over to Pete Frank's Orange team. At 7:15:00 GET Capcom Bob Overmyer was relieved by Bob Parker, and Commander of the backup crew, John Young, left the control room where he had been sitting beside the Capcom after returning from witnessing the launch at the Cape.

HSK MISSION DAY 2
FRIDAY, 8 DECEMBER 1972
TLC – DAY 1

Times: AEDT (HSK local time)

Prime HSK	**Track Duration**	**AOS/ LOS**
CSM	12h 56m 00s	1002:00 2258:00

Handovers	**AEDT**
CSM 2-way from GDS	1133:00
CSM 2-way to CAN – 11h 3m	2236:00

Wing HSKX	**Track Duration**	**AOS/LOS**
IU	12h 45m 00s	1008:00 2253:00

Handovers	**AEDT**
IU 2-way from GDS	1418:00
IU 2-way to MAD – 8h 10m	2228:00

DSS43	**Track Duration**	**AOS/LOS**
CSM	12h 36m 00s	1008:00 2244:00

At 8:59:31 GET (0832:31 spacecraft time, 0132:31 AEDT), 80,000 kilometres from Earth, travelling at 9,836 kilometres per hour with the spacecraft spinning at 3 revolutions per hour for thermal control, the crew's first rest period of nearly 6 hours began. Although they had been awake and active emotionally for about 21½ hours, they were too excited to sleep – only managing to doze off intermittently.

At 10:00:00 GET (0933:00 AEDT) there was another shift change at Houston, with the Orange Team handing over to Jerry Griffin's Gold Team. Bob Parker stayed on as Capcom until Gordon Fullerton took over to wake the astronauts up.

At around 0500 AEDT (midday locally in Houston), while the astronauts were still resting, Booster Systems engineer Frank Van Renssalaer stood up from his console in Mission Control and packed his briefcase. His had just finished his last task for the Apollo program, organising the booster for lunar impact. He called the Flight Director: *"I've enjoyed working with you on the Apollo Program,"* and walked out, leaving an empty console. It was the last time that console would ever be used. So began the end of the operational phase of the Apollo flights to the Moon.

Houston roused the crew up at 15:02:57 GET (0735:57 AEDT) at the end of their rest period to find they were over the Pacific Ocean, and the Earth had shrunk dramatically. While the American continents were rolling away from them, and Australia was approaching them, the astronauts tucked into a breakfast of sausage patties, grits and cocoa.

In a brief exchange at 18:57:58 GET (1130:58 AEDT), Fullerton called,

"17, we'll be having a communications handover to Honeysuckle in about a minute and a half."

Cernan, *"Okay, Gordo."*

Schmitt, *"That's great. Next time I look at Earth, I'll see what's happening in Australia."*

An hour and five minutes later Schmitt gave a description of what he could see over Australia,

"There's a front going off across to the coast of Australia north of Sydney and largely a little

south of Brisbane, and…. and swings across the whole of Australia and seems to come – near as I can tell – go by into the Indian Ocean about… well… where the Great Sandy Desert intersects the north western coast of Australia ….. but the bulk of Australia is clear, all the south and the north."

Overmyer, *"Roger."*

Schmitt, *"That puts all the major cities of the south – Perth and Adelaide, at least, and Melbourne certainly, in the clear. And in north Darwin, are very nicely clear today……. The folks in Carnarvon ought to be enjoying a very nice day."*

Overmyer, *"Roger. I hope we can get this out to them and let them know that you are watching and tell them how good the weather is."*

Schmitt, *"Oh, that's all right – I'm just having fun, Bob."*

At 21:10:24 GET (1343:24 AEDT) Schmitt interrupted a break with,

"Bob, are you with me?"

Overmyer, *"Roger – we wouldn't go away Jack. We're listening. Did you call?"*

Schmitt, *"Well, I just… yes. I almost lost a pass there, and just a couple more words about Australia. As a general land mass it's red. Very strong red hues, except for the north and eastern coasts, where that red gradually merges into a greenish grey. It's as… as red as portions of…of northern Africa appeared to be yesterday."*

Overmyer, *"Roger."*

Schmitt, *"Very striking colour. It would be more of an orange red, really, with brown subduing it. It's not … obviously not crimson, or anything like that."*

At 23:38:35 GET (1611:35 AEDT) the new 64-metre antenna at Tidbinbilla rated a mention:

Overmyer, *"Jack, how do you read us now?"*

Schmitt, *"You're on – clear."*

Overmyer, *"Okay, 17. For the last two hours we've been getting high bit rate data from a new facility at Tidbinbilla. And they are working their first Apollo flight ever – you might give then a cheery hello."*

Schmitt, *"Tidbinbilla, is that correct?"*

Listen to HSK speak with Apollo 17

Thirty minutes after the weather report, there was a comms outage from Houston incoming to Honeysuckle. Telemetry Supervisor Laurie Turner goes up to the spacecraft on Net 1 to let them know of the difficulty. Gene Cernan replies, and after comms is restored, CAPCOM Bob Overmyer resumes communication. Honeysuckle spoke with Apollo 17 – from 21:41:25 GET.

Thanks to Ben Feist at Apollo In Real Time for finding the clip!

LISTEN

1.9mb file. Running time – 1m 27s

Overmyer, *"That's affirmative. It's very close to the Honeysuckle base…"*

Schmitt, *"Where is that?"*

Overmyer, *"Very close to Honeysuckle."*

Schmitt, *"Well, how you doing? How you doing, mates? We certainly appreciate you guys being on the loop for this one."*

The Public Affairs announcer added, *"The new 210 foot dish antenna at Tidbinbilla, which is near Honeysuckle Creek, which in turn is near Canberra, now on line and accounting for our excellent signal strength on the spacecraft."*

Listen to the *'cheerio'* call to DSS43

Public Affairs audio recorded at Houston. 23:37:50 GET. Thanks to Apollo In Real Time.

LISTEN

3mb mp3 file. Running time: 2m 20s

On 3rd May 1973, Apollo 17 LMP Harrison Schmitt visits Honeysuckle Creek. Photo: Hamish Lindsay.

Telemetry Supervisor Laurie Turner chats with him at the Operations Console, no doubt recalling Laurie's conversation with the crew six months earlier. Scan of 5x4 inch negative: Colin Mackellar 2022.

The next rest/sleep period began at 24:42:00 GET (1715:00 AEDT) with Cernan and Evans turning in before Schmitt. Their circadian clocks were telling them it was midnight:

> Overmyer, *"Jack, did the Command Module pilot get off line and is he sacked out too?"*
>
> Schmitt, *"Yeah, I lost both those guys. They decided they wanted to sleep and I may be rumbling around here for a while…… I'll tell you Bob. About half way through the day I think I acclimated and I really feel good. I've been eating a lot better and the only thing I really ever felt was a slight headache. It really – not the fullness of head that people describe, I guess - but just a little headache. I could have been looking at the Earth too much – I don't know."*

Then Schmitt explained his feelings,

> *"Bob, I probably ought to qualify all those remarks about the Earth's weather. It's purely a novice talking about something he is very unfamiliar with, except for having a long standing interest in it, and I think one philosophical point, if any, that comes out of it is that somebody, probably three and a half billion years ago, could have looked at the Earth and described patterns not too dissimilar. And it was within those patterns that life developed, and now you see, obvious to everybody, what that life has progressed to doing. I certainly think that all of us feel it has not stopped doing that progression and we'll probably see it doing things that even you and I can't imagine them doing. I certainly hope so."*

So, 44 rumbling minutes later, at 25:26:26 GET (1759:26 AEDT) Schmitt ended the day with,

"Talk to you in the morning – or to somebody anyway."

Overmyer, *"Roger – Parker will wake you up I think."*

Schmitt, *"Oh, gosh!"*

Overmyer, *"Have a good sleep."*

While the crew were sleeping, at 30:03:00 GET (2236:00 AEDT) Apollo 17 crossed the half way mark in distance between the Earth and the Moon. The spacecraft was at a distance of 212,585.5 kilometres from both the Earth and Moon. Its velocity relative to the Earth was 4,961.9 kilometres per hour, and relative to the Moon was 4,198.2 kilometres per hour.

HSK MISSION DAY 3
SATURDAY, 9 DECEMBER 1972
TLC – DAY 2

Times: AEDT (HSK local time)

Prime HSK	Track Duration	AOS/ LOS
IU	12h 326m 00s	1035:00 2307:00

Handovers	AEDT
IU 2-way from GDS	1417:00
IU 2-way to MAD – 8h 31m	2248:00

Wing HSKX	Track Duration	AOS/LOS
CSM	12h 45m 00s	1008:00 2253:00

Handovers	AEDT
CSM 2-way from GDS	1053:00
CSM 2-way to MAD – 11h 40m	2233:00

DSS43	Track Duration	AOS/LOS
CSM	12h 21m 00s	1034:00 2255:00

The next day in the spacecraft began at 33:31:23 GET (0204:23 AEDT) with the usual medical and status reports. Schmitt reported he had a breakfast of cinnamon toast bread, mixed fruit, instant breakfast, coffee, lemonade, peach ambrosia, one slice of bread, grapefruit drink, gingerbread, and an orange drink,

"…And I have one complaint. Somebody slighted me on a caramel candy in meal C."

Fullerton, *"Roger. We'll start an investigation."*

The 2-hour 40-minute launch delays caused ground controllers to modify Apollo 17's trajectory so that it would arrive at the Moon at the originally scheduled time. They shortened the Trans Lunar Coast (TLC) time by having the crew make a 1.73-second SPS burn midcourse correction at 35:29:59.91 GET (0402:59 AEDT).

With only Goldstone tracking, Cernan and Schmitt transferred to the LM at 40:10:00 GET (0843 AEDT) to check the LM out. They found that #4 docking latch was not properly latched. Evans moved the latch handle between 30° and 45°, disengaging the hook from the docking ring. After discussion with ground control, it was decided to curtail further action on the latch until the second LM inspection. The remainder of the LM checks were okay, and they climbed back into the Command Module, and the LM was closed out at 42:11:00 GET (1044 AEDT), just a few minutes after we acquired the CSM's signal at Honeysuckle Creek.

At 48:09:00 GET (1642:00 AEDT) Gene Kranz's White team took over from Pete Frank's Orange team, led tonight by Chuck Lewis. At 48:36:12 GET (1709:12 AEDT) the last words were spoken before the astronauts bunked down for another planned rest/sleep period of 8 hours.

Cernan sleeping. Image: NASA

HSK MISSION DAY 4
SUNDAY, 10 DECEMBER 1972
TLC – DAY 3

Times: AEDT (HSK local time)

Prime HSK	Track Duration	AOS/ LOS
CSM	12h 51m 00s	1103:00 2254:00

Handovers	AEDT
CSM 2-way from GDS	1423:00
CSM 2-way to MAD – 8h 0m	2223:00

Wing HSKX	Track Duration	AOS/LOS
IU	12h 12m 00s	1053:00 2305:00

Handovers	AEDT
IU 2-way from GDS	1146:00
IU 2-way to MAD – 10h 52m	2305:00

DSS43	Track Duration	AOS/LOS
CSM	12h 10m 00s	1050:00 2300:00

Cernan noted that they must have been very tired as it took Houston ten attempts to wake the astronauts up beginning at 56:30:00 GET (0103:00 AEDT). The ground tried three loud renditions of *"I'm Jay, Jay, Jay Jayhawk,"* the fighting song of Evan's alma mater, the University of Kansas. Finally, an hour after the planned wake up time, Schmitt spotted a light blinking at them and said, *"Hey! We're asleep."*

Fullerton, relieved to hear a response at last, replied, *"That's the understatement of the year."*

Schmitt, *"Never let Evans be on watch."*

Fullerton, *"I think we'll go along with that from here on."*

Schmitt, with a laugh, *"That was some party last night, Gordy. Man, that was a humdinger!"*

Fullerton, *"Must have been."*

At 59:59:00 GET (0432 AEDT) a second housekeeping visit to the LM began and all tests checked out okay. While Cernan and Schmitt were busy in the LM, Evans was troubleshooting the latch #4 problem. Following instructions from Houston, he stroked the latch handle and succeeded in cocking the latch and left it cocked for the CSM/LM rendezvous later on.

At 65 hours the GET clocks were all advanced by 2 hours 40 minutes to 67 hours 40 minutes to bring it back into line with the original Flight Plan. This essay has done the same.

At 68:19 GET (1012 AEDT) a one hour visual light flash experiment began. In earlier missions astronauts had reported that with their eyes shut they sometimes saw brief streaks of light. It was suspected that cosmic rays were triggering their retinas. For this experiment Evans donned a helmet that covered his eyes and had slowly moving plates of photographic film that would record any cosmic rays entering his head. He wore the helmet for an hour and reported all the flashes he saw. Cernan wore a blindfold and also reported any flashes he saw. It took the two astronauts about 15 minutes for their eyes to adapt to the dark to see the flashes. They then reported seeing bright and dull flashes once every 2½ minutes.

Cernan described what he saw, *"Mark, Gene. I've got a series of random lines, which do not appear to be the width of my field of view, that are moving like a flashing horizon with thunderstorms on the horizon. They're dimly flashing, and they're moving across the eye from left to right and from top to bottom. It's stopped now.... .*

... Mark, this is Gene again. Going from the upper left to the bottom right. Lines of the same sort of thing. Dimly lit flashing horizon-type flashes. But they're linear. They're linear, and they tend to come from the... either the upper left or the upper right and work their way downward. Now they've stopped. Both eyes."

At 73:17:45 GET (1510:45 AEDT) the spacecraft left the Earth's gravitational influence and at 61,000 kilometres from the Moon the spacecraft slowed to a speed relative to the Moon of 2,583

kilometres per hour before it began to dive faster and faster down to the Moon.

At 73:47:15 GET (1540:15 AEDT) Houston wished them another goodnight with, *"Goodnight, Gene. Got a busy day tomorrow, and we'll ... we'll be with you then."*

At 74:50:00 GET Gene Kranz and his White Team moved in to take over the shift from Chuck Lewis, temporarily leading the Orange Team.

After their sleep period of 7 hours 43 minutes, it was still late Sunday at Honeysuckle Creek when Gene Cernan called Houston first at 81:30:09 GET (23:23:09 AEDT). Houston gave the astronauts an extra half hour off as everything was in such good shape. At Honeysuckle Creek we had just finished our day's tracking 18 minutes before.

HSK MISSION DAY 5
MONDAY, 11 DECEMBER 1972
INTO LUNAR ORBIT
Times: AEDT (HSK local time)

EVENT	GET	AEDT
CSM – LOI [1]	88:54:22	0657:22
Saturn IVB impact	89:39:42	0732:42
Descent Orbit Insertion	93:11:37	1104:37

[1] Orbit 109.5 x 26.9 kilometres

Prime HSK	Track Duration	AOS/ LOS
CSM [2 / 3]	10h 36m 00s	1128:00 2204:00

[2] AOS - Orbit 3 | [3] LOS - Orbit 8

Handovers	AEDT
CSM 2-way	1501:00
CSM 3-way	2253:00

Wing HSKX	Track Duration	AOS/LOS
CSM	11h 53m 00s	1128:00 2321:00

DSS43	Track Duration	AOS/LOS
CSM	11h 48m 00s	1128:00 2316:00

At 83 hours GET (0053:00 AEDT) there was another shift change in Mission Control with Gerry Griffin's team replacing Kranz's team. Gordon Fullerton took over from Bob Parker as Capcom.

Parker, *"And 17, your peaceful night shift Capcom is signing off – I'll talk to you on the surface tomorrow. Good luck."*

At 86:49:00 GET (0442:00 AEDT) Cernan could see the Moon now, some 18,500 kilometres away. The Sun was low on the lunar horizon, but the Moon seemed to blot out everything else.

He let out a shout, *"Boy, is it big – Gordo, we're coming right down on top of it. I'll tell you, when you get out here, it's a big mamou! Gordy, it's a sight to remember, not just because of the uniqueness of the view, but because we all have got to ask ourselves if we really know where we are and what we are looking at right at this moment and when you answer that question, it's yes, it certainly becomes an epic sight in your mind."*

Not even the simulators in Houston could portray the dramatic reality of this moment.

Cernan shaded his eyes from the Sun's relentless glare and tried to remember the view he had in Apollo 10. Outside the spacecraft it was brilliant sunlight as they closed in on the Moon, now large and close by – though Cernan could not see it, he could feel its presence.

Cernan, *"You can literally watch yourself fall down in. As we get closer it's going to be pretty dramatic because we're falling the way you climb on out of the Moon when you leave it. I remember remarks at the time 'Gee if we could see it like this when we came back we'd have to close our eyes."*

Fullerton, *"Roger we agree."*

Cernan, *"Gordy, we're considering putting the window covers on!"*

Fullerton, *"You're chicken, huh?"*

Cernan, *"I don't think anybody in any of the missions had this approach. I think everybody, starting with Apollo 8, went into darkness in the shadow of the Moon, and got on their back and, at a predetermined time, fired the CSM engine –*

in darkness and upside down and going backwards – and then, all of a sudden – maybe five minutes, maybe ten minutes later – we'd come out of darkness at fifty miles or thereabouts above the surface and it's 'WOW! Look at those craters. There it is. Man, it's just like instant sunlight and we're THERE!' I mean, it's like we've been flying in the darkness to rendezvous with this thing we can't see (meaning the Moon) *– and we know we're close because we're in the shadow – and all of a sudden, WHAM, someone turns the lights on. And then the next major thing is to come around and see the Earthrise.*

Now, on Apollo 17 – and nobody told me it was going to happen – we went through the darkness and came out into sunlight before we got to the Moon. And we were coming in on this damn target, and we were seeing, to start with, just a sliver, just a slice of the Moon. And then we started to see more of it as we snuck around behind it. And it's getting big so fast you can't believe it. And I'm telling you, you talk about rolling over on your back and making a dive bombing run at some point some 50 or 60 miles above the surface! That was the most spectacular entry into lunar orbit. I don't think any of the other flights ever saw that.

I put my eye to the monocular and wow! I could see straight down into some of the craters. High ridges rolled away over the horizon like waves of an ocean."

Cernan, *"I never thought I'd see a geologist speechless at his first near shot at the Moon, but I haven't heard a word from him yet."*

Schmitt, *"This geologist turned engineer for an hour."*

Fullerton, *"He's probably speechless because there's no clouds to talk about."*

Schmitt added his impressions, *"The main thing that gets your attention first is the spacecraft sunrise – it's actually a lunar sunset – where you have absolute black and gradually you start to pick up these brilliantly illuminated bits of the mountains and craters below you, also you see no sign of an atmosphere – of course I knew there was no atmosphere – but the Earth's atmosphere is so distinctive when you don't see one on the Moon that gets your attention."*

It was time to go into lunar orbit (LOI).

Fullerton, *"Apollo 17, Houston. If you three are interested in sticking around for a while, you have our GO for LOI."*

Cernan, *"Roger Houston. Understand. America is GO for LOI. And let it be known that the crew of America is GO for LOI."*

Tracked by Madrid and Goldstone, Challenger disappeared behind the Moon at 88:43:21 GET (0636:21 AEDT), almost exactly four years after Apollo 8.

Into Lunar Orbit

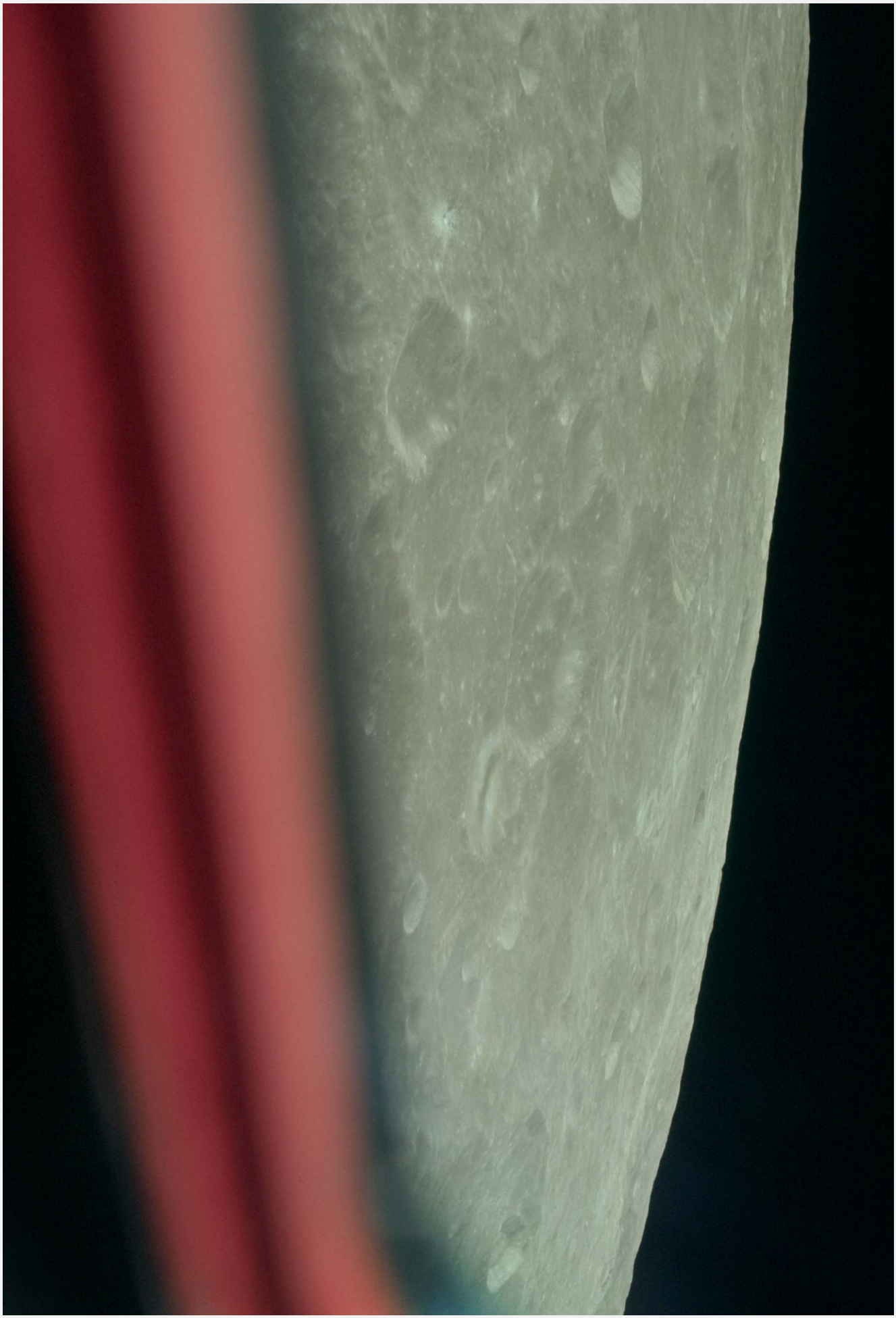
At an altitude of 142.2 kilometres above the Moon with 88:54:22.6 hours on their GET clock (0647:22 AEDT) they fired the SPS motor for 6 minutes 33.16 seconds to place them in a 97.4 by 314.8 kilometre elliptical orbit.

They had been travelling from Earth to the Moon (TLC) for exactly 83 hours 2 minutes 18 seconds.

Once they were in orbit Schmitt glued himself to his window and launched into an excited tirade of descriptions of the lunar surface,

"Going into lunar orbit gave me a chance as a geologist to begin to look first hand at features that I had seen only in photographs. As you fly over these features such as crater Copernicus you get to see a three dimensional view that I had never been able to do from photographs at the time. One thing, though, on our early orbits we had strong Earth light in the part of the Moon not illuminated by the Sun and I was impressed by how strong that light was; I could see all the features I was familiar with very distinctly – it was strong enough to cast shadows."

Then suddenly they plunged into the Moon's shadow for about an hour, emerging back into sunlight at 0439 AEDT. Cernan felt a slight impression of vertigo, as if he was falling down a shaft to pancake onto a crater. Schmitt was also impressed by the sheer bulk of the rock floating in front of them, and became silent, again unable to communicate his feelings.



A Moon with a View! Image: NASA

The S-IVB impacted the lunar surface at 89:39:42 GET (0732:42 AEDT). The impact point was latitude 4.21° south and longitude 12.37° west, 155.6 kilometres from the target point, 339 kilometres from the Apollo 12 seismometer, 157 kilometres from the Apollo 14 seismometer, 1,032 kilometres from the Apollo 15 seismometer, and 850 kilometres from the Apollo 16 seismometer. The impact was recorded by all four ALSEP instruments from the previous missions. At impact, the S-IVB was travelling at 9,180 kilometres per hour.

At 90:43:00 GET (0836 AEDT) the spacecraft went behind the Moon's rim at the end of its first orbit and Goldstone's Net 1 loops fell silent.

Flight Director Pete Frank' of the Orange Team in Mission Control received a *'GO'* for a DOI burn from all the positions so at 93:11:37.43 GET (1104:37 AEDT), just after the start of the third orbit behind the Moon and just under 23½ minutes before we had AOS, a 22.27 second SPS Descent Orbit Insertion (DOI) burn was executed to lower the CSM to the descent orbit of 109.2 by 26.8 kilometres in preparation for undocking the LM, and for the astronauts to familiarise themselves with the landing area. Gazing out of his window Schmitt snapped out of his trance and launched into a breathless geologist's description of the lunarscape passing by, *"not mere sentences, but whole paragraphs in a single breath,"* Cernan commented.

Schmitt called down, *"My goodness, Bob. This is Jack. It's awful hard to spend much time up here anticipating. The events come so fast, and certainly are exciting and rewarding, each one, one at a time. But obviously tomorrow is going to be the biggie."*

It is interesting that with all the high tech equipment around them, a humble pair of scissors was a life threatening important part of their kit. It was all they had to slice open their food packs. There were three pairs – one for the CSM and two for the LM. The Command Module's pair was lost, and Evans was determined to find them.

Evans, *"If ever I find my pair of scissors here one of these days I think it takes about 4 bolts on either side of the optics – where they stow the optics? It looks like there are four little bolts that'll come out. And I think they may be back behind there. There's a great big slot up at the top – oh, it's at least an inch between the top of the optic thing and the top of the spacecraft. I looked back there with a flashlight but couldn't see anything."*

Schmitt, *"I think the Commander might have something to say."*

Cernan to Parker, *"Hey, Bob, just ignore everything he said. We'll leave him a pair of our scissors – he's just worried about being hungry."*

Parker, *"Roger, Those are your EVA scissors too, aren't they?"*

Cernan,
"Yeah, but we can handle it with one down there. He is not taking the spacecraft apart to find his scissors, and I will not let him go hungry."

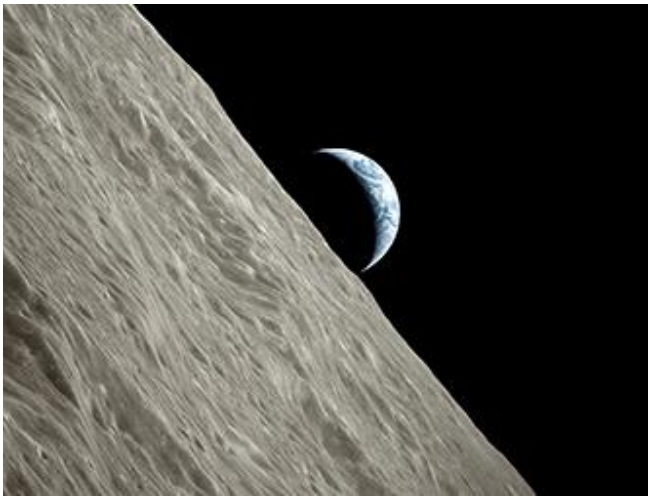
The CSM/LM combination was retained in this orbit 17 hours before the spacecraft were separated, giving the astronauts a rest period beginning at 97:47:07 GET (1540:07AEDT) during the fifth orbit around the Moon.

At 98:52:00 GET (1645:00 AEDT) in Mission Control Pete Frank's team handed over to Gene Kranz and his White Team.

During the ninth orbit at 105:45:00 GET (2338:00 AEDT) the astronauts woke up to the words *"Good morning, America, how are you?"* from the song *"The City of New Orleans"* sung by Arlo Guthrie.

Capcom Joe Allen, *"Good morning America, how are you?"*

Evans, *"This is America, that's a good way to wake up. Thank you, Joe, that's great."*



HSK MISSION DAY 6
TUESDAY, 12 DECEMBER 1972
LUNAR LANDING & LUNAR STAY DAY 1

Times: AEDT (HSK local time)

EVENT [4]	GET	AEDT
CSM/LM undocking	110:27:56	0420:56
LM touchdown [5]	113:01:58	0654:58
Cernan on surface	117:11:09	1104:09
EVA-1 – 7h 11m 53s	117:01:49 124:13:42	1054:49 1806:42
TV through HSK – 4h 55m	118:40:00 123:34:00	1232:00 1727:00
First Apollo 17 ALSEP data received	120:01:00	1354:00

[4] CSM orbits 15 through 21

[5] Landing Coordinates : 20.18809° N 30.77475° E

Prime HSK	Track Duration	AOS/LOS
LM, Rover, ALSEP1&4	10h 40m 00s	1232:00 2312:00

Handovers	AEDT
LM/Rover 2-way from GDS	1525:00
LM/Rover 2-way to MAD – 8h 13m	2338:00

Wing HSKX	Track Duration	AOS/LOS
CSM [6]	9h 4m 00s	1222:00 2126:00

Handovers	AEDT
CSM 2-way – 7h 55m CSM 3-way	1405:00 2200:00
CSM 2-way to GWM – 0h 22m	2131:00 2153:00

[6] CSM orbits 16 through 20

DSS43	Track Duration	AOS/LOS
CSM	11h 7m 00s	1222:00 2329:00

Parkes	Track Duration	AOS/LOS
LM - Rover	8h 01m 00s	1349:00 2150:00

They began dressing into their space suits during the 10th orbit, Cernan saying, *"Gordo, we're hustling like heck – we might make it,"* as they vanished around the corner.

They entered the LM at 107:42 GET (0835 spacecraft time, 11 December, 0135 AEDT) and organised the ships for separating.

The Last Apollo Lunar Landing

As they entered their thirteenth orbit, they undocked with a 3.4 second RCS burn at 110:27:56 GET (0420:56 AEDT) at an altitude of 87.4 kilometres, while in an orbit of 113.9 by 21.3 kilometres.

Only Madrid was tracking during the undocking, with Goldstone joining in for the landing itself. It was breakfast time in the early morning at Honeysuckle Creek, out of sight on the other side of the planet.

At 110:59:39 GET (0452:39 AEDT), after undocking, Cernan called,

"Gordo, we've got the landing site – we're coming right over the front of it – stand by a minute, you can see the Slide; I think you can see the Great Cross."

Fullerton, *"Roger."*

Cernan, *"We'll get a picture of America coming right across it."*

Fullerton, *"All righty."*

Schmitt, *"Super targeting."*

Cernan, *"Gosh, we've got Family Mountain; we've got, of course, the Massif; we can see the Scarp; we can see the light mantle, I've got the Great Cross, Camelot, Sherlock"*

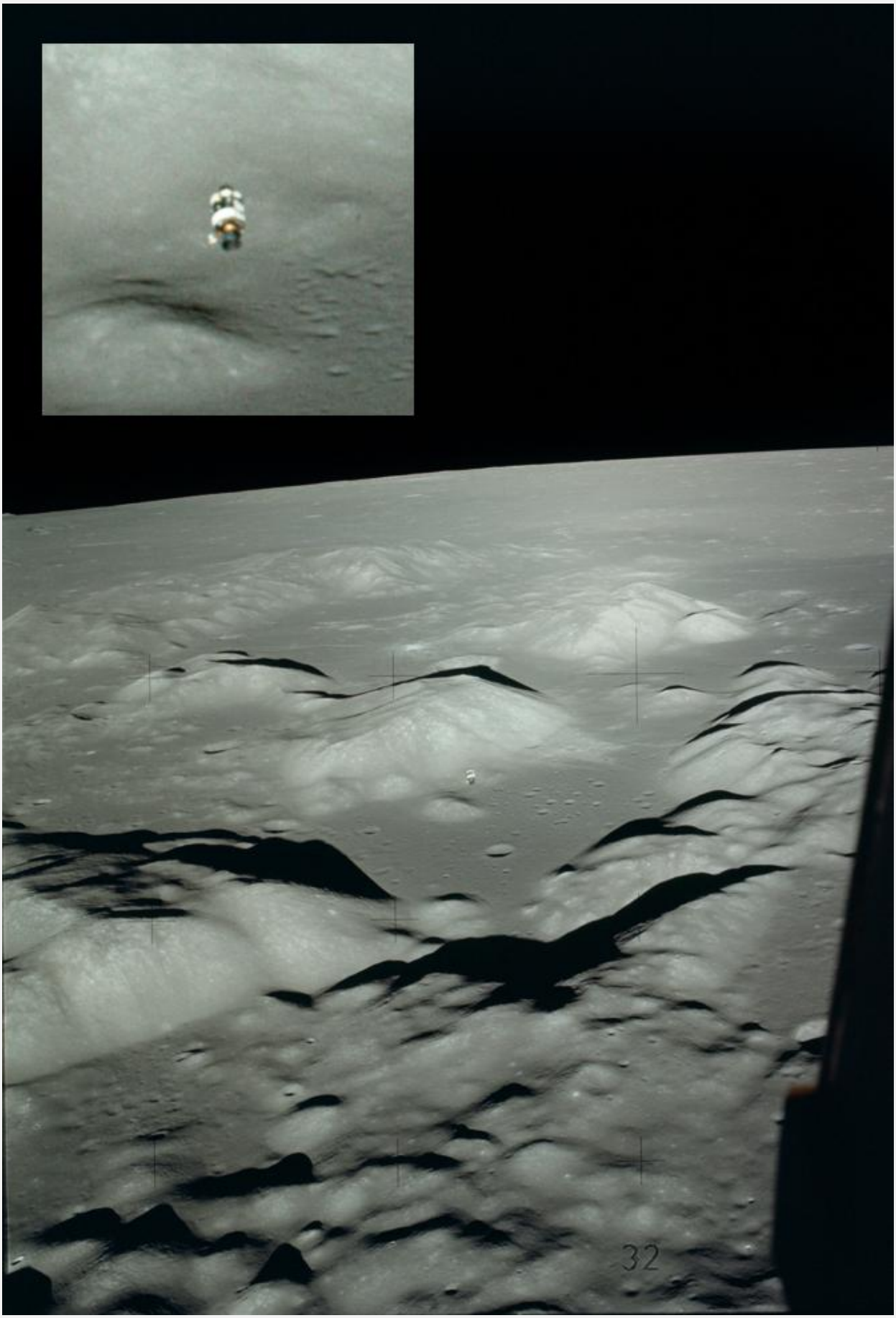
Schmitt,
"Believe it or not, Houston, they're all there."

Fullerton, *"How about that."*

Schmitt, *"I see possible structure in the upper part of the South Massif, a little bit east of station 2. It's sub-horizontal, dipping to the south east."*

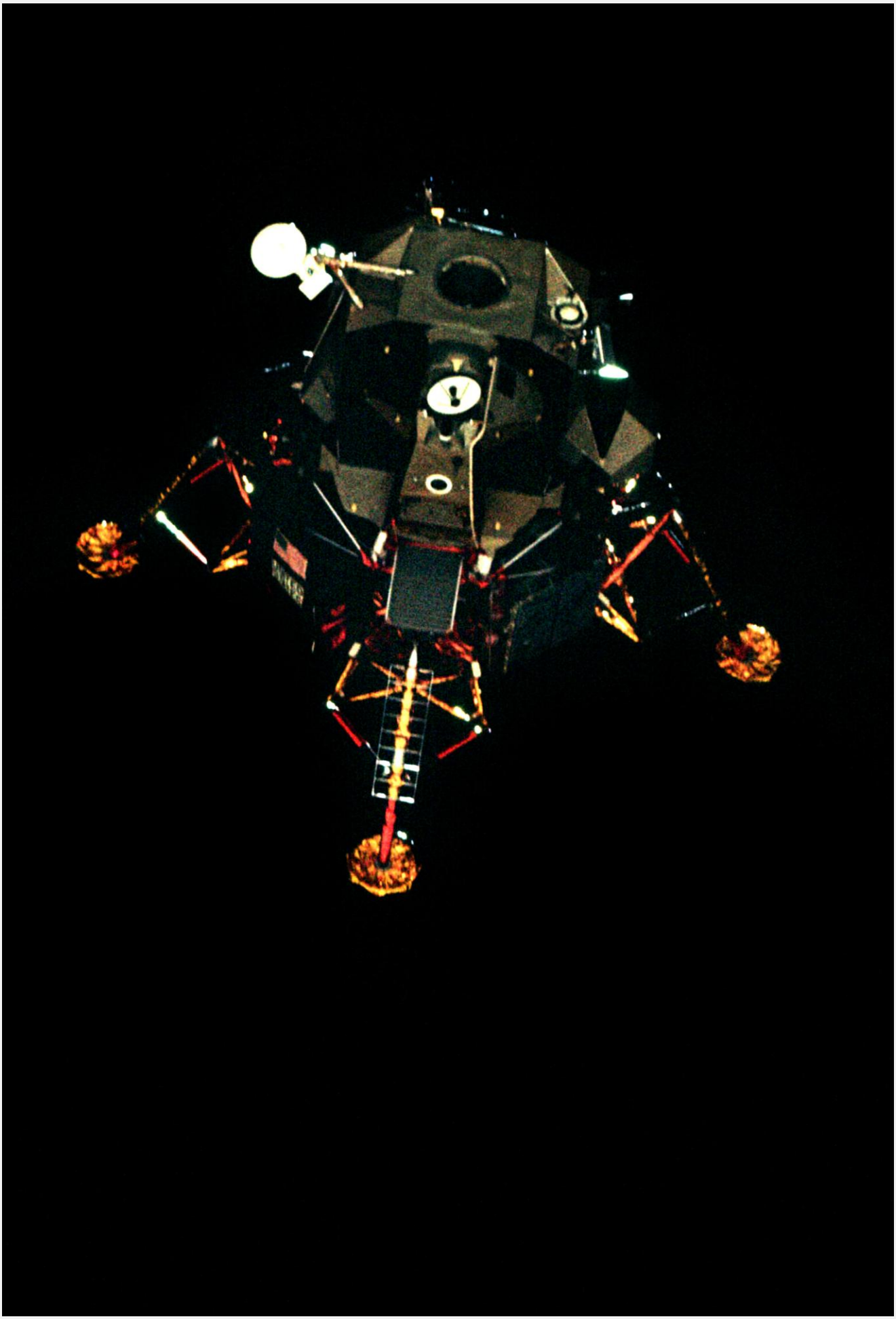
Cernan, *"Houston, I can even see Poppie, right where we're going to set this baby down."*

Fullerton, *"Very good."*



Lost among the Mountains of the Moon. Image: NASA

The CSM America speeds over the lunar surface, photographed from the Lunar Module. Below the CSM lies the target for the mission, the Taurus-Littrow Valley with the Sculptured Hills in the foreground. Directly behind the CSM is South Massif and to the right is North Massif. Away in the distance is Mare Serenitatis. Close-up of CSM in inset.



Challenger hangs in the blackness of space after separation from America. Image NASA

Cernan,

"As a matter of fact I can see Rudolph. I can even see the Triangle; Rudolph, Frosty and Punk. Man - Gordo, this is absolutely spectacular!"

Fullerton, *"Sure sounds like it."*

After undocking, the CSM backed away with a 3.8 second burn at 111:57:28.9 GET (0550:28 AEDT) to circularise its orbit to 129.6 by 100 kilometres. At 112:02:42 GET (0555:42 AEDT) a second LM descent orbit insertion burn of 21.5 seconds lowered its orbit to 110.4 by 11.5 kilometres. From this orbit, at a height of 17 kilometres, a long 12 minute 5 second Descent Propulsion System (DPS) burn at 112:49:53 GET (642:53 AEDT) set the LM on a course for the lunar surface.

Cernan, *"Ignition, Houston. Attitude looks good. Engine override is ON, Master arm is OFF. We got a Descent Quantity Light on at ignition ... just prior to ignition."*

This light was warning there was not enough fuel to land but actually was a false warning. Cernan and Schmitt both knew that they had enough fuel and decided it wasn't particularly important.

Cernan noted, *"Theoretically, by the numbers, we probably should have aborted. But you don't just do things; you don't overreact."*

Cycling the PQGS (Propellent Quantity Gauging System) switch extinguished the light.

Now they were zipping along 17.3 kilometres above the lunar surface, lying on their backs, with their feet facing forward, looking up at the black sky. Cernan flew the LM a little south of the CSM's orbital plane so they could line up with the axis of the Taurus-Littrow Valley.

Coming in to land Schmitt called the numbers while Cernan skilfully steered the LM into the Valley of Taurus-Littrow.

"I knew this place better than the palm of my own hand," wrote Cernan, *"And there were no surprises as we zoomed towards the jagged highlands that separate the Sea of Tranquillity from the Sea of Serenity."*

Schmitt, *"My job was to make sure that the Commander had all the information that he needed in order to identify where the computer was taking us for our landing so if that did not look like a good landing spot he could what we call redesignate, to tell the computer to change where it was taking us, and he had to look out the window the whole time. He had a grid in his window that he could use, and I gave him numbers to look at on that grid. Then as we got closer to the surface I was giving him the horizontal and lateral velocities as well as the rate of descent.*

So, my job was basically to act as a transmitter of information to the Commander so he could undertake a safe landing. I did glance out the window a couple of times."

Listen to the Descent and Landing

This recording of the Apollo 17 descent and lunar landing was made at Honeysuckle Creek.

Goldstone was tracking and so this was recorded from the Net 1 feed. It begins as Challenger is at 57,000 feet (17.3km). Touchdown is 10'41" into the recording. Preserved by Alan Foster. Transfer by Colin Mackellar.

LISTEN

11.8MB mp3 file. Running time: 13m 25s

Cernan felt the LM had become part of him, responding to his every command,

"Hey, I don't need numbers any more. I got it."

He felt it was hard enough keeping his focus on what was coming and too busy to listen to any more data, for the numbers didn't tell the whole story. What he saw outside through the window forced decisions on when to slow down, dodge left or right or maintain a steady rate.

From 8 kilometres east of the landing site, at an altitude of 3,810 metres, Cernan kept Houston informed,

View from the Lunar Module *Challenger* as it descends towards the Taurus-Littrow Valley. Image: NASA/16mm

The shadow of the LM on final descent can be seen at top left. Image: NASA/16mm

"Okay, Gordo, I've got Nansen; I've got Lara; and I've got the Scarp…. oh, man, we're level with the top of the Massifs now!"

Then at a height of 3,657 metres Cernan started to bring the spacecraft upright and could now begin to see their target with crater Poppie in his sights.

All the earlier Apollo flights had the Earth overhead as they came in to land, but in Apollo 17 the astronauts were looking straight at the Earth as they came down the valley.

At 2,133 metres they were upright, and Cernan wrote, *"Earth now dangled like a colourful Christmas ornament smack-dab in the middle of Challenger's window."* Slipping between North Massif on their right, and South Massif on their left, the LM hopped over an unexpected huge boulder and deep hole before heading towards the crater Camelot. Beyond were jagged, tooth-like rocks rearing out of the lurain. At 300 metres Cernan felt the chosen target looked good…

Challenger's Touchdown

Cernan: *"Stand by for touchdown."*

Schmitt: *"Stand by. 25 feet, down at 2. Fuel's good. 20 feet. Going down at 2. 10 feet. 10 feet."*

Spotting a clear patch Cernan dropped the Lunar Module onto the lunar surface. The dangling sensors brushed the lurain, triggering the blue console light on, and Schmitt immediately announced, *"Contact."*

Cernan shut the motors off, and the spacecraft suddenly dropped like a stone. The two astronauts felt as though their stomachs were jolted up into their throats.

Landing occurred at 113:01:58 GET (1354:58 spacecraft time on 11 December, or 0654:58 AEDT on 12 December).

Challenger had landed in the Taurus-Littrow region at latitude 20.18809° North and longitude 30.77475° East (Davies et al 1987), within 200 metres east of the planned landing point.

Madrid was prime station for the landing sequence, with Goldstone joining in just before the landing itself.

At Honeysuckle Creek we still had to wait for 5 hours 38 minutes for the Moon to rise for us to see Challenger's signal.

Inside the LM all the tensions, decisions and action of the descent suddenly evaporated. Both astronauts were stunned by the sudden stillness and silence; the only sound their breathing in their helmets. Even the loquacious Schmitt was staring out of the window, speechless. They had been so busy flying the spacecraft with Schmitt calling out numbers and occasional Houston comments there was little time to be aware of anything else.

Cernan recovered, took his hands off the thruster controls, and announced,

"Okay Houston, the Challenger has landed!"

Fullerton, *"Roger, Challenger. That's super."*

Cernan to Fullerton, *"Boy, you bet it is, Gordo."*

Cernan to Schmitt, *"Boy, when you said shut down, I shut down and we dropped, didn't we?"*

Schmitt, *"Yes, sir! But we is here."*

Cernan: *"Man, is we here!"*

Cernan explained how he landed, *"You hit the stop button when you're ten feet above the lunar surface, the length of the probes sticking down from each of the struts. You're coming down at two or three feet per second, and you've got noise, and the engine is effectively holding you up. True, you're in one-sixth gravity and you don't tend to fall very fast. But all of a sudden, one of the probes touches, you get the contact light, you shut that thing down and boom, your stomach goes up in your throat for a split-split second. You've shut down all your thrust – and it shuts down immediately – and you go 'burrup'."*

Schmitt said, *"Gene landed the LM as if it were an everyday event."*

Cernan noticed that they had left the Earth almost at New Moon. As they stayed there the fraction of the Earth that was sunlit got less and less and it got to be a three quarters Earth and then a half Earth by the time they left lunar orbit to come home.

Once they had completed the post-landing procedures for an emergency lift-off, and a check on the spacecraft systems was satisfactory, they took off their helmets and gloves about 18 minutes after touchdown. A check showed they still had fuel for 117 seconds of flying left, so they could have had a tour around the valley before landing, but Cernan was intent on getting the spacecraft down quickly and safely.

Jokingly Schmitt asked, *"Where'd you land? You never let me look outside at all. Hey, you can see the boulder tracks!"*

Schmitt could see long trails down the steep slopes of North Massif where dislodged boulders had rolled down, leaving strings of small craters where they had bounced in the air and crash landed on their way down.

Cernan,
"God, there are some holes and rocks around here. Who told me this was a flat landing site?"

Schmitt, *"It is flat! For crying out loud, what do you want? An airtight guarantee?"*

Cernan noticed the LM was not quite level, *"Let's see, we got about 2 degrees left roll and about 5 degrees pitch-up."*

Climbing Down the Ladder and onto the Lunar Surface

The first EVA commenced four hours after landing, at 117:01:49 GET (1054:49 AEDT) with the de-pressurisation of the LM cabin. When the pressure had dropped low enough Cernan leaned down and pulled on the handle to open the hatch. The moment the hatch opened all the remaining oxygen rushed out taking anything lying around with it. The astronauts had to be careful to stow any loose items away before opening the hatch.

Coming to the end of his EVA checklist, Cernan then announced:

"Well, the next thing it says is that Gene gets out!"

Schmitt, looking at his cuff checklist:
"I don't see that."

Cernan: *"That's what it says on my checklist"*

Cernan got down on his knees and pushed his feet through the hatch and began to crawl out backwards.

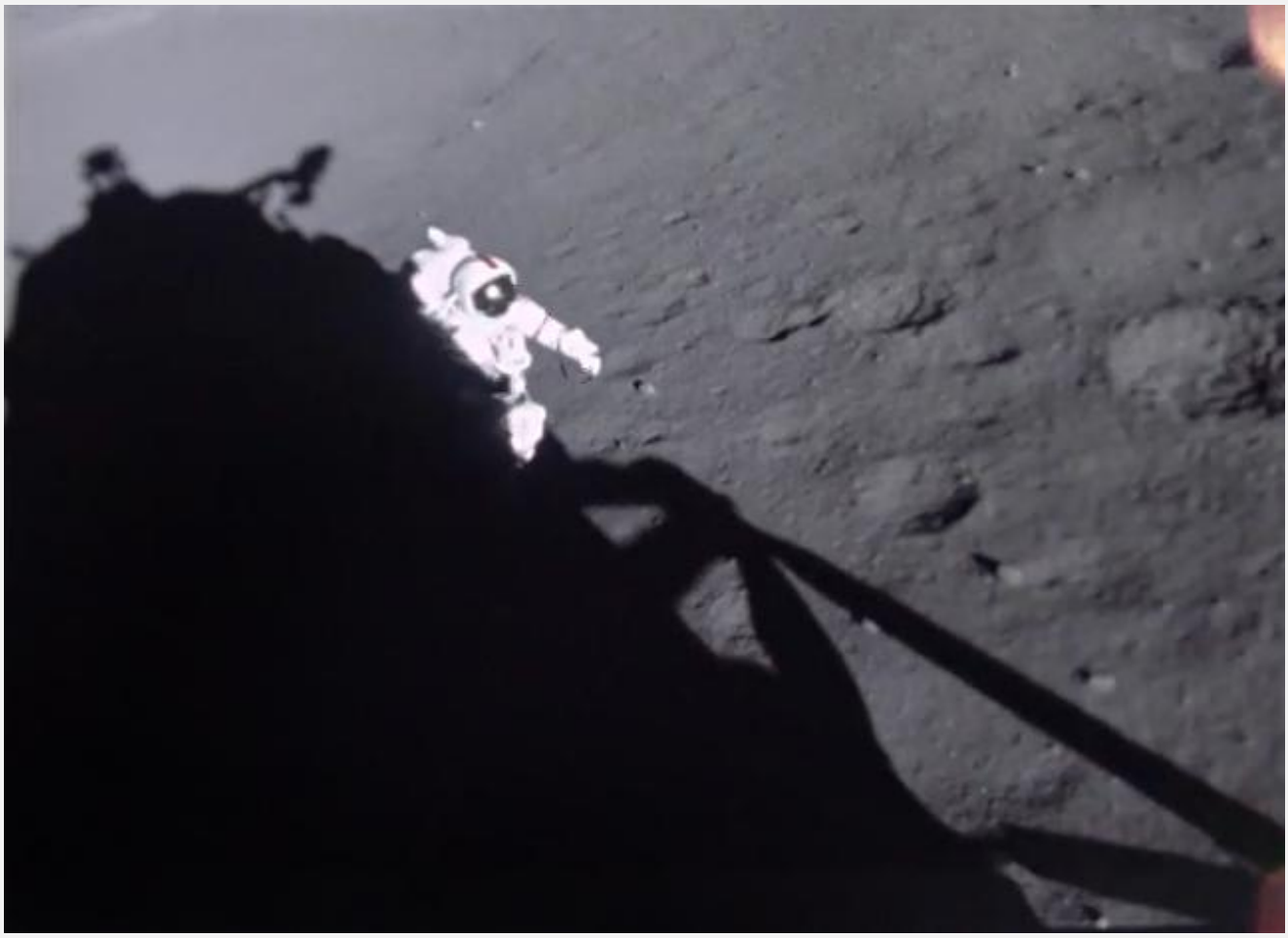
Cernan: *"How are my legs? Am I getting out?"*

Schmitt:
"Well, I don't know, I can't see your legs."

Cernan: *"Oh, okay."*

Schmitt: *"I think you're getting out though, because there's not as much of you in here as there used to be..."*

As in all the Apollo missions the LM landed early in the morning with the ladder facing to the west, therefore it was in shadow throughout the landing activities. This time there was no MESA TV camera to record the first steps; it was sacrificed for more fuel for extra hover time. It wasn't until



Commander Gene Cernan taking some of his first steps on the surface of the Moon. Image: NASA/16mm

the Rover camera came on line that Earthlings could see what was going on.

Cernan climbed down onto the lunar surface at 117:11:09 GET (1104:09 AEDT) and announced,

> *"I'm on the footpad, and Houston, as I step off at Taurus-Littrow we'd like to dedicate the first step of Apollo 17 to all those who made it possible."*

He looked around at the looming mountains, giant boulders, landslides, and craters. Though there was no sign of a green blade of grass, an insect, an animal or a cloud, he had a comfortable feeling of belonging. Then to his satisfaction he found they had landed next to the crater he had called Punk, after his daughter.

"Jack, I'm out here. Oh, my golly! Unbelievable! But it is bright in the Sun…. okay. We landed in a very shallow depression. That's why we've got a slight pitch-up angle. It's a very shallow, dinner-plate like dish crater just about the width of the struts. How you doing Jack?"

As Schmitt crawled backwards onto the porch Cernan was exploring around the LM,

"Hey, Bob. I'm East of the LM now and the back strut of the LM is…. well, the LM straddles this crater I talked about, and that's where we get the pitch angle; the back strut is probably right down in the eastern one third of the crater. Just a very subtle crater."

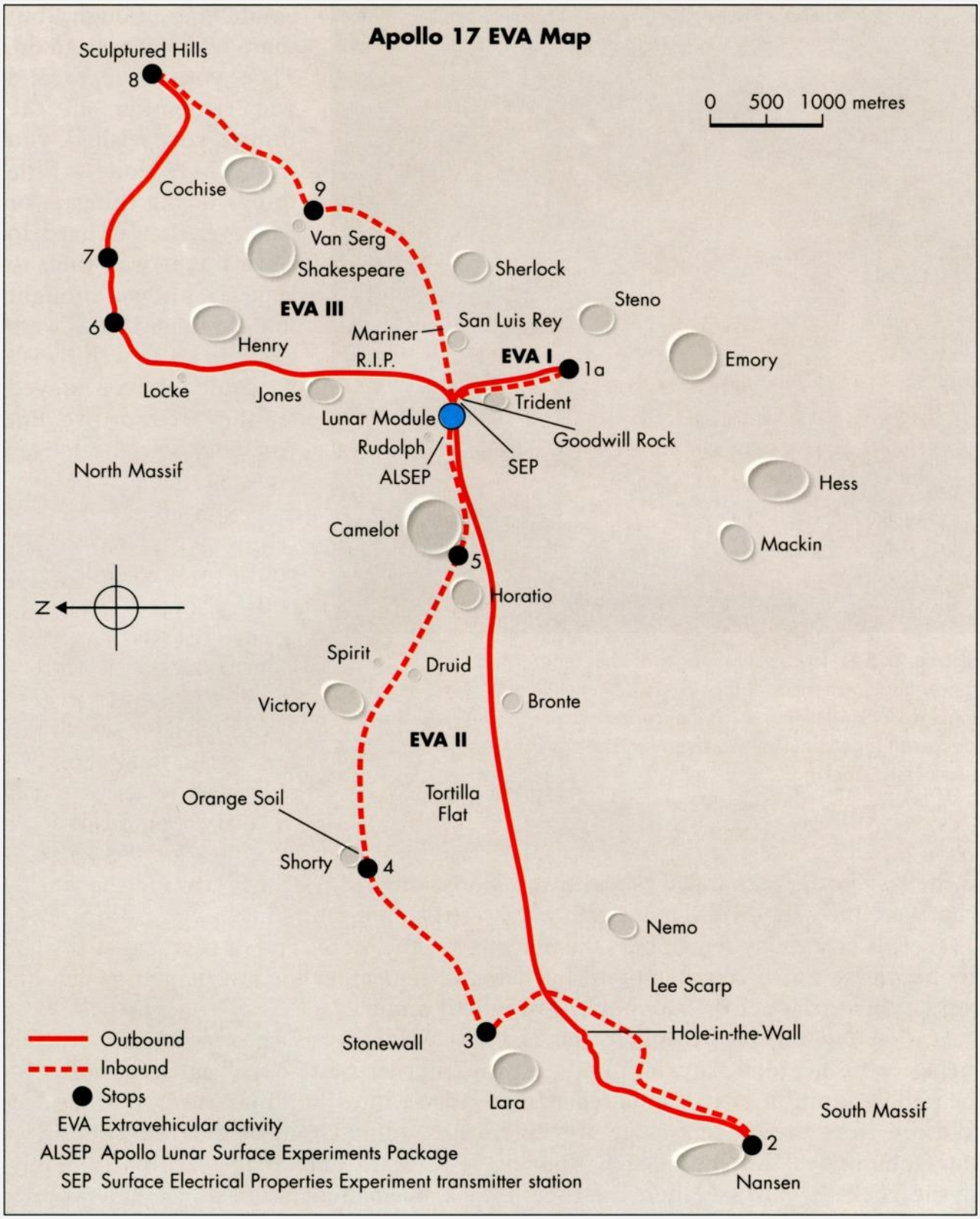
Showing their confidence in the mission equipment, neither John Young in Apollo 16, nor Cernan collected contingency samples.

Cernan wrote, *"Learning how to walk was like balancing on a bowl of Jell-O, until I figured out how to shift my weight while doing a sort of bunny hop."*

Schmitt,
"Hey, man. You had some forward velocity!"

Cernan, *"That's what I wanted to have."*

Cernan, *"Boy. Look at some of those rocks that are filleted here, Jack….and there are sure a lot of sparklies in them. Awful lot of sparklies."*



Apollo 17 traverse map. Created by Hamish Lindsay.

Cernan was excited to see that the soil glittered with what seemed like millions of tiny diamonds, but geologist Schmitt joined him and blew the magic away when he told him they were specks of glass, *"…like a vesicular, very light-coloured porphyry of some kind; it's about ten or fifteen percent vesicles."*

Schmitt, *"After working around the Lunar Module for about half an hour, it wasn't until I moved away from the Lunar Module to take some photographs that I began to see this entire scene before me in a deep mountain valley – the mountains on either side were 2,300 to 2,000 metres high, brilliantly illuminated by a Sun as*

bright as any Alice Spring's sun that you've ever seen. It really was a spectacular sight, particularly when you looked above the south western mountain where this beautiful blue planet Earth was hanging up there – always in the same spot in the sky. Any time you wanted to see home all you had to do was look up.

The black sky was the hardest to get used to. You're so used to a blue sky on a bright sunny day on Earth – a bright sunny day on the Moon gives you a jet black sky.

The Earth does look bigger than the Moon from Earth by a factor of four in terms of area, but you don't have any references such as houses, or trees or power poles so it's very difficult to say, yeah, it looks bigger. Early on it looked like the size of a two thirds Moon."

Officially the Earth spans 2º of the lunar sky.

In his book Cernan says he found the bright blue Earth kept drawing his gaze away from the colourless surface around him. He felt it was the most spectacular sight of the whole journey. However, when he tried to get Schmitt to be awestruck too, he was taken aback by Schmitt's blasé reaction.

I asked Schmitt what his reaction to Cernan's comment was,

"Well, I was very impressed with the Earth for three days on the way out to the Moon. While I spent those three days Gene may not have been feeling quite as good as I did and didn't spend as much time looking at the Earth. I had been looking at the Earth for three days, so for me, if I had seen one Earth I had seen 'em all."

The First Excursion in the Lunar Rover

The Goldstone and Honeysuckle Creek complexes supported the first EVA and Rover excursion, Goldstone carrying the tracking until we picked up the signal at 118:39:00 GET (1232 AEDT) at Honeysuckle Creek Prime. The 26 metre diameter dish at Honeysuckle Creek's Wing site and the new 64 metre dish (DSS43) at Tidbinbilla tracked the CSM. Parkes provided good television signals from the Rover. Goldstone dropped off at around 1710 AEDT and we were then the only contact with the astronauts until the end of the EVA.

The crew began to offload the Lunar Rover at 117:31:10 GET (1124 AEDT).

The first television picture from the Rover was received at Houston at 118:14:05 GET (1207:05 AEDT).

Before setting up the flag and deploying ALSEP, at 118:19:06 GET (1212:06 AEDT) Cernan calibrated the Lunar Traverse Gravimeter. A unique experiment to Apollo 17 it was primarily used to make relative gravity measurements at a number of sites in the landing area to obtain information about the geological substructure. Readings were to be taken at the beginning and end of each excursion, and the instrument was not to be disturbed while measuring. All Cernan had to do was push a button marked GRAV to start the cycle and push another after 3 minutes to see the result. The crew read the results back to Earth. It was successful, the results suggesting that the basalt layer filling the valley was about 1 kilometre thick.

Cernan, *"Let me steady the Rover and punch the button… okay, Bob – mark, gravimeter – and the light is flashing."*

The light flashed to warn the astronauts not to disturb the gravimeter while it was measuring.

Schmitt began singing, *"Oh, bury me not on the lone prairie, where the coyotes howl and the wind blows free. Okay, where am I? – You're doing a gravimeter reading and getting the flag. I've got your camera – I'm going to salvage the scissors."*

Cernan, *"Okay, get the scissors and I'll be putting the flag in. And don't go near the Rover,"* so Schmitt hung the scissors on a hook on the Lunar Module ladder.

Raising the Flag

Then they began to assemble and set the Stars and Stripes flag flying for the TV camera at 118:20:58 GET (1213:58 AEDT).

Cernan, *"Okay Jack, how about the flag right over here in this little mound?"*

Schmitt, *"Which mound?"*

Cernan, *"Well, let me take a look here."*

Schmitt, *"How about right up there on that little high point?"*

Cernan trialling the Lunar Roving Vehicle.
Image: NASA – Colour corrected, courtesy Kipp Teague's Apollo Image Archive.

"Hallelujah, Houston, Challenger's baby is on a roll," called Gene Cernan. After unloading the Lunar Rover, Cernan took it for a spin before loading it with all the equipment required for their scientific exploring. Here he is racing past Jack Schmitt and his camera.

Cernan, *"Right up in here where I'm going."*

Schmitt, jokingly with a laugh, *"Yeah. Of course – your idea of a high point might be different to mine. I meant the North Massif!"*

Cernan, *"That's probably the best place in the world for the flag – right up on top."*

They moved over to the rim of a small 1.8 metre crater and Schmitt pushed the lower half of the flagpole into the regolith before Cernan belted it in with his hammer about 16 times. The staff broke through a hard layer and penetrated about 40 centimetres into the surface. Cernan inserted the top half with the flag, and they tried to smooth the cloth out. The flagpole was embedded firmly enough to resist the blast from the launch rocket and remains standing to this day.

Cernan, *"We'll take a couple of pictures this way, and we'll take a couple that way. How's that?"*

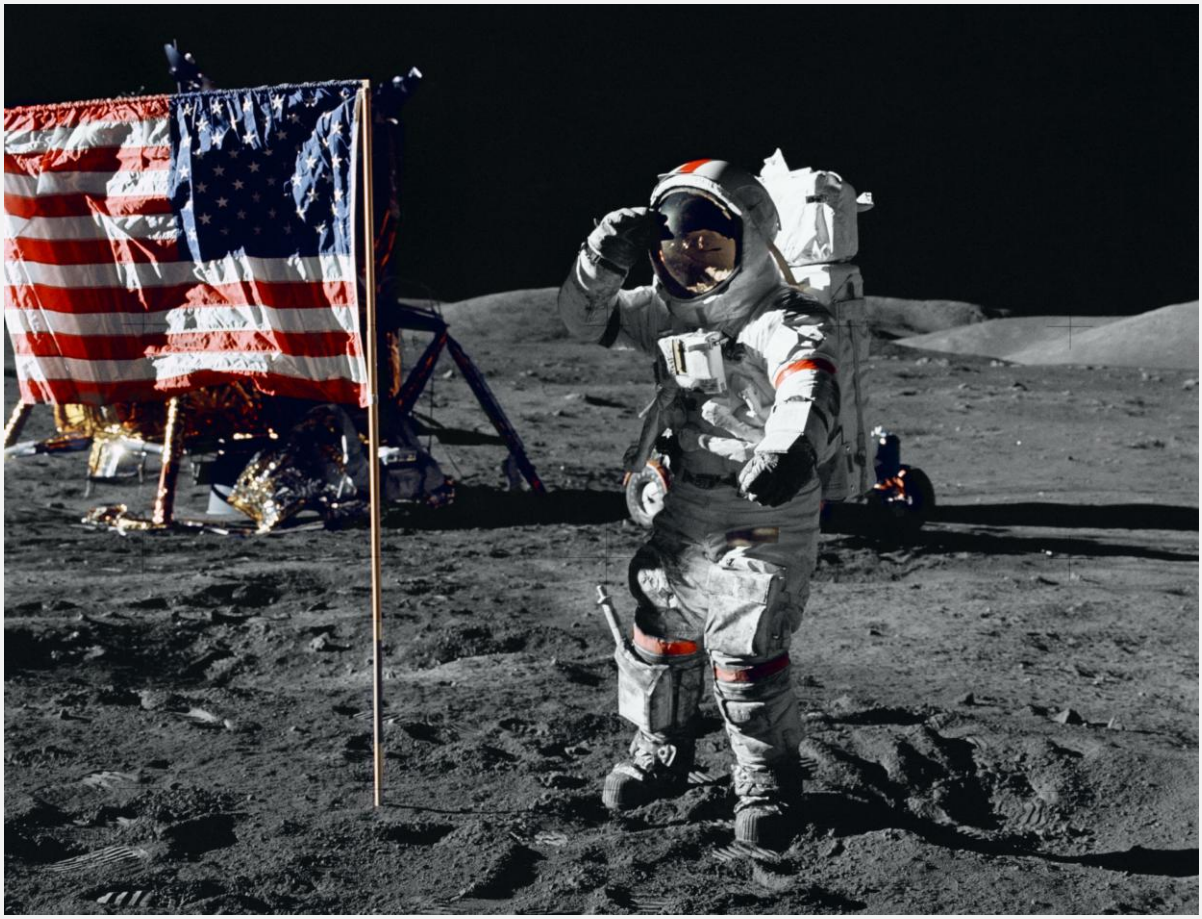
Cernan turned the flag to point east, *"We can get the Rover in the background."*

Schmitt, *"Yeah… and the LM."*

Cernan, *"This has got to be one of the most proud moments of my life, I guarantee you."*

Schmitt, *"Houston, I don't know how many of you are aware of this, but this flag has flown in the MOCR (Mission Operations Control Room at the Johnson Space Center in Houston) since Apollo 11. And we very proudly deploy it on the Moon, to stay for as long as it can, in honour of all those people who have worked so hard to put us here and to put every other crew here and to make the country, United States, and mankind, something different than it was."*

Above: Jack Schmitt, US flag and Earth. **Below:** Gene Cernan salutes the flag. Images: NASA



Parker, *"Roger, 17, and presuming to speak on behalf of some of those that work on the MOCR, we thank you very much."*

They then took pictures of each other with the Earth in the sky behind the flag.

Setting up ALSEP

With the flag erected, Cernan moved over to the LM to unload the SEP (Surface Electrical Properties) experiment and put it onto the Rover, while Schmitt set up the Cosmic Ray Experiment. The SEP measured the dielectric properties of the subsurface, which are strongly affected by water or ice, and to work in conjunction with the orbiting radar sounder and other radar experiments. Signals from the transmitter that passed both above and below the lunar surface were picked up by a receiver mounted on the Rover, which also carried a tape recorder to record the data for return to Earth.

By 118:38:30 GET (1231:30 AEDT) Schmitt had begun to unload the ALSEP (Apollo Lunar Surface Experiments) package and set off singing *"We're off to see the Wizard."* Walking around small craters, Schmitt found carrying the 27 kilogram (lunar weight) ALSEP was harder than he expected because it was difficult holding the barbell with arms that were already tired, and he had to carry it over 90 metres to the chosen site. He said, *"You didn't know if you were ever going to recover and be able to use your hands again."*

Schmitt, *"I'm going to go deploy an ALSEP."*

Cernan, *"Have at it."*

Schmitt, *"First I've got to find an ALSEP site."*

Cernan, *"Don't fall into* (crater) *Camelot."*

Then…

Cernan, *"Oh – you wouldn't believe it!"*

Schmitt, *"You did it again,"* thinking Cernan had pressed a wrong button on the gravimeter experiment.

Cernan, *"No….there goes the fender!"*

Schmitt, *"Oh, shoot!"*

Cernan *"And I hate to say it, but I'm going to have to take some time to try… I'm going to have to get that fender back on."*

Parker, *"Okay, was it the rear fender, Geno?"*

Cernan, *"Yeah. Caught it with my hammer, and it just popped right off."*

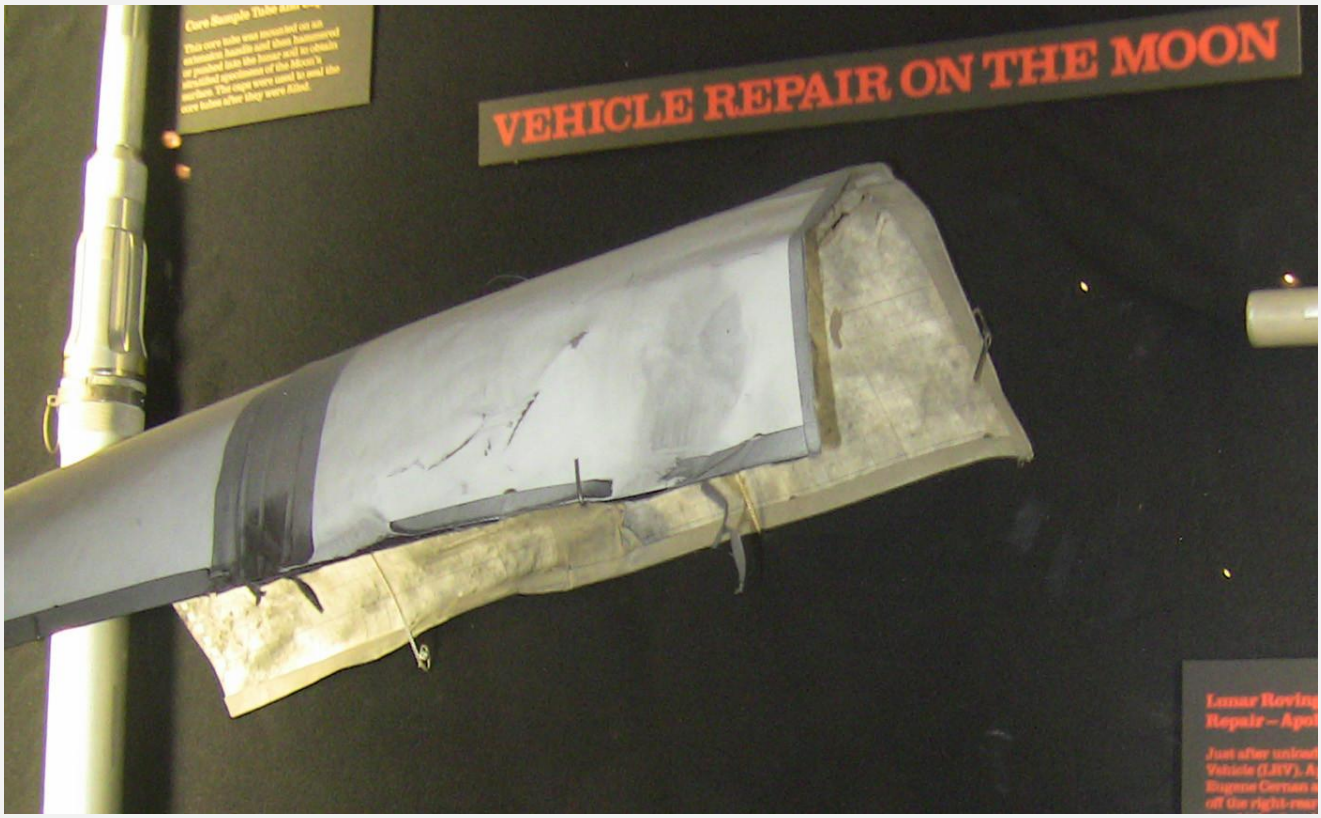
The now familiar routine of exploring around the LM in the Rover was held up by Cernan breaking part of the Rover's dust fender. As Cernan explained to me,

"Yeah, I caught it under my hammer. The reason it was so important to fix it was because of the lunar dust. It's fine like graphite, but rather than a lubricant, it's a friction producing material – it gets into everything – into your visor, into the electronic gear, and when we drove the Rover without that portion of that fender we had a rooster tail of dust thrown completely over the top – over everything, and that was just unacceptable.

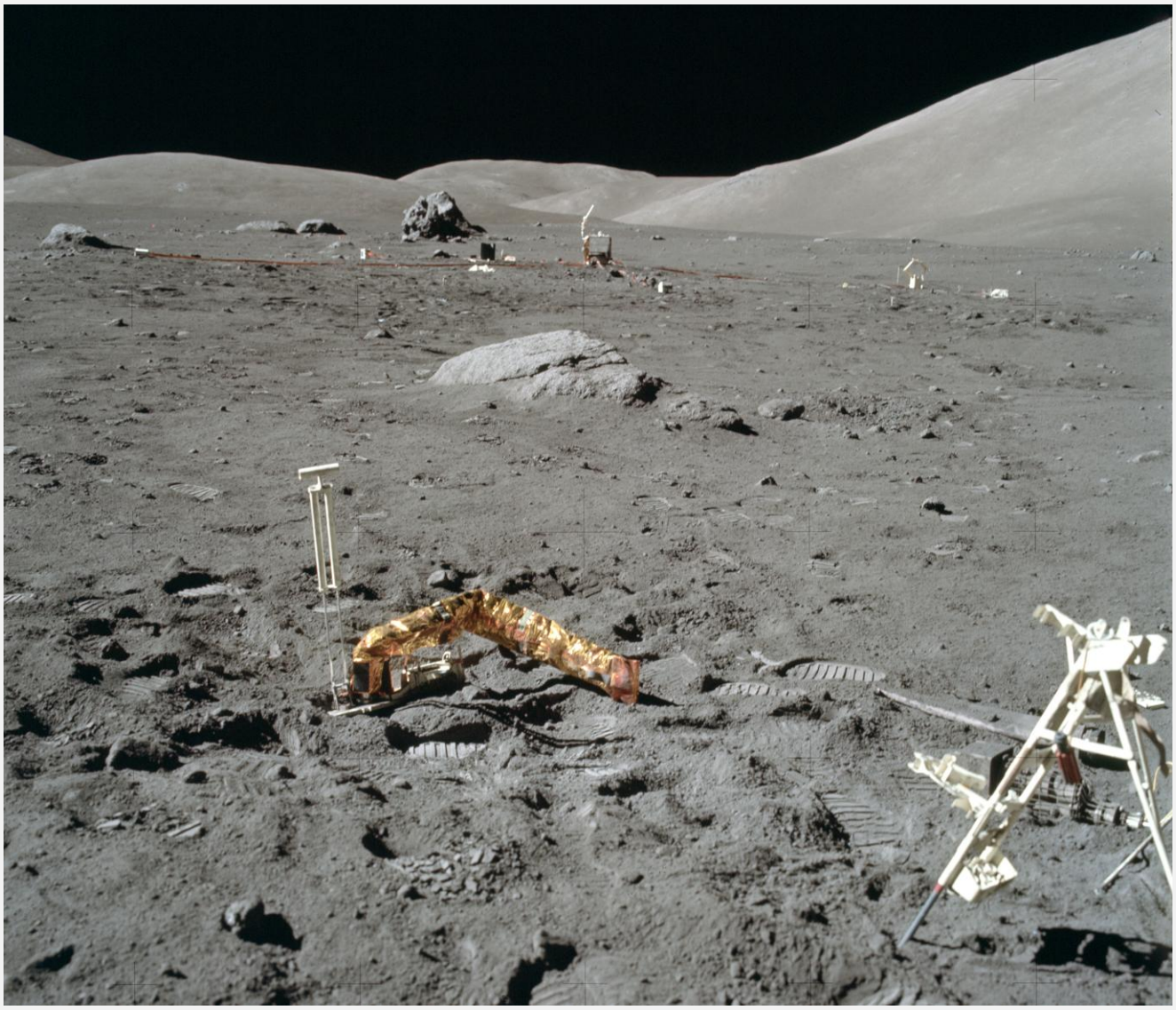
So, we made a fender out of some geology maps.

We took duct tape, but we couldn't use it because of all that lunar dust, we couldn't clean it off enough for the tape to stick. So, we taped a couple of maps together the night before and then had to use light clamps from inside the LM to clamp it on to the existing portion of the fender. When we came home we needed the clamps because they held both lights, so we brought the fender home and it's now in the Smithsonian in Washington."

This was the first automotive repair on the moon.



Above: These are the maps taped together to form a makeshift fender –
on display in the Smithsonian's National Air and Space Museum, Washington.
Photos: Colin Mackellar
Below: Another view looking from underneath to show the lunar maps.



Various parts of the Apollo Lunar Surface Experiment Package, set up on the lunar surface. Image: NASA

The ALSEP station was finally set up 180 metres west north west of the LM and was operational by 121:35:00 GET (1528:00 AEDT).

While Cernan was working beside the LM, Schmitt running back to the LM with some core stems, began to sing again,

"I was strolling on the Moon one day ..."

Cernan joined him in duet, *"… in the merry, merry month of…"*

Cernan, *"May."*

Schmitt, *"December."*

Cernan, *"No, May."*

Schmitt, *"May."*

Cernan, *"May's the month this year."*

Schmitt, *"May, that's right."*

Cernan, *"May is the year, the month."*

Schmitt continued singing,
"When much to my surprise, a pair of bonny eyes … be-doop-doo-doo."

Parker interrupted, *"Sorry about that guys, but today may be December."*

Departure for Station 1

Forty minutes late with setting up the ALSEP experiment, the first excursion of 2.4 kilometres to the crater Emory was shortened by half. The two astronauts climbed aboard the Rover at 121:51:02 GET (1544 AEDT) and set off in a southerly direction for the first station. Originally the plan was to inspect the crater Steno, named after the 17th century Danish scientist Nicholas Stenonis, on the way to the similar crater Emory, a kilometre further on. But due to the late ALSEP deployment they only went as far as crater Steno.

At Honeysuckle Creek, Test Equipment Supervisor Nevil Eyre monitors Rover television as Jack Schmitt sets up the Surface Electrical Properties Experiment. Note the two Ampex VR600 2" video-tape recorders on the left and the older Ampex VR1100 on the right. Polaroid photo scanned by Ed von Renouard.

Cernan advised the ground: *"We're configuring for geology, now, Bob."*

Capcom Parker: *"Okay, copy that."*

On the way they stopped at a site selected for a Surface Electrical Properties (SEP) experiment.

Cernan found that it was hard to rubberneck and drive at the same time. Because they were travelling at up to 10 kilometres per hour and there were no tracks to follow, he had to watch their path for holes and small boulders very carefully, so he left most of the vocal describing to Schmitt.

While driving Cernan found craters of all sizes were scattered over the lurain and large boulders forced him to detour. The hazards were partially buried in the dust, which made it harder to spot them. To make matters worse the broken fender fell off again showering the Rover with thick dust.

Cernan wrote, *"It was like trying to look through a waterfall of dirt, and since I was also driving straight into the Sun, I could barely see where I was going. The wire mesh wheels collected some impressive dents when I sideswiped a few boulders."*

EVA 1

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 1 – 0h 32m 45s	122:04:02 122:36:47	1557:02 1629:47

They stopped about 150-metres from the 610-metre diameter Steno Crater and began working on a small blocky-rimmed 20-metre diameter crater, nearly 4 metres deep.

Schmitt: *"Okay, get your hammer. We're going to need it."*

Cernan: *"I've been carrying it all day – it's about time I used it. Okay."*

Schmitt found that he had trouble getting his gloved hand around the handle of the hammer,

so, as Cernan was bigger and stronger with longer arms, he usually carried and used it.

Cernan, *"You had to hold onto the hammer and that meant you had to squeeze your fingers against the pressure of the gloves. After you did that for a while your hand and your forearm muscle would get sore, so you would have to take a rest."*

At Station 1 the two astronauts spent their time taking photographs and collecting rock and soil samples and getting used to working with each other in the lunar environment. Due to lack of time no core samples were taken. They found that the blocks on the rim of this crater were the same as the landing site.

Parker, *"And 17, we'd like to have you guys driving in 10 minutes, please."*

Schmitt, *"Nag… nag… nag."*

Parker, *"That's right… that's right… that's right."*

On the way back home, they stopped briefly to drop off a seismic profiling charge 600 metres from the LM, before they reached a site on the opposite side of the LM from the ALSEP, where they deployed the Surface Electrical Properties (SEP) experiment at 122:51:02 GET (1644:02 AEDT). Schmitt jogged back to the LM while Cernan drove the Rover back.

The first Rover excursion was a bit frustrating for an enthusiastic Jack Schmitt. He had wanted to get out and do some serious geology, but, by the end of the first day, he was concerned that, if he and Cernan had to leave early for some reason, they would take home very little information about the geology of Taurus-Littrow. At the ALSEP site and then, at their one geology stop, they had collected samples of coarse-grained basalt which, undoubtedly, represented the top layers of the bedrock that underlay the soil. However, they hadn't seen or collected any rocks that might be representative of the deeper bedrock, or of the Massifs, therefore, the site was not yet well characterized.

Arriving back at the LM at 123:16:15 GET (1709:15 AEDT), dirty and exhausted, the crew brushed themselves down with a big brush hanging beside the ladder. The two astronauts found they were startled by discarded plastic foam packing suddenly exploding because of the sunlight

At Honeysuckle Creek, John Vanderkly (left), and Brian Hale in the Recorders section, not long after Apollo 17's first EVA. It is 128:57:52 GET, or 10:50:53pm AEDT, just 22 minutes before LOS. On the Moon, Cernan and Schmitt are settling down to sleep. Photo: Ed von Renouard

heating the internal trapped air bubbles and building up the pressure.

Cernan, *"My God, it blew up!"*

Schmitt, *"Yeah."*

Cernan, *"I thought I'd been hit by a … look at that stuff, it just keeps flying over the tops of our heads. I thought we were the closest witnesses to a lunar meteor impact."*

Parker, *"John* (Young) *says it blew up on his mission* (Apollo 16) *too."*

After entering the LM and the cabin was re-pressurized at 124:13:42 GET (0106:42 spacecraft time; 1806:42 AEDT), just over 33 minutes behind the flight plan, while Madrid were tracking. The first EVA lasted 7 hours 11 minutes 53 seconds. The distance travelled in the Rover was 3.3 kilometres; vehicle drive time was 33 minutes, and 14.3 kilograms of samples were collected.

Cernan noted the backs of his hands were blistered, *"….with a fiery red rawness. My fingers felt almost broken and I had to flex them to see if they still worked."*

At 129:02:00 GET (2255:00 AEDT) Cernan called down, *"Joe, we're asleep. There's no need to answer. See you in the morning."*

They slept in hammocks strung in an X shape, Schmitt's stretched across the bottom and Cernan's stretched across the top, over the ascent engine cover, with the space suits under him. Both were dog tired. Cernan had trouble falling asleep, listening to the hum of the environmental systems. At one stage he reached up and pulled away the nearest shade to look out and saw that the motionless flag still glistened in the sunshine, and the Earth still dominated the coal black sky. He was very aware of the deathly stillness outside the spacecraft.

Schmitt commented, *"I slept very well. I woke up a couple of times to make sure I was hearing the fans and pumps and things I was supposed to hear and then went right back to sleep. Sleeping in one sixth gravity in a hammock was really very comfortable."*

Above them, Evans was already 5 hours into a sound sleep, in his 21st orbit.

HSK MISSION DAY 7
WEDNESDAY, 13 DECEMBER 1972
LUNAR STAY – DAY 2

Times: AEDT (HSK local time)

EVENT	GET	AEDT
EVA-2 - 7h 36m 56s	140:35:06 148:12:02	1028:06 1805:02

Prime HSK	Track Duration	AOS/LOS
LM – Rover TV	4h 38m 00s	1257:00 14/0022:00
ALSEP 2 / CSM	10h 21m 00s	1327:00 2348:00
LM / LRV 2-way LM / LRV 3-way	4h 32m 00s	1706:00 2138:00

Handovers	AEDT
CSM 2-way – 7h 54m CSM 3-way	1403:00 2157:00
LM 2-way to MAD – 2h 30m	2138:00 14/0008:00

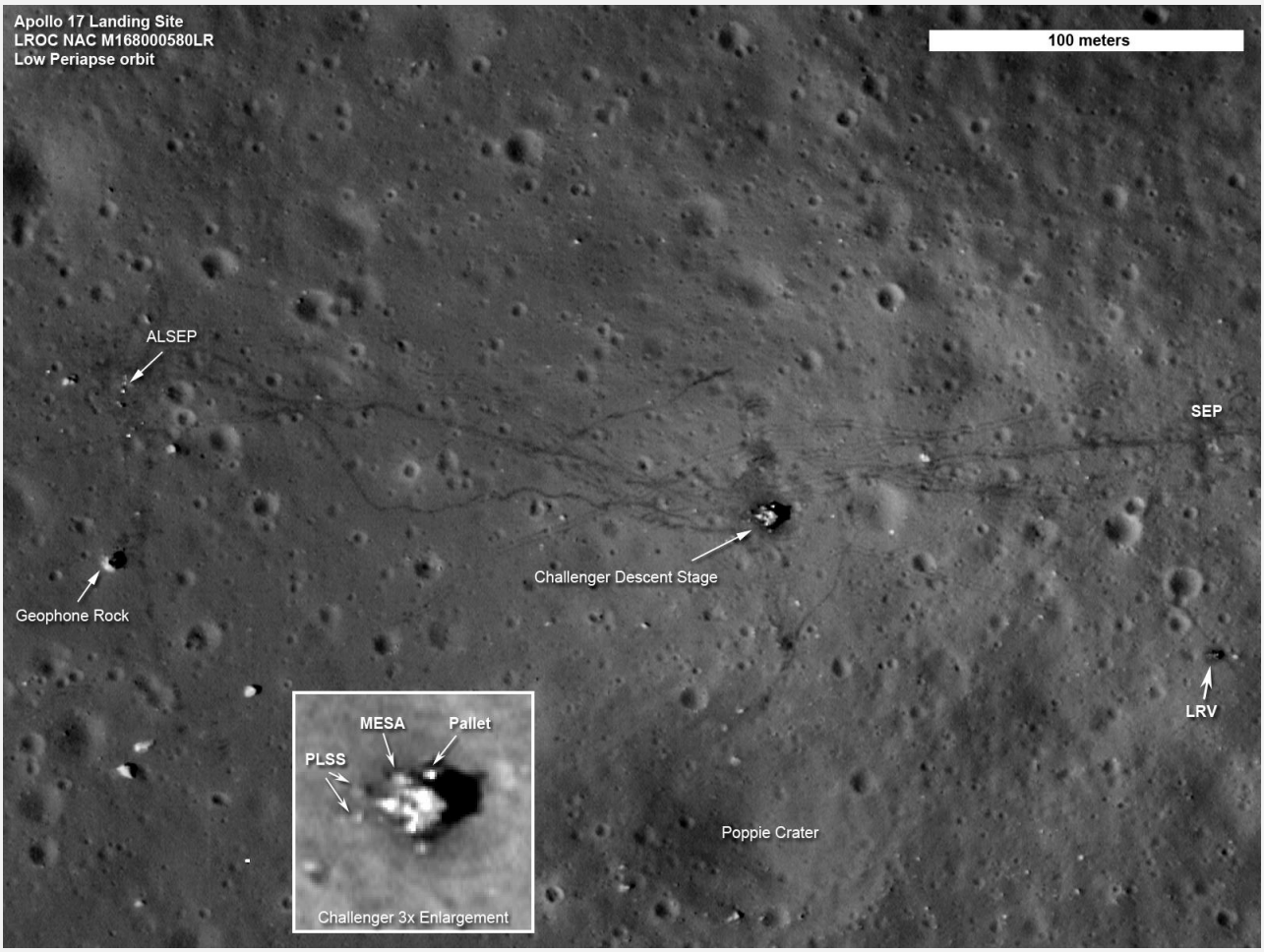
Wing HSKX	Track Duration	AOS/LOS
CSM [7]	9h 4m 00s	1222:00 2126:00

Handovers	AEDT
CSM 2-way – 7h 54m CSM 3-way	1403:00 2157:00
LM 2-way to MAD – 2h 30m	2138:00 14/0008:00

[7] CSM orbits 28 through 34

DSS43	Track Duration	AOS/LOS
CSM	11h 3m 00s	1257:00 14/0014:00

Parkes	Track Duration	AOS/LOS
LM / Rover	7h 25m 00s	1453:00 2218:00



Apollo 17 landing site as seen from NASA's Lunar Reconnaissance Orbiter. Image: NASA/LROC

The Second Excursion

They were woken up at 136:55:00 GET (1348 Spacecraft time December 12; 0648 AEDT) after an 8 hour break by Capcom Gordon Fullerton playing Wagner's *"Ride of the Valkyries."*

Fullerton: *"Good morning Challenger."*

Schmitt: *"Sounded like Parker had the duty* (of picking the wake up music). *Both monumental and epic."*

Fullerton: *"Jack, that's supposed to take you back to Caltech final's week."*

Fullerton and Schmitt were both undergraduates at the California Institute of Technology, and it was traditional for students to wake everyone up on the mornings of the final examinations by playing the *"Ride of the Valkyries"* at full volume.

Cernan: *"Gordy, we're going to eat here. Why don't you talk to us about the fender?"*

Fullerton: *"Okay, let me round up John Young. He stepped out for a second. We'll have him here in a minute. Might as well let the resident expert on fenders talk."*

When John Young arrived at the console, Fullerton announced, *"Okay, I'll turn the microphone over to Captain Young."*

Young came on the microphone and detailed how they had worked out a fix for the broken Rover fender before they began breakfast and the day's activities. The second EVA began 80 minutes late, with cabin depressurisation at 140:35:06 GET (1028:06 AEDT). Madrid was just ending their track and Goldstone was well into their tracking period. Schmitt was hoping that when they depressurised the LM all the dust they brought in from the day before was sucked out, but Cernan announced,

"There goes a lot of junk. Sure, wish it would clean the dust out. But it isn't. It's cleaning everything else out."

The dust had settled down between the cracks in the fitted floor, and the astronauts found it impossible to clean it out.

The astronauts, particularly Schmitt, found the second day was more exciting than the first because they were going to be doing some useful geology. Schmitt commented that climbing onto the surface of the Moon wasn't as adrenaline pumping as launch, Trans Lunar Injection, Lunar Orbit Insertion, Power Descent Initiation, landing, lift-off from the lunar surface and Trans Earth Injection, but he agreed, *"Training is a great suppressor of adrenaline."*

Cernan admitted the first time he climbed out his adrenaline was on a high, but the second time he was more calm and collected, confirming his first day wasn't his imagination,

"It wasn't one of those heart-pounding things, but it was still a little unbelievable that I was actually there. The first day was almost literally like walking in a dream the whole time; the second day you could look around and begin to appreciate a little more where you were and prepare to be a little more productive … and we could begin enjoying ourselves."

The Rover's TV camera was switched on at 140:45:00 GET (1038 AEDT). Madrid had dropped over the horizon so only Goldstone monitored the events on the lunar surface as the astronauts prepared for their second excursion in the Rover.

As he bounced onto the lunar surface Cernan announced: *"Okay, Houston. On this fine Tuesday evening, as I step out on the plains of Taurus-Littrow, Apollo 17 is ready to go to work."*

It was just after 1730 spacecraft (Houston) time.

Schmitt, looking out from the porch, agreed as they both laughed, *"Funny, there's not a cloud in the sky. Except on the Earth."*

Schmitt was aware that everyone had underestimated distances on the Moon's surface, so he asked for the ground to be prepared to measure the length of his shadow so he could be more accurate in estimating distances, It always looked a lot shorter than it really was.

Schmitt:
"Hey, Bob, what's my shadow length now?"

Parker: *"Stand by. I'll ask … we'll get it for you momentarily."*

Parker: *"Okay, Jack – we've got 4.5 metres, or 15 feet."*

Schmitt: *"4.5 metres, uh? ...hmmmmm"*

Cernan: *"Fifteen feet!!? Is that how long I am on the ground? No wonder I've misjudged distances! Zap!"*

After various minor maintenance jobs, the first task was to attach the new fender of four plasticised maps with clamps cannibalised from the optical alignment telescope lamp.

As Cernan stuck the new fender over the top of the wheel and overlapped it with the remaining bit of the original fender he commented,

"Hope this thing gets stiff. It's just a flapper. Sure, isn't stiff like I want it to be."

Schmitt, *"You want me to hold it there?"*

Cernan, *"Yeah … you're going to have to, I reckon. But it may do the job….I want it about right above the axle. Let me align it … okay … hold it right there."*

Cernan fixed the map to the fender by screwing the clamps up tight, and lifted the rear edge to check for coverage,

"Now, that'll give us plenty of room down there. Yeah, I just don't want to interfere with the steering."

Schmitt,
"You think it will stop the dust that way?"

Cernan, *"Well, it will stop some of it … if it stays on."*

At 141:19:00 GET (1112 AEDT) Schmitt grabbed his camera and hopped the 140 metres over to the SEP (Surface Electrical Properties) experiment site to check it out and take some photographs.

Five minutes later Cernan drove from the LM to pick up Schmitt:

"I'm on the way…on the way, Jack."

Schmitt: *"I'm waiting."*

Cernan: *"Oh, there you are over there, huh?"*

Parker: *"And, Jack, how's the rooster tail look on that fender?"*

Schmitt: *"Looks like it's going backwards."*

Schmitt deploys the Surface Electrical Properties experiment. Image: NASA
Designed to measure the electrical properties of the lunar regolith at the Taurus-Littrow site.
Results revealed an extremely dry surface with a composition consistent with high-titanium basalt.

Cernan:
"I don't see anything coming up over the top."

Schmitt: *"Looks like a good fix."*

Cernan, *"Okay, Jack, I've got to come around… I'm going to come on this side and head west."*

Departure for Station 2

Running about 80 minutes behind the planned schedule in the Flight Plan, the Rover departed for Camelot and Station 2 at 141:31:43 GET (1124:43 AEDT), only tracked by Goldstone until at Honeysuckle Creek we joined them at 1327. The aim was to get to Station 2 at Nansen, nearly 8 kilometres away, as quickly as possible as this leg was the most demanding of all the excursions in the Apollo program. They set off on a heading of 260° at their maximum speed of 11 kilometres per hour, Schmitt dropping off three seismic explosive charges as they began their journey.

Parker: *"Okay. One other thing I might mention to you guys as you're driving here, Jack, before you start talking again, is that, as you go by Camelot, you might keep an eye out for blocks along the rim there, because remember, we may be wanting to come back and move Station 5 to an area where there's blocks, unless there are blocks at the present, nominal Station 5. So, you might keep an eye for that and plan for the way back. Also, we're under a 63 minute limit to get you from the LM out to Station 2 because of OPS drive back."*

The experts on the ground wanted to be sure that assigning the crater such a high priority was justified, and Parker reminded them of the distance limit of being able to walk back in case the Rover failed to proceed, or one of the suits failed. There was no guarantee that the blocks would be visible from beyond the rim, but it would be nice to confirm their presence.

As they bounced along the crater riddled surface the scenery ahead was spectacular – clear and sharp as there was no atmosphere. On Earth one would probably take some deep breaths to enjoy the pristine fresh air, but here on the Moon it was just more of the pure oxygen they had had all along. Cernan had to dodge around boulders, holes and craters, which slowed them down quite a bit. As they were driving down sun the craters were hard to see. Cernan: *"I'll tell you, it takes all your time to drive though. You look around and you're in a hole."*

Schmitt: *"Watch that crater. There you go. I tell you, when Gene decides to turn … Whoooo!"*

Cernan explained that being the driver you knew when you were going to turn and could anticipate manoeuvres, whereas the passenger had to hang on unaware of what was coming next.

They crested a rise and Schmitt called:
"We've got the … oooh, and there's Camelot."

Cernan: *"Oh, whooo! Manischewitz. Take a couple of pictures looking at that."*

Cernan turned the Rover so that Schmitt could a take photos without having to turn his body.

Cernan: *"That is a 600 metre crater."*

Schmitt: *"And it's very blocky. We won't have any problem finding blocks on the rim."*

Cernan: *"Man, are there blocks there!"*

Schmitt: *"Bob, there is an extremely blocky area. I think Station 5 was over there where that block area is."*

They passed about 140 metres south of Camelot and Station 5, heading west. Once past Camelot the lurain changed.

Schmitt: *"The total block population has changed. Once we get away from the rim of Camelot the block frequency is quite a bit smaller. It's down, maybe to less than 1 percent of the surface."*

As they approached Horatio on their right, Cernan announced: *"Horatio has got to be … there's Horatio, right there."*

Schmitt: *"Yeah, that's Horatio."*

Cernan: *"I don't know if I want to take you down there or not – Yeah, Jack, hold on; I'll take you down there."*

Cernan drove the Rover along the crest of the southern rim of the crater, while Schmitt described what they were seeing: *"Horatio has quite a different appearance to Camelot. And the main one is the blocks do not get to the rim."*

Cernan: *"It's an undulating, hummocky traverse terrain in there, Jack."*

Schmitt: *"Yeah."*

Cernan: *"These little craters make it bumpy; but, other than that, it's really smooth sailing."*

Horatio had layering in its walls that suggested the subfloor was overlaid by a blanket of regolith 18 to 30 metres thick.

Once past Horatio and the blocks thinned out they entered a shallow depression flat enough for Cernan to press the accelerator to the floor:

"We're climbing, Jack. Because I've been full bore most of the time, and all I can get out of it is 10 clicks (kilometres per hour)*; and when I decelerate, she decelerates in a hurry."*

Cernan still had to concentrate hard on where they were going; flying over crests hoping there were no unseen holes or rocks on the other side and swerving around any in their path. He was very aware the Rover's clearance was only 36 centimetres. It looked as though their heading of 260° was taking them directly to their target of Station 2. Cernan left any geological descriptions to Schmitt. They crossed Tortilla Flat until they became aware of the bulk of South Massif beginning to fill their visors. They began to drive over a light mantle, which at its periphery was just a thin veneer of finely grained material.

Cernan:
"Boy, is that South Massif getting big. Who-ee – hold on! (as they dived into a small crater)*."*

The astronauts became interested in boulders they could see had rolled down steep slopes, leaving a long trough behind. By sampling boulders at the bottom, they were hoping to get samples of rock from higher up the mountain.

Schmitt: *"There are a lot of boulder tracks coming down from the blue-grey rocks, Bob. We'll see whether or not we're going to get to those tracks at Nansen, or we might want to move over to the tracks and see if we can find the boulder that made them."*

They had to zig-zag up the 30° slope until finally they crested a rise to descend into a broad trough below South Massif. They had arrived at Station 2, about 80 metres above the valley floor.

Cernan: *"Yeah. I think if I come up here, do a hard left turn; you unbuckle your belt, you'll roll right down into the bottom of Nansen."*

Schmitt: *"Yeah, sir … boy, I tell you, if I hang on to this camera until you stop and can tighten it up, it'll be a miracle."*

Because the bracket holding the Hassleblad to his suit had come loose, Schmitt had to hang onto the camera most of the trip, and keeping a grip against the pressure of the suit was very tiring. By the time they reached Station 3 fatigue began to affect Schmitt's performance.

As they closed in to the base of the South Massif (2,300 metres altitude), its summit elevation had climbed to an angle of about 25º above them, and the bulk of the mountain started to fill their sky.

They noticed the Earth was getting closer to the top and realized if they couldn't see it if it went behind the mountain they would lose their direct communications to Goldstone.

Cernan commented, *"What was really impressive about the Massifs was how massive they were; they were so massive they overpowered you. Visually they weren't overly impressive – they didn't have cliffs and abrupt breaks and snow-cover you see in the Rockies; but they were massive, jumbo mountains."*

Schmitt: "That is a high mountain!"

Cernan: *"Jimmeny Christmas!! Listen, if the Earth goes behind it – we're changing Station 2!"*

Cernan: *"Yeah, that's where we're going to make Station 2; right up there."*

Schmitt: *"What – straight ahead?"*

Cernan: *"Yep."*

Schmitt: *"Yep – okay."*

Cernan: *"Boy, you're looking right into Nansen."*

Schmitt: *"Yeah. We're right where we wanted to be for Station 2. And it looks like a great place. Big blocks. It looks like quite a bit of variety from here. Different colours, anyway. Greys and lighter-coloured tans."*

Cernan: *"Okay Jack, I'm going to do a 180 degree and park the Rover at 045* (north-east)*."*

EVA-2: STATION 2 - NANSEN

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 2 [8] – 1h 5m 55s	142:41:30 143:47:25	1234:30 1340:25

[8] Nansen, by South Massif. The farthest west travelled

After 70 minutes of driving at an average speed of 7.5 kilometres per hour they arrived at geology Station 2 by the crater Nansen (named after Fridtjof Nansen, the Norwegian Arctic explorer), 7.9 kilometres directly west of the LM, or 9.1 kilometres distance actually travelled.

Nansen itself was more of a depression than a crater, part of a trench along the base of the mountain, which seemed to have been partially swamped by an avalanche. Schmitt was very pleased to see a number of boulder tracks leading away from the trench. The South Massif was tan-grey on its flank, but where the slope shallowed near the summit there were blue-grey outcrops from which boulders had rolled, many ending up at Nansen. The Station 2 site was among a cluster of rocks 90 metres east of Nansen. The object of the visit was not for the crater itself, but the bright mantle that covered its near-massif half completely, and its north east half partly.

After setting up the TV, the first job was to get rid of all the dust they had collected on the trip so far. As soon as he could Schmitt headed for the nearest boulders. The first one, about a metre high, they called Boulder 1.

Schmitt: *"The blue-grey rocks are breccias. There's a very rough foliation in them – and I'm not sure – it's shown by the elongate knobs on the surface. It looks like a fracture foliation of some kind."*

Cernan: *"Jack, that rock has almost got to have come down* (from higher up the mountain)*, don't you think?"*

Schmitt: *"Oh, no question about it. I'll bet you it's the same as the blue-grey rocks we see up higher. Here's some more blue-grey ones over here."*

Cernan: *"One comment. When you look down into the bottom of Nansen, it looks – like, I guess, would sound obvious – that some of the debris that has rolled off of the South Massif covers up the original material there that covers the north wall of Nansen. There is a distinct difference. You've got that very wrinkled texture in the north slopes of Nansen, and you've got the South Massif debris in the south slopes of Nansen. And the debris, of course, overlays the north slope. And all the rock fragments, all the boulders that have come down, are all on the south side of the slope of Nansen."*

Parker: *"Okay, 17. And for your thinking in the next few minutes, you might also factor in the question the Backroom raises about taking 10 minutes out of Station 4 and adding it into this station, given the wealth of interest that seems to be occurring here. You might think about that. You haven't been to Station 4, so it's a little hard*

The elongated shape of Nansen Crater. Note the rover parked on the right. Image: NASA

to judge. But if you think 10 minutes can be very profitably spent, you might as well do that."

Schmitt: *"Okay, Bob, we'll think about it."*

Schmitt: *"Hey, Bob – how long have we been at this station?"*

Parker: *"Standby … You've been here about 40 minutes right now. Can you believe it?"*

Schmitt: *"Is that right?"*

Parker:
"And we're going to give you that extra 10 minutes out of Station 4. That leaves you about 20 minutes; then you'll have to be moving."

Parker: *"Can you guys see the LM, or are you too far down to see the LM?"*

Cernan: *"The LM is over about three rises in the Scarp before we can even see it."*

Parker: *"I thought that might have happened."*

Cernan: *"I'm not even at a level of the last hill we came over."*

They decided to roll a boulder downhill, so Cernan warned Schmitt: *"Lookout Jack,"* before pushing it with his right foot. It rocked forward and fell back. Cernan gave it a harder shove, and it turned over twice, reaching Schmitt who kicked the rock again, but it stopped.

Parker: *"Don't hit the Rover."*

Cernan: *"Get that sample under there, Jack, under that rock."*

Schmitt scraped soil about 4 centimetres deep from under where the rock had been sitting and poured it into a sample bag. The geologists are always keen to get samples that haven't been exposed to the Sun's solar wind.

Nansen's rocks proved to be breccias of various types – the more they looked the more variety of colour and clast size they found – there were solid rocks and clods of regolith that looked like rocks until they were handled. One of the fragments of rock from this visit turned out to be one of the oldest dated rock ever sampled on the Moon, dated at 4.6 billion years, plus or minus 0.1 billion years.

Honeysuckle Creek joined Goldstone tracking the Rover as it was about to leave Nansen and heard Cernan call,

"Okay, Bob, we're ready – we're rolling."

When they left Station 2 at Nansen after a 66 minute stay, Cernan and Schmitt had completed one of the longest excursion stops on the Moon.

As they started off Schmitt decided to summarise their findings at Station 2:

"All right. Those two major kinds of blocks that we sampled there...they were about the only two varieties we saw in the area. It's a long extrapolation I realize, but they do resemble in colour, and I believe in texture, the blue-grey rocks and the light-tan rocks up on the Massif. So, I feel confident that – fairly confident – that

we sampled at least the two major units visible from a distance in the South Massif."

Parker: *"Excellent, excellent."*

Cernan commented that this ride to Station 2 and back has stayed clear in his mind,

"Because of the really spectacular terrain and driving the Rover and riding on it was really a challenge and was really fun. The one-sixth gravity just did not hold the Rover to the ground very well. You always bounced around a lot, and if you had any speed, that just aggravated the bounce and if you were going downhill and you had to turn left or right, the tendency of the Rover to spin or roll was pretty great. It was not your ordinary trip to the Moon. It's a shame that the TV pictures and still pictures don't really give a full appreciation of how steep some of those rolling hills were in this valley."

Schmitt: *"There are your tracks! Hey, we crossed somebody's tracks!"*

Cernan: *"We sure did. We just made a loop."*

Parker: *"Hope they look like yours."*

At Station 2 a traverse gravimeter experiment reading was measured, samples scooped up, and photography taken.

The trip to Station 3 was pretty straightforward with no specific crater to drive to. Any crater that would seem to have excavated the base of the scarp would do. There was a brief stop further north on the rim of Nansen to collect samples, take photos, and take a Gravimeter reading at what became known as Station 2A.

EVA-2: STATION 2A

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 2A [9] – 12m 03s	143:52:59 144:05:02	1345:59 1358:02

[9] Scarp by South Massif.

Before they stopped Schmitt took a panoramic photo of the scene, commenting that none of the craters in the light mantle appear to show bedrock – all seemed to be instant rock craters. Cernan offered to change the target stop.

Parker, *"No, no, no. Good Lord. Stay on the road that you're on."*

Cernan, *"Well, I'm not on any road, but I'm stopping here."*

Parker,
"I thought you guys were making a road."

Because they were taking a reading without putting the Gravimeter on the lurain, Cernan tried to level the Rover as much as possible. Both astronauts had to get off the Rover for the reading and collected samples.

They left Station 2A and continued in a north easterly direction across the Lee-Lincoln scarp. Mysterious mare, or wrinkle, ridges were of particular interest to the geologists. Were they volcanic flows, swellings over subsurface intrusions, purely tectonic folds, or perhaps something else? After the mission many geologists tackled this area.

According to Don Wilhelms in his book To a Rocky Moon, it has been generally agreed that most ridges, including Lee-Lincoln, resulted from shortening of the mare surface area caused by subsidence of mascon maria. In this case Mare Serenitatis sank within its basin, and the basalts near the surface were compressed and pushed into Taurus-Littrow Valley and into the North and South Massifs.

EVA-2: STATION 3

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 3 [10] – 37m 08s	144:28:38 145:05:56	1421:38 1458:56

[10] Lara and Ballet Craters.

The Rover moved on to Station 3, by the 500 metre wide crater Lara, named after the heroine of the film 'Dr Zhivago'. Schmitt was naming features from his recent reading material. Cernan parked the Rover with a heading of 43°, 15 metres out from the rim of the first crater.

Station 3 was on the north east rim of Lara, which is deformed by the Lee-Lincoln scarph and covered by the light mantling material, the main objective of the visit.

Station 3 included a closer look at Ballet Crater. Image: NASA

Cernan turned to Schmitt: *"Jack, is it worth coming here?"*

Schmitt: *"Looks like a pretty good location."*

Cernan: *"Okay."*

Schmitt: *"We can sample the rim materials of this crater … Bob, I'm at, let's say the east southeast rim of a, oh … 30 metre crater – in the light mantle of course – up on the Scarp and maybe 200 metres from the rim of Lara in a north east direction."*

Parker: *"Okay, copy that."*

Plans were changed to save time. Mission Control decided to split the two astronauts tasks with Cernan taking a core sample and a gravity meter reading while Schmitt took a series of pan photographs and some surface samples.

Cernan had a successful core drilling attempt, belting the 42 centimetre long tubes into the surface around 5 centimetres a stroke.

Cernan: *"Well, that first core has gone down pretty good, Bob."*

Parker: *"Okay, great."*

Pulling the tube out of the surface, Cernan noted the tip was full of fragments of rock and clods of dark regolith. He pointed the end of the tube at the TV camera so the eager scientists in the back room of Mission Control could see the individual pebbles and regolith clods jammed into the core.

Both astronauts found their jobs much harder working solo. Schmitt explains: *"With two of us working together, bagging samples was fairly easy; but it was a lot harder solo. You hold the bag in one hand, and somehow or other get your scoop out over it so that you can dump the sample in it. It's made all the harder because you're moving your arms against the pressure in the suit while gripping both the bag and scoop."* By the end of the last EVA, he learned to pick up samples more efficiently.

While Cernan was packing his core samples Schmitt set off to explore the crater's rim to collect rock fragments. He brought back 15 rocks some of which were of the blue-grey type that almost certainly came off the outcrop on the South Massif. Cernan noticed that Schmitt was having trouble dropping and picking up samples, seeing him bending down on his knees, rocking about and flailing his arms around trying to recover.

His antics were also noticed back in Houston.

Parker: *"Hey, Gene, would you go over and help Twinkletoes, please?"*

Cernan: *"Want some help, Jack? I'll be there."*

Schmitt: *"No, I don't need any help. I just need better bags."*

A bit later, Parker told Schmitt: *"And be advised that the switchboard here at MSC* (Manned Spacecraft Center, Houston) *has been lit up by calls from the Houston Ballet Foundation requesting your services for next season."*

Schmitt replied: *"I should hope so," and tried a high kick and leap, "How's that?"*

As a consequence of this little episode the crater was called Ballet Crater.

Schmitt told me his version of this episode,

"Actually, something that we did not want to do was one person sampling – it's easier for two people to do, one to hold the sample bag and the other to pick up the sample but because of some other activity we wanted to do at that point, Cernan was not available for assisting in the sampling.

My hands got tired and it got increasingly difficult to hold onto everything. I tried to pick it up and I dropped it. One sixth gravity on a slope and your feet will turn a little bit underneath you. It's not something you get concerned about, it's just something you get used to when working on the Moon."

Cernan:
"Bob, what else do you want us to do here?"

Parker: *"Nothing. Get on the Rover and leave."*

Schmitt: *"Get the heck out!"*

Schmitt:
"We didn't really do all the things we wanted to, but I think we did everything we could."

Parker: *"We did everything we wanted to."*

Cernan: *"Okay, let's get ready to roll."*

Schmitt: *"Okay. Going to Shorty."*

At Station 3 another traverse gravimeter reading was obtained, more samples collected, and photographs taken.

The Parkes Radio Telescope picked up the Rover's signal at the end of the visit to Station 3.

At Honeysuckle Creek we had already been tracking for 1 hour 26 minutes.

Although they had originally planned to stop for 45 minutes at Lara, after only 38 minutes the astronauts set off on a bearing of 69°, heading towards the early morning Sun. They couldn't see Shorty, as it was hidden by the rolling lurain, but they knew it was 2.6 kilometres away to the north-east.

They were bouncing down a deep valley, able to see tracks in the massif slopes left by giant boulders that had been dislodged and rolled down into the valley, and to the west an 80 metre high scarp. Shortly after moving off Schmitt saw a 3 metre boulder standing all on its own, so they detoured over to have a closer look.

Schmitt: *"You going to drive by this big rock?"*

Cernan: *"Want a look at it? Can't see it. I can't see when that reflection of the LCRU shines into my eyes."*

After photographing the boulder they pressed on, pausing to collect samples without getting off the Rover. Next they came across a deep 15 metre crater with a blocky rim.

Schmitt: *"Hey can you swing a little bit and let me get that fragmented crater? See that one on your left there?"*

Parker: *"And 17, the word from the Backroom is with that last Rover sample you got we'd like you to go straight to Station 4."*

Schmitt: *"Bob, I thought the purpose was to sample the light mantle?"*

Parker: *"We talked to them about that, but they …"*

Schmitt: *"We didn't sample light mantle at that last one."*

Parker: *"I agree. I talked to them about that. But they are so anxious to get to Station 4, I guess they don't want to do it."*

Cernan:
"That's Shorty straight ahead of us, I think."

Schmitt: *"Yeah."*

Cernan: *"Yep – that's got to be it."*

Cernan:
"Oh, look at the boulder sitting on that rim!"

Schmitt: *"It's different."*

Cernan: *"It's darker. Let's go over there."*

Schmitt: *"No question."*

Cernan: *"Which rim did I want to park on?"*

Schmitt: *"Well, I think we ought to park over here near that big boulder."*

Cernan: *"Yeah. If we can get up there. I think I can."*

Schmitt: *"Shorty is a crater, the size of which you know (100 metres). It's obviously darker rimmed, although the fragment population for most of the blanket does not seem too different than the light mantle. But inside…….whoo, whoo, whoo!"*

Schmitt sang out as it looked as though they were going into the crater.

"That's about as far as I want to take it," said Cernan as he parked the Rover on the southern rim of Shorty Crater.

EVA-2: STATION 4

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 4 [11] – 36m 6s	145:22:57 145:59:03	1515:57 1552:03

[11] Shorty Crater

Shorty, 110 metres across, was named after a legless San Francisco wino character in Richard Brautigan's novel 'Trout Fishing in America.' It is a small impact crater punched through the light coloured material left by an avalanche of debris from South Massif. Schmitt commented that Station 4 was a lot more exciting visually than Lara at Station 3. They found that it was as dark as the photographs from orbit indicated.

Station 3 was a lot of hard work, this Station turned out to be fun. He started out describing what he could see:

"Okay, Houston. Shorty is clearly a darker-rimmed crater. The inner wall is quite blocky but… except for the western portion of it, which is less blocky than the others.

The floor is hummocky, as we thought it was in the (Apollo 15) *photographs. The central peak, if you will, or central mound, is very blocky and jagged. And the impression I have of the other mounds in the bottom is that they look like slump masses that may have come off the side. That's just what they look like. I'm not sure that … they have a bench appearance."*

Orange Soil!

Schmitt, about to take a panoramic photo close to the boulder, noticed what appeared to be orange soil where his boots had scuffed the surface:

"Oh, hey!!… wait a minute."

Cernan, *"What?"*

Schmitt, *"There is orange soil!!"*

Cernan, initially sceptical, was it some reflection? *"Well, don't move till I see it."*

Schmitt, excited: *"It's all over orange."*

Cernan, *"Don't move till I see it."*

Schmitt: *"I stirred it up with my feet!"*

Cernan, now excited too: *"Hey – it is! I can see it from here."*

Schmitt: *"It's orange!"*

Cernan, *"Wait a minute, let me put my visor up… It's still orange!"*

Schmitt, *"Sure it is! Crazy!"*

Schmitt could see the orange through the regolith, but it became more obvious after being stirred up.

"I've got to dig a trench, Houston."

Parker: *"Copy that. I guess we'd better work fast."*

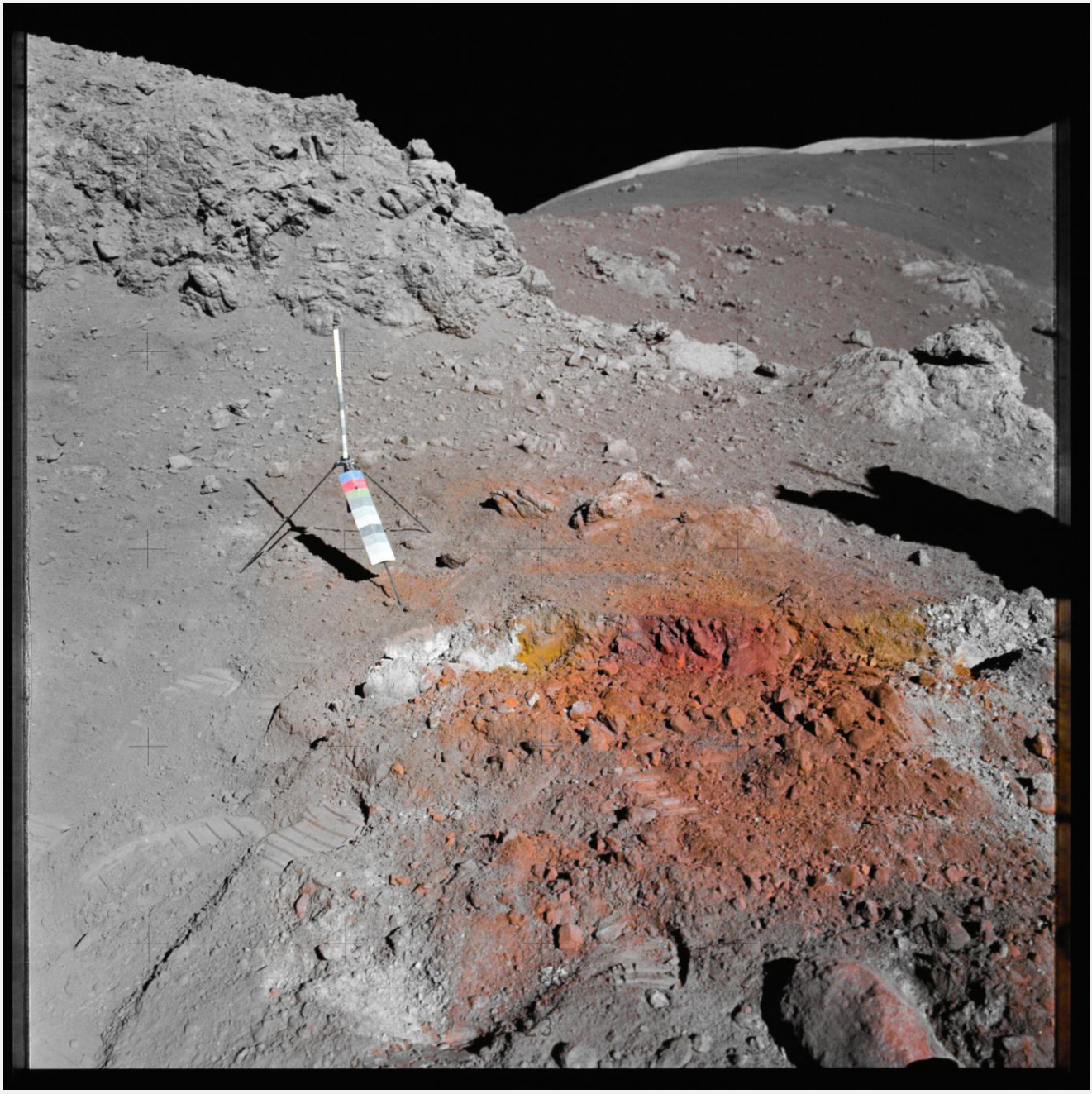
Cernan, *"Hey! He's not going out of his wits. It really is."*

Cernan finished at the Rover while Schmitt took his panoramic photo, then dug a trench across the orange soil:

"Okay, Bob, I've trenched across the trend of the orange. There is light grey material on either side."

Cernan joined Schmitt and looked into the trench: *"Oh, man, that's incredible …"*

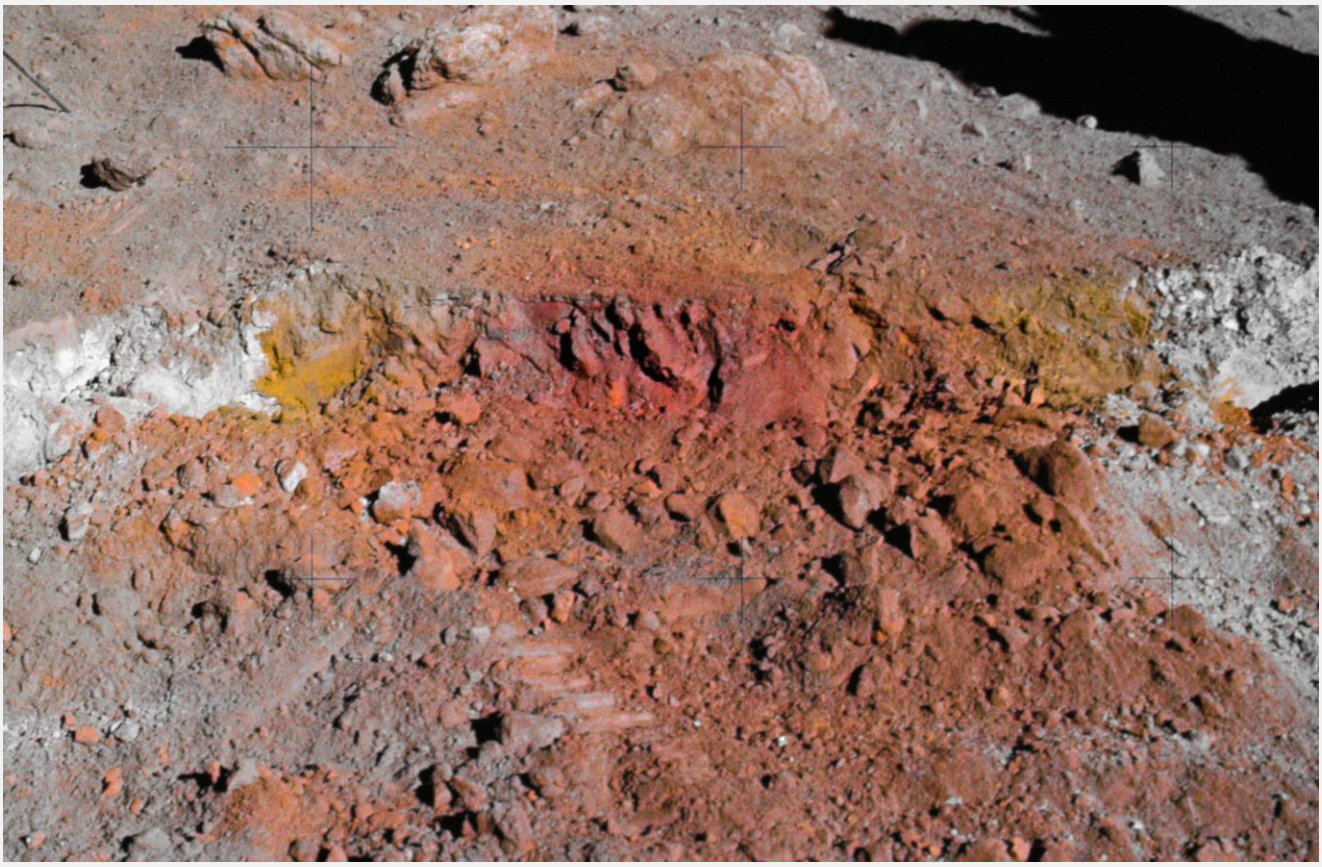
The boffins in the Backroom decided they wanted a double length core sample, so Cernan began



“There is orange soil!”

With thanks to Dr Ron Wells - The photo, AS17-137-20990, served as the paradigm for correcting the orange, yellow, and red colours in the soil. Details of the colour-balancing process are given in the Supplemental Information PDF to the paper by Wells, Petro, and Schmitt, 2019. "Red/Orange Volcanic Ash Deposits on the Lunar Surface Documented in Colour-Balanced Apollo 17 Hasselblad Surface and Orbital Photographs Compared with Apollo Panoramic, Metric Mapping, and Lunar Reconnaissance Orbiter Photos", Journal of Geophysical Research (JGR)-Planets, passed 1st review round.

The photo 137-20990 was contrast-balanced to provide a corrected gnomon colour chart. The colour intensities in the red, orange, and yellow channels were varied until a match was obtained with the in situ reports and observations of astronaut Schmitt who actively participated in the balancing process. The colours were not matched to the gnomon chart but rather to Schmitt's observations standing in front of the trench at zero phase angle (angle between the direction of the solar rays and the camera). The zero phase view is brighter than at increasing phase angles. Consequently, the brightness of the gnomon chart became over-saturated in 137-20990 having a phase angle of ~45 deg and was replaced with the contrast-balanced version. These points are discussed in the JGR-Planets article.



A closer view of the colourful deposits on the rim of Shorty Crater.

hammering his core tubes down into the surface, meeting surprising resistance. Luckily bringing the core back up proved relatively easy.

Schmitt: *"The central portion of the zone actually has a crimson hue, or a red hue. Outside of that it's orange. And outside of that, it's grey. The bottom of the core is very black compared to anything we've seen …"*

Indicating they had driven the core right through the orange layer. The black, more a very dark bluish grey, layer was mostly beads of crystallised glass of the same composition as the orange, but with a different cooling history. The orange glass is billions of years old, but Shorty is only millions of years old. Volcanic materials were sampled on the Moon, but no volcanic craters.

Parker: *"And after the core, we'd like for you to go over and sample some of the big rocks there on the rim, if you could very quickly. That'll be the next order of priority after that."*

They were running out of time.

But not to forget lonely Ron Evans in the Command Module, still spinning around the Moon on his 29th orbit. When Evans appeared from behind the Moon his Capcom called up:

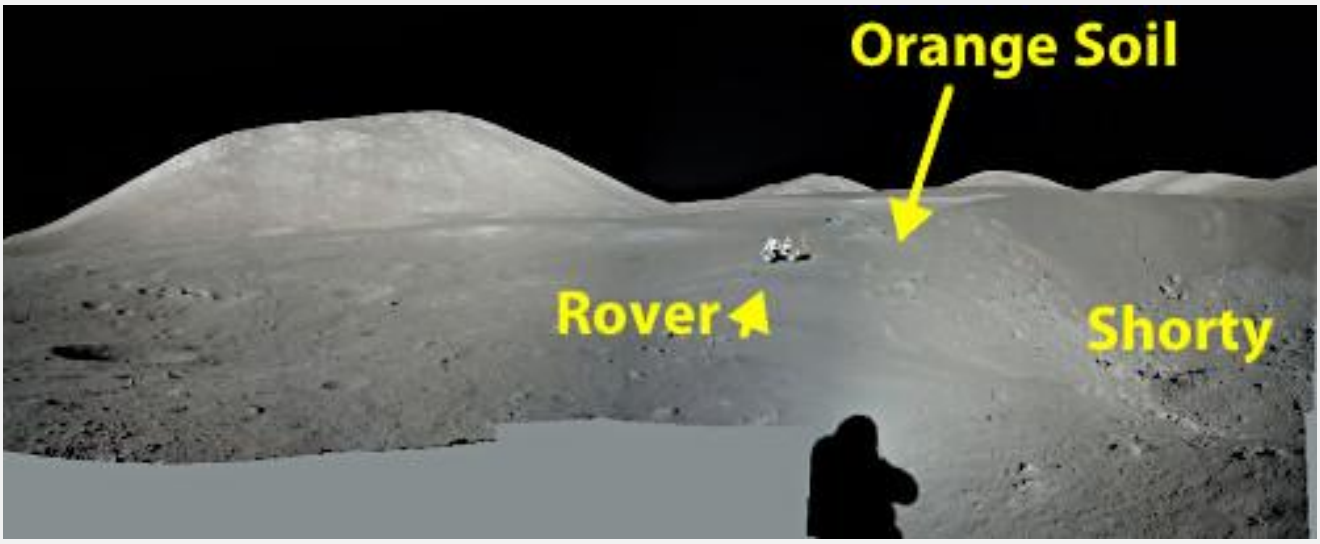
"While you're doing your pre-sleep checklist, you might be interested that at Shorty the surface crew found some very, very orange soil – a great deal of it … Jack's kind of like a boy at Christmas time. I'll tell you, a little kid at Christmas time on that one."

Evans: *"I bet he would be. Hey, that's a great find, by gosh! … I'll be darned!"*

When told about the orange soil, Evans studied the lunar surface more intently, and decided he could see areas with orange tints, including around Shorty.

Cernan comments, *"I was concerned that Ron* (Evans) *was being influenced by the power of suggestion, but when we got back into orbit, I ate my thoughts because we really did see areas that you could definitely define as orange."*

Parker *"And we'd like to get a quick sample of the basalt up there on the rim, and Gene's stereo pan, and then press on."*



The panorama taken by Gene Cernan at Station 4.
Assembled and annotated by Colin Mackellar from NASA images AS17-137-21005 to AS17-137-21016.
Images sourced from the Apollo Lunar Surface Journal.

While Cernan prepared the core sample, Schmitt went over to the boulder. It was partly buried and so eroded it was falling apart. Schmitt was able to break pieces off with his gloved hand.

Schmitt: *"The basalt* (from the large boulder) *is in bag 512."*

Watch Lunar Module Lift-off

HSK Video Tech, Ed von Renouard used his Super 8mm camera to film segments before and after the orange soil discovery.

WATCH

90.11mb mp4 file. Running time – 2m 42s

After 36 minutes at Shorty, as they prepared to leave, Cernan warned:

"Okay, Jack, I'm going to make a very sharp turn here, because I don't want to go down that hill (into the crater)*."*

Schmitt: *"We're moving, Houston."*

Parker: *"Roger, you're moving exactly 37 seconds early."*

Cernan chanted: *"We got to go to Victory!"*

At Station 4 the usual traverse gravimeter experiment was tried, the endless samples with a trench gathered, and a double-core tube inserted in the regolith, with photography.

The astronauts drove 1.5 kilometres from Shorty to Victory Crater on a heading of 90° though, as they were driving directly into the Sun, Cernan zig-zagged to ease the glare in their eyes. Victory Crater is a vee shaped set of three craters commemorating British Prime Minister Winston Churchill. Conversation eased off as both were pleased to have a few moments breather after the emotional pressure and frenzy of Shorty.

< More on the Super 8mm film

If you watch carefully, you can see the reflection of Ed von Renouard holding his Super 8mm camera.

As Ed Fendell in Houston commands the Rover TV camera to pan to the right, at 1m 19s, you see Gene Cernan completing his still photography panorama.

While driving along and thinking back to the orange soil at Shorty, Cernan asked Houston:

"It was really orange….could you see that colour on the television?"

Schmitt: *"No answer."*

Cernan: *"I'll bet they couldn't."*

Parker: *"No, we couldn't see it, Gene."*

They stopped twice at Victory Crater to scoop up samples before arriving at Camelot to park just outside the sharp edged field of rocks on the southern rim.

Cernan: *"I'll park right over here so they can look into it* (the crater)*."*

Schmitt: *"You still got to turn, remember?"*

Cernan: *"Yeah, that's why I want to leave myself a little room over there."*

Schmitt: *"Whoa!"*

Cernan: *"Okay Bob, we're stopped."*

EVA-2: STATION 5

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 5 [12] – 30m 43s	146:25:15 146:55:58	1618:15 1648:58

[12] Camelot Crater

Cernan described to me what the lunar scene looked like,

"When you are on the surface of the moon in the daytime it's a paradox. You are standing on the surface of the moon lit by sunlight – you, your body and the surroundings, and you look up at the sky and it's black – it's not darkness – it's just black. Most people confuse darkness with blackness – they are totally two different words. Darkness is the absence of light in my definition. Blackness is a void. Blackness is the absence of almost anything. If you look at the Earth from the moon it reflects sunlight, yet it is surrounded by the blackest black you could ever conceive in your mind – the absence of anything. The blackness has three dimensions. I didn't find the black sky above oppressive. I define blackness as the infinity of time and space and if you let your mind and imagination wander the infinity of time and space does anything but close in upon you – it just goes on forever.

When you stand on the moon and look up and see that blackness which goes all the way to the horizon of the moon, it doesn't feel like you are being closed in upon like a black painted ceiling at all – as a matter of fact it is exactly the opposite.

When you are on the moon you can't look anywhere near the sun – it's devastatingly bright. When we drove the Rover back to the east it was a lot more difficult to see up sun than down sun because of the reflective surface. The closer you looked toward the sun you just couldn't see much definition at all.

A lot of people say can you see anything else in the daytime on the moon – can you see stars? The answer to that is yes – if you shield your face and eyes from all the reflected light around you can see stars in the daytime on the moon – not as brightly as at night of course."

Cernan was also very conscious of the rotation of the Earth while watching it from the Moon over a period of time. Over hours you could see the seas and continents passing by, usually under clouds. He marvelled there was nothing holding the planet up – it was just suspended there in front of him. Schmitt was very aware of the bright Australian deserts in sunlight.

Cernan: *"How's our time, Bob?"* The original plan called for a 30 minute stop.

Parker: *"Stand by. We're talking about that now. Stand by. You've got 25 minutes at this station, guys. We've given you somewhat of an extension here. You're using up some of it back at the LM, but we've given you somewhat of an extension. You've got 25 minutes at this station. The primary priority will be subfloor documented samples, and then subfloor rake soil … As you can imagine."*

Schmitt: *"Okay."*

Schmitt went over to a big boulder: *"Boy, this is certainly a uniform floor, as we mapped it. It's certainly a uniform rock type, I'll tell you. The only variations are those grey zones which seem to be either finer or have an absence of vesicles.*

Camelot! Camelot! Camelot!* Image: NASA
Part panorama taken by Cernan from the south rim of the 610 metre wide, Camelot Crater. **"It's only a model."*

Boy, I'm nose to nose with a piece of it right now."

Looking around the area Cernan commented: *"Talk about a block field …"*

It was ten minutes before Cernan could join Schmitt among the boulders. He picked one out and gave it three mighty swipes:

"Here's a piece, right here."

Schmitt: *"Okay, can you hand me a bag, or I'll pick it up with a scoop, whichever you prefer."*

Schmitt examined the rock before putting it in the bag.

Schmitt: *"Wish we'd started on that structured rock because we're going to run out of time. Let's go over there and get at least one off it."*

Cernan: *"Yeah, we'll get it."*

Parker: *"… if you could get that rake soil and maybe also get the soil off the top of one of those boulders that you thought you saw."*

Schmitt: *"Yep. Phew, I've got to have Gene with me since I can't carry sample bags. I probably can if I'm careful, but I keep dropping them."*

Schmitt skimmed some soil off the rock at about knee height: *"Whoops, oh yeah; I got some soil."*

Cernan: *"Don't kick up anything new."*

Schmitt scooped two more samples , then he said: *"I think we had better leave it at that."*

Cernan: *"That's the soil from the top of the rock, and we're taking a piece of the rock itself, which looks pretty much like the other ones, Bob. It might be a little more vesicular."*

Parker: *"Roger. And the present time, we drop the rake soil; we'd just like to get the kilogram of soil somewhere between the boulders – as open a location as you can. That'll replace the rake soil sample we were going to get. And we'd like you moving in 3 minutes."*

Schmitt: *"Let's do it right here."*

Cernan: *"Yeah, right there."*

Schmitt: *"Hello, Houston."*

Parker: *"Hello, 17. Loud and clear. We'd like you to leave immediately, if not sooner."*

Cernan, striding along, jumped into a gallop, and began singing: *"Hippity-hoppity, hippity-hoppity, hippity-hoppity, over hill and dale … hippity-hopping along. My golly, this time goes fast!"*

Parker: *"That's affirm."*

After a 30 minute stay at Camelot, the two astronauts piled aboard the Rover and began heading home to the Lunar Module.

Parker: *"And give us a mark when you're going."*

Schmitt: *"Oh, I'm sorry, we've been going about a minute."*

Parker: *"Okay, copy that."*

Most of the boulders seemed to be partially buried, a few were sitting on top. Later Cernan said they had to watch their step in the cluttered boulder field of Camelot.

They were hopping around between rocks and boulders, and they could easily have tripped over a 30 centimetre high rock. They certainly wouldn't want to fall onto another rock, which could damage their suits.

At Station 5 a traverse gravimeter experiment was completed, and soil sampling, and then photography undertaken.

The crew arrived back home at the LM at 147:12:24 GET (1705:24 AEDT) and entered the cabin, just as Honeysuckle Creek punched the transmitter ON button to go two way. It was re-pressurized at 148:12:02 GET (0105:02am spacecraft time, 1805:02 AEDT) just over 2 hours behind the flight plan, Outside the LM the surface temperature had risen to 44°C.

The second extravehicular activity lasted 7 hours 36 minutes 56 seconds. The distance travelled in the lunar rover was 20.4 kilometres, vehicle drive time was 2 hours 25 minutes, and the crew collected 56 samples weighing 34.1 kilograms. They had taken 218 colour and 627 black and white photographs. These figures would become records that could not be beaten until a possible visit sometime in the future.

By their spacecraft clock it was 1:00am as they prepared for another rest period their arms felt heavy and weary, and their hands were raw and bleeding from the constant activity with the gloves. Luckily they had some hand lotion to soothe them. It had been a big day. Looking back, Cernan felt he enjoyed the second EVA more than the first. The first day seemed more like a dream as they explored the sights and sensations of walking on the Moon's surface and constantly checking everything. With the Rover operational and the ALSEP already set up they could concentrate on their Rover excursion. There was also more time to look around and felt he appreciated being where he was much more.

Schmitt summed up the day with,

"Geologically the second day was far more exciting, it was almost a full day of geological exploration, with several important discoveries, particularly the so-called orange soil which turned out to be volcanic glass beads, concentrated in a pure form, and that was rather unexpected, not totally because we thought that it might be a volcanic crater – it was not; it was an impact crater – but it had exposed volcanic material. That was a very exciting day for me. It was pure exploration for the most part, and we made quite a number of discoveries at the base of the North Massif."

John Saxon, Operations Supervisor at Honeysuckle Creek particularly remembers,

"Supporting the Lunar Rover was quite stressful for us, particularly for the technician at the Signal Data Demodulator (SDDS) *equipment. The astronauts were supposed to stop at each station – then manually position the Rover antenna to point at the Earth for maximum signal strength* (particularly the FM TV)*. But often they drove off with the same signal modes and the antenna pointing in all directions, which left the poor SDDS technician struggling to find the best signal source for the various data types. This in turn had the rest of the station trying to keep up with the differing sources! But reading the account of the astronauts' EVA's, I can well understand how such a small item as antenna positioning could be overlooked."*

At 152:25:00 GET (2218:00 AEDT) goodnights were exchanged as the astronauts settled down for an 8 hour rest/sleep period, well satisfied with the day's events.

Allen, *"Just want to end by saying what a terrific job you did today, and really looking forward to tomorrow."*

Cernan, *"Thank you Joe. Tomorrow we answer all the unanswered questions, right?"*

Allen, *"If not more!"*

Above them Ron Evans was sleeping his way through his 33rd orbit.

HSK MISSION DAY 8
THURSDAY, 14 DECEMBER 1972
LUNAR STAY – DAY 3

Times: AEDT (HSK local time)

EVENT	GET	AEDT
CSM lunar orbits 41 through 46		
EVA-3 [13] - 7h 15m 08s	163:32:48 170:47:56	0925:48 1640:56
TV though HSK from AOS - duration 2h 23m 00s		1404:00 1637:00
TV through Parkes - duration 0h 37m 00s		1600:00 1637:00

[13] Total mission EVA time 44.17 man-hours - a new record

Prime HSK	Track Duration	AOS/LOS
LM	10h 39m 00s	1404:00 15/0043:00
LM / LRV 2-way LM / LRV 3-way	6h 15m 00s	1708:00 2323:00

Wing HSKX	Track Duration	AOS/LOS
CSM & LM [7]	10h 55m 00s	1402:00 15/0057:00
CSM 2-way LM 2-way	5h 56m 00s 1h 30m 00s	1708:00 2323:00

Handovers	AEDT
LM 3-way to MAD	2337:00 15/0043:00

DSS43	Track Duration	AOS/LOS
CSM	10h 45m 00s	1402:00 15/0047:00

Parkes	Track Duration	AOS/LOS
LM / Rover	6h 43m 00s	1600:00 2243:00

The Third Excursion

With Madrid and Goldstone tracking, at 160:25:04 GET (1318:04 spacecraft time 13 December, 0618:04 AEDT), after a 15 hour 30 minute rest period in the LM, an hour longer than scheduled, Houston played the Texas Aggie War Hymn, *"Light my Fire"* of the Texas University of Agriculture and Mechanic Arts as wake–up music. As it was founded as an agriculture school, the students were known as *"Aggies"*.

Capcom Gordon Fullerton, *"Hello there, Challenger. The Gold Team Flight Director picked out the morning selection, and he said that if you can find some maroon dirt* (the Aggie colours are maroon and white)*, today, instead of orange, you'll probably get a lot more co-operation out of him."*

Cernan, not impressed, *"I figured the Gold Team might do that. You know, I've woke up to a lot of pleasant thoughts, but never to an Aggie before … Hey, Gordo, don't forget I'm a Boilermaker."*

Slang: A *"Boilermaker"* is an alumnus of Purdue University.

Both astronauts slept through the rest period, Cernan 6 hours of half restless and half good sleep periods, while Schmitt had 6 hours of good sleep. The spacecraft was in excellent shape:

Fullerton, *"The Challenger looks as good as ever. No problems at all through the night."*

Cernan, *"That's outstanding. How's America?"*

Fullerton, *"It's in the same shape. Just clicking along. Ron's been up a few hours now and is really gathering up the data."*

The last day was planned to explore the North Massif and Sculptured Hills areas in the north-eastern part of the Taurus-Littrow valley. As the crater at Shorty seemed to be from volcanic activity, it was hoped that Van Serg might be volcanic too.

Cernan: *"I've got to get down out of 5 psi* (34.5 kPa suit pressure)*, too, here before I can turn too well and open the hatch. I'm going to let it come down a little bit this time, so I don't get down there unnecessarily."*

Cernan found that while the pressure was at 34.5 kPa you might as well have been in a block of

concrete but dropping it to 3.7 psi (25.5 kPa) gave him a lot more flexibility to bend down to open the hatch. When you're bending down you're literally straining against the suit, so he didn't want to bend until his suit pressure was down, also, there was no point in getting down until the cabin pressure was low enough to open the hatch. He found he had to hold the hatch open against whatever pressure was there; if he didn't, any residual pressure would slam it shut again.

The cabin was de-pressurized at 163:32:48 GET (0925:48 AEDT) ready for the last EVA, nearly 53 minutes later than planned. As Cernan stepped onto the lunar surface for his third day on the Moon, he announced,

> *"Okay, Bob, I'm on the pad. And it's about 4:30 on a Wednesday* afternoon (American Central and spacecraft time)*, as I step out on to the plains of Taurus-Littrow's beautiful valley."*

At Honeysuckle Creek it was 0925 AEDT on Thursday morning, with 4 hours 38 minutes 12 seconds to go to AOS.

Then Cernan spoke to himself.

> *"Okay, get the visor down, Geno. Get the visor down … Holy Smoley … I think I'd better leave it up,"* then to the world *" Beautiful out here today, Bob. We can look to the east for a change … a little bit anyway because of the higher Sun angle."*

They found it was easier to look towards the east now, as the blinding glare from the Sun was less as it had risen to a height of 33° in the sky. In Houston, Parker tossed in a random comment:

> *"And 17, if you guys are interested, your shadows will be 8 feet* [2.4 metres] *long tonight."*
>
> Schmitt answered:
> *"How many metres is that, Bob?"*
>
> Cernan laughed: *"I'll draw it out … I'll step it out for ya … you can measure it!"*

By now the astronauts were dog-tired and their hands were raw and bleeding, with blisters on their knuckles. It felt like their fingernails had been driven back into the joints.

Cernan commented that it took over three weeks for the lunar dust to grow out of the quick of his fingernails. All they could do was try to soothe them with hand lotion. Neither of them were going to admit any discomfort in case there were repercussions from the doctors to threaten the third EVA. Cernan discarded his cover gloves for the third excursion. Unable to scratch their noses in the suits, Cernan had a little strip of Velcro installed in the helmet so they could reach across and relieve any itch. During the rest time they managed to fix Schmitt's loose camera mount, so he had an easier time on this excursion.

The TV was switched on at 163:55 GET (0948 AEDT) and the third Rover excursion began at 164:16:31 GET (1009:31 AEDT) as they headed for the SEP (Surface Electrical Property Experiment) site with Madrid and Goldstone tracking their signal.

> Cernan wrote: *"We had breakfast, dressed, and set off for work in our car,"*

…but of course the circumstances were rather different to the earthbound city commuter.

Departure for Turning Point Rock and Station 6

At 164:22:36 GET (1015:36 AEDT) they set off almost due North for a 3 kilometre drive to Turning Point Rock at the base of North Massif and then turned east to run diagonally up a 20° slope a further 400 metres to Station 6 at the base of North Massif, passing Jones Crater and Henry Crater (named after Prince Henry the Navigator).

> Cernan, *"Here's Henry right there, Jack."*
>
> Schmitt, *"There's Henry. Henry looks much like Horatio did. Has boulders on its inner wall, but not as many. They look light coloured – a light albedo, gabbroic appearance."*
>
> Cernan,
> *"I'm navigating, Bob… heading north west now … to get around the western rim of Henry."*

Looking up at North Massif they noticed the boulders, some seemed house-sized, were lying on the lower flanks, and the boulder tracks zigzagged across the slopes, instead of running straight downhill as they did at South Massif. By 1034 AEDT they were driving between Henry and Locke craters full bore at 12 kilometres per hour and approaching Turning Point Rock, rearing 7 metres out of the regolith.

Turning Point Rock on the way to Station 6. Image: NASA

At 164:44:42 GET (1037:42 AEDT) they stopped beside it for Jack to scoop up a sample.

Cernan: *"I'm going to take a tour around that boulder* (Turning Point Rock) *and give them a fix on it."*

Parker: *"Yeah, that would be a good mark to give a range and bearing on, since it's a pretty discrete point."*

Schmitt: *"Man that is a big rock up there … Turning Point Rock is a split rock; it has what looks like a northwest- southeast overhang, with another block just this side of it, just to the south of the overhang. It's a pyramid shape in cross-section – triangular shape in cross-section, and it looks pretty well fractured."*

Cernan: *"Okay, Jack, I know I can get up to Station 6."*

Cernan: *"Boy, this is a big rock, Jack. Phew!"*

Cernan: *"Okay, Bob, I'm 3 metres from Turning Point Rock on the east side."*

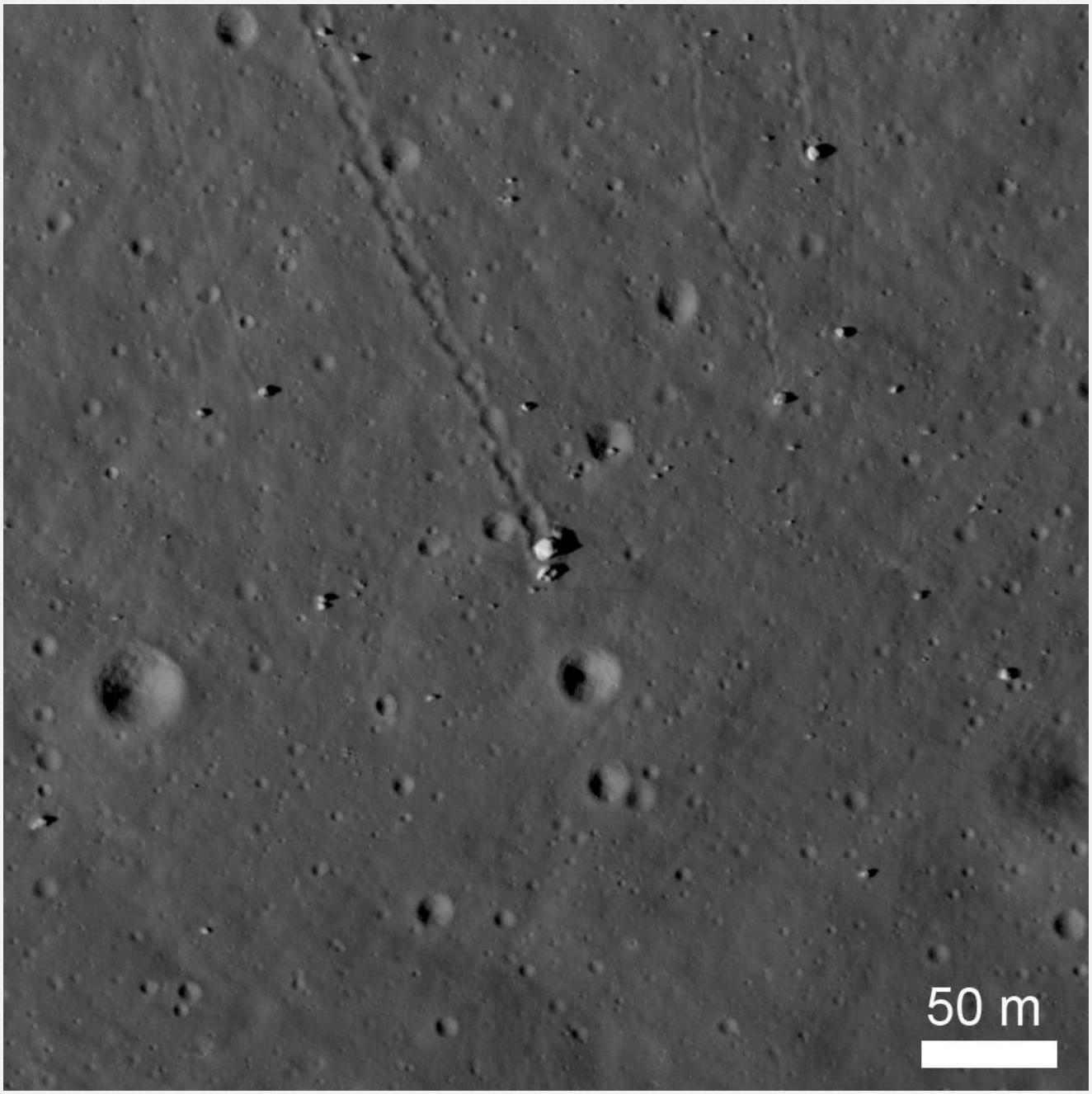
They stopped to take a sample before peeling off to the north east to drive 400 metres diagonally up a 20° slope to Station 6. Cernan pointed out that they had to be careful driving across a steep slope because if you hit a bump or big stone travelling at any speed you could become unstable and flip over.

EVA-3: STATION 6

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 6 [14] – 1h 10m 46s	164:51:24 166:02:10	1044:24 1155:10

[14] Split Rock or Tracy's Boulder



Station 6 allowed Apollo 17 astronauts to explore a collection of boulders and regolith that represents the rocks from the mighty North Massif. Five large boulder fragments lie at the base of a long boulder trail, all from a single boulder that rolled down the hill and broke apart. Image and Caption: NAC M134991788R [NASA/GSFC/Arizona State University].

As they reached the lower slopes of the North Massif the terrain became very steep with little basaltic lava beneath them. They arrived at Station 6 about 76 metres above the valley floor, 3.1 kilometres from the LM, and parked the Rover beside a big split boulder, nearly as high as the LM. Beside Tracy's Rock, near the base of North Massif, Cernan was unable to find a level spot to park the Rover, so he parked across the slope, heading just south of east.

Cernan: *"That's not very level, but we're not going to get much more level than that."*

Schmitt: *"No … that's good."*

Cernan: *"Let me … they wanted 107 … that's the best I can do."*

Houston wanted the Rover heading 107° to assist with battery cooling.

Cernan: *"Okay. We're parked on a heading of 107. Are you happy with that?"*

Parker: *"Roger. Sounds great."*

Split Rock, aka Tracy's Rock. The rover 'parked on a slope' with astronaut Schmitt. Image: NASA

Schmitt: (Laughing)
"You parked on a slope, too."

Cernan: *"There's no level ... There's no level spot to park here, though."*

Both had difficulty getting off the Rover due to the steep slope. Cernan had to climb out uphill, whereas Schmitt had to drop off downhill. The slope where the Rover was parked was estimated to be about 20°; the Rover was designed to handle up to 25°.

Cernan with a chuckle: *"I've got to go uphill!"*

Schmitt: *"I just about ended up down at the bottom of the hill!"*

Schmitt: *"You want me to block the wheels?" (Both laugh) "You got the brake on, I hope."*

Cernan: *"You betcha! … I don't know if I can lean uphill enough!* (to get off) (laughs*) I can't. Holy Smoley! Boy, are we on a slope?"*

The astronauts were stunned by the view from Station 6, a broad panorama of the valley.

Cernan commented,
"Here we could see everything – Challenger, the Scarp, the Sculptured Hills, and everything. It was fantastic."

Station 6 was a huge boulder split into five pieces that seemed to have rolled about 1,200 metres down the mountainside, dropping vertically by more than 500 metres, and broken into several pieces about 22 million years ago. They estimated there was at least a metre between the two bigger pieces. The five large fragments were once a single boulder about 6 metres high by 10 metres long and 18 metres thick. Schmitt immediately began analysing the pieces and probable history of the rock, while Cernan got busy with his camera. The rock turned out to be an impact melt fine-matrix breccia. Luckily they took ample samples – if they had only taken a chip off one end and moved on, they would have missed the real story the rock had to tell.

The rock didn't have a name until after the mission. Cernan tells the story in the *Apollo Lunar Surface Journal*. Astronaut Alan Bean was painting a picture of the rock from a picture and wanted a story for it. Cernan said he would have printed his 9 year old daughter's name in the dust if he had thought about it and wrote it out on a piece of paper for Bean, who then put her name in where Cernan had scraped out a sample, visible in the photograph. *Click picture below to Bean's website*

Station 6 - Split Boulder, later known as Tracy's Rock. Image: NASA

Jack Schmitt is about to walk behind the rock, which has rolled down the steep side of North Massif leaving a 450 metre furrow and broken into five pieces. It is a breccia, or rock made of fragments of other rocks. The Lunar Rover is parked on a slope on the right. Behind the Rover, about 8 kilometres away, is South Massif. The Lunar Module, arrowed, is visible just to the right of the peak of the rock.

Schmitt: *"And this boulder's got its own little track! Right up the hill, cross contour. It's a chain-of-craters track, and it looks like it stops … off where it started. It starts in, what looks to be, a lighter-coloured linear zone. Trying to give your perspective, it's probably only about a third of the way up the North Massif."*

The trough reached back up the hill about half a kilometre.

Schmitt moved across and found a boulder trough: *"Hey, I'm standing in a boulder track – how does that make you feel?"*

Cernan: *"That makes me feel like I'm coming over to do some sampling … Think how it would have been if you were standing there before that boulder came by!"*

Schmitt: *"I'd rather not think about it."*

Cernan was coming down across slope, caught a foot on a small ridge and fell on his hands and knees.

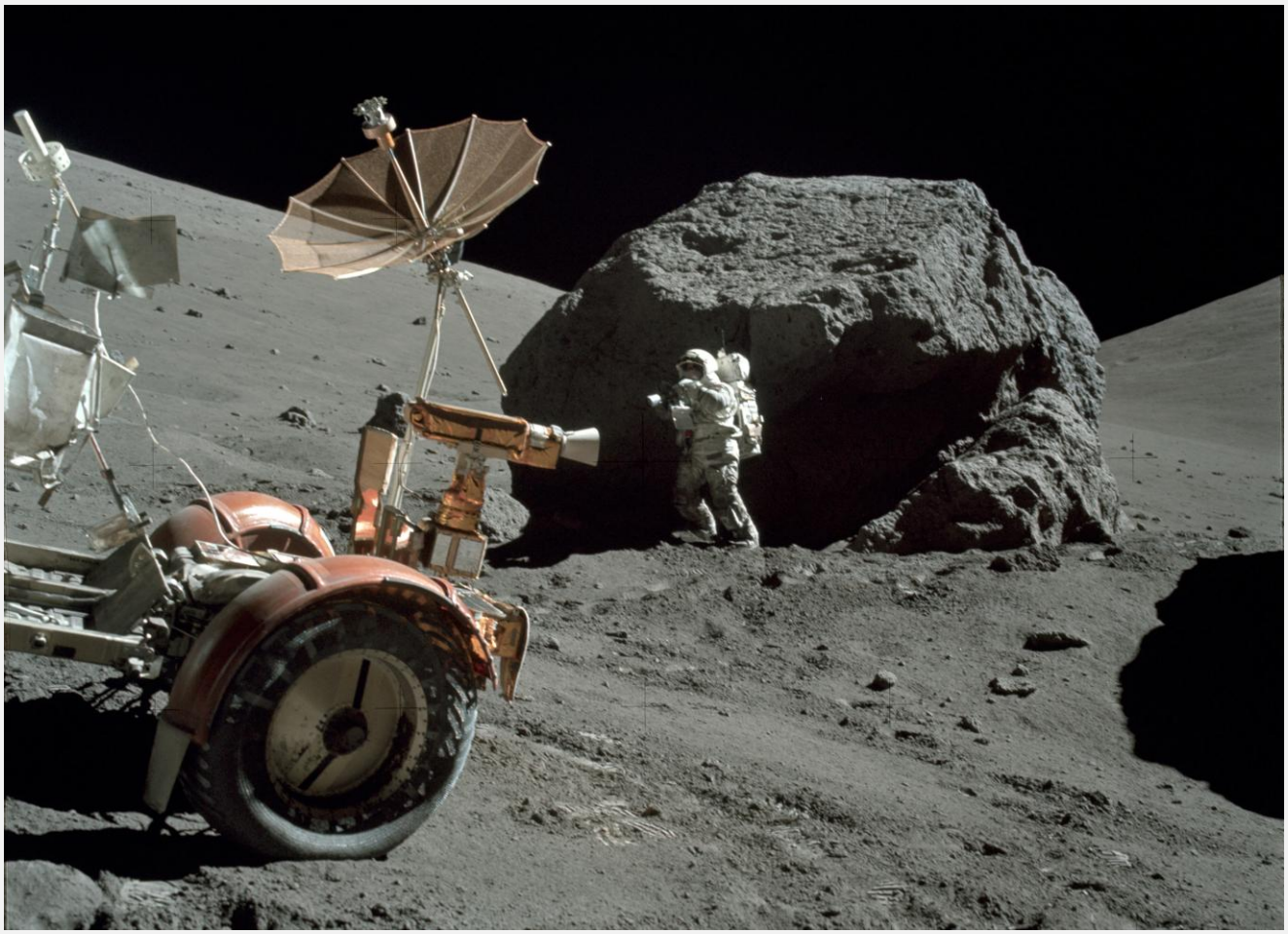
Schmitt, seeing Cernan fall queried, *"You okay?"*

Cernan, getting up, *"Remind me to dust my camera, will you?"*

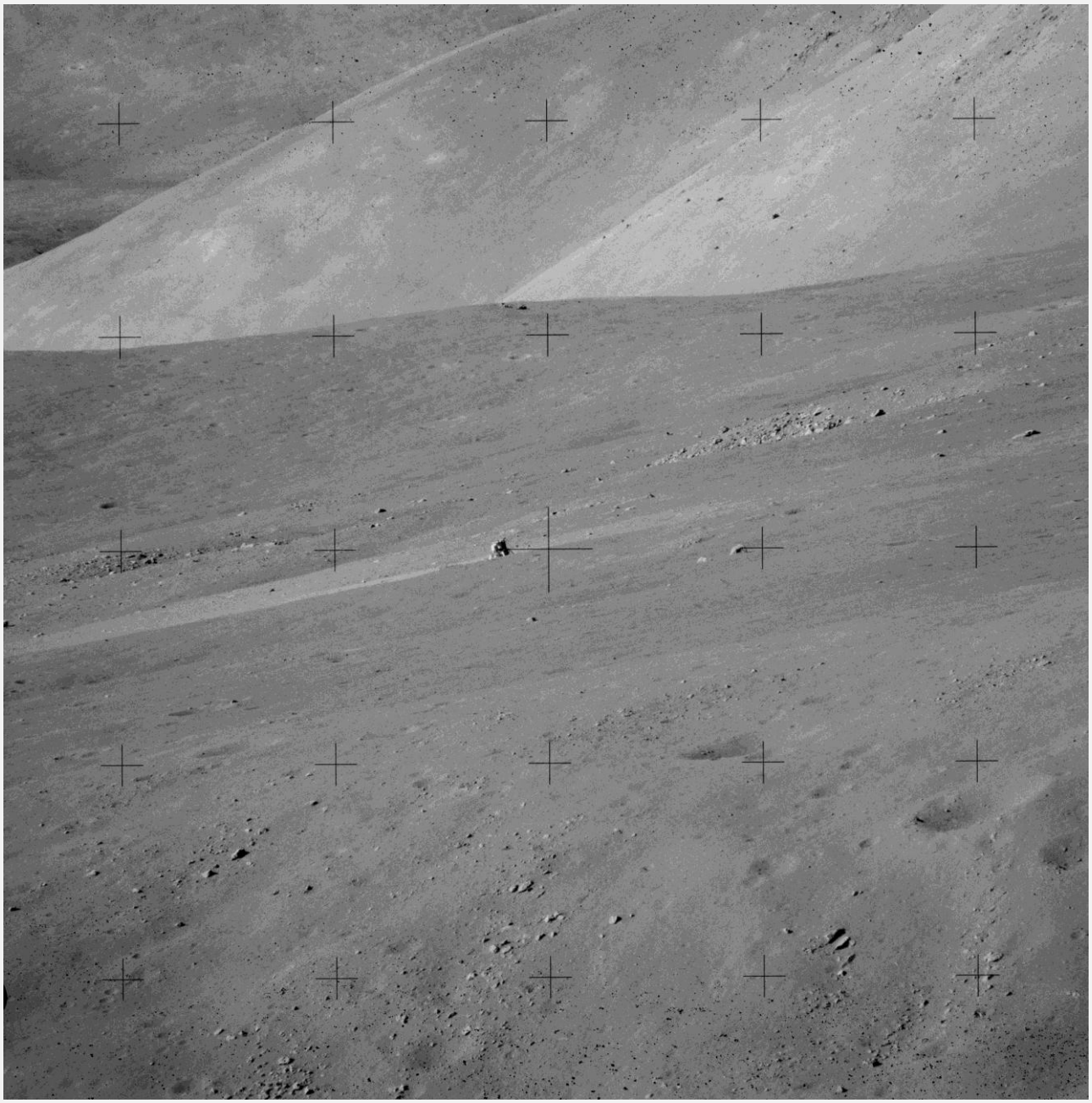
Schmitt immediately answered, *"Don't forget to dust your camera."*

When asked by people to remind them to do something, Schmitt has a habit of reminding them there and then so he couldn't be blamed for forgetting to remind them later.

They sampled some of the material from the split in the boulder, particularly looking for the north facing overhang, Schmitt reaching as far under the rock as he could.



Above: Jack Schmitt stands on the other side of Tracy's Rock, at Station 6.
Image: NASA AS17-146-22294
Below: Enhanced portion of the above photo, showing Jack's face and Snoopy cap.



Seen from Station 6, the lonely Lunar Module *Challenger,*
which is about 3.2 kilometres away, and is dwarfed by the flanks of South Massif. Image: NASA

Parker: *"Do you guys have a feeling that the two halves of the big boulder are different rocks? Or is it the same rock split?"*

Schmitt: *"No, they were all one boulder, I think. They are just two major rock types in wherever they came from."*

Lunar dust was penetrating everything, slowing up their progress. Then the Rover's make-shift fender fell off again.

Before they left the station Cernan called down an accident report,

"Houston, we've got a couple of dented tyres."

Parker, *"What's a dented tyre?"*

Cernan, *"A dented tyre is a little golf ball sized indentation in the mesh. How does that sound to you?"*

Parker, *"Sounds like a dented tyre."*

Although only 45 minutes was planned for this station, it was 1 hour 11 minutes before they set off for Station 7, 500 metres away just off the slopes of North Massif; about a 7 minute drive.

Cernan: *"I'm rolling."*

Parker: *"You guys may still have your visors up. We can't tell, but you might be better off with them down – if you've forgotten that they're up."*

Schmitt: *"Well…Boy I can't see* (due to dust scratching his visor). *My hands work just as well* (as an eye shade) *as my visor, as a matter of fact."*

The steep slope troubled the astronauts as their Rover scooted along at an angle of 20°, Schmitt on the lower side.

Schmitt: *" … Ohhh, easy."*

Cernan: *"You feel like you're on a downslope over there?"*

Schmitt: *"Yeah. I feel like you're about ready to spin out downhill any minute."*

Cernan: *"Do you?* (Tongue in cheek) *I don't feel that at all up here."*

Schmitt:
"Bob, it's hard to give you much description, looking into the Sun the way we are."

Referring to Station 7 Parker added: *"This is going to be a very short station. Probably not more than 10 or 15 minutes. Just to grab, as I say, a maximum variety of hand samples with a minimum amount of documentation and a minimum amount of time."*

The main task at Station 7 was to get a collection of fragments, along with some documentation. Apart from being a trained and experienced geologist, Schmitt handled the 'scoop', so he was primarily responsible for collecting the samples. Cernan had a stronger hand, so usually wielded the hammer to break fragments off boulders, usually guided by Schmitt.

After a 500 metre drive the Rover arrived at Station 7. Cernan called Houston; *"Right in here. Right here to give you as much of a level spot as I can. That's about as level a spot as I can find. I'm inside the slope of a crater, Bob."*

EVA-3: STATION 7

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 7 [15] – 22m 04s	166:09:05 166:31:09	1202:05 1224:09

[15] Collection of small breccia rock samples

Schmitt:
"You want me to help with the dusting, Geno?"

Cernan: *"No, I'll get it. Only one guy can do it."*

Cernan, *"You know what? I'm getting tired of dusting … my primary tools: the dust brush and the hammer. And my head! … Okay, you ready to pick up small rocks?"*

Schmitt, *"Picking."*

Cernan: *"Well, let's see … see what kind of variety we can get here."*

Schmitt, looking at the site: *"There is another one of our blue-grey breccias, I think, over there; re-crystallised breccias with some of that crushed anorthosite in it."*

Cernan: *"You notice the temperature difference with that high Sun angle?"*

Schmitt: *"Yup."*

Cernan: *"Boy, Challenger looks a long way away – that's three kilometres, huh?"*

Schmitt: *"Yup."*

They left Station 7 at 166:31:09 GET (1224:09 AEDT), after a stop of 22 minutes 4 seconds.

Cernan: *"Okay, Bob, I'd like the range and bearing to the … we're roll … we …"*

Schmitt: *"How did you get in reverse?"*

Cernan: *"I don't know… okay, we're rolling …"*

Parker: *"Okay. We want a heading of around 125, and there's going to be a small turn, I think it's at SWP Crater at 225 and 3.4, there'll be a slight turn. That's a heading of 125 is what you should start out on."*

Schmitt: *"I thought we were bypassing SWP?"*

SWP is a small crater named after the Science Working Panel that had set the program's scientific objectives, and the two astronauts skirted around it, heading for Cochise.

Cernan, *"Do you have a lot of static, Jack, or is it just me?*

Schmitt, *"No – I think it's just you. People are always giving you static."*

Cernan, *"Bob, if you are still reading me, I'm looking at the Sculptured Hills, and I still have that impression of an old man, wrinkled face*

appearance, even up close at this Sun angle. And those wrinkles go from, generally up slope at the west to down slope at the east."

Schmitt, *"Hey … are you … no you're right at the edge of Cochise, aren't you?"*

They weren't, they were about 350 metres north of Cochise, generally driving south-east. Cernan noticed that if they were in the Sun continuously for more than thirty minutes they could start to feel the Sun penetrating the suits.

The Rover reached SWP at 166:40 GET (133:00 AEDT), Cernan announcing,

"Here's SWP Jack. It's coming right up, and I'll go along the southern rim."

Schmitt, *"SWP's a bigger hole than I thought it was … SWP even has some blocks in the wall."*

Cernan, *"Yeah, but eastern and southeastern rim of SWP are just continuous with slopes of the Sculptured Hills."*

They were already thinking of heading for the next station at a bearing of 238°.

Parker reminded them,

"And remember again, Station 8 is a very flexible area. You just get to a place where it looks feasible to sample the Sculptured Hills."

Cernan was impressed with their vehicle, *"Let me tell you, this Rover is a machine. I don't know if it saw that hill we're climbing – but I did."*

EVA-3: STATION 8

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 8 [16] – 47m 53s	166:47:40 167:35:33	1240:40 1328:33

[16] At the base of Sculptured Hills

Two kilometres east of Station 7 they reached the Station 8 area, at the base of the Sculptured Hills and the easternmost point of the excursions. This meant they had completed exploring the whole valley. It was also the easternmost point of all the Apollo missions on the Moon.

Cernan called, *"I have to park about 045 because I've got to be pointing uphill so we can get out."*

Parker,
"Okay. Any place you want to. 045 is fine."

As the astronauts hopped around Station 8 Parker called,

"A reminder 17. We'd like to have you leaving here in thee-zero minutes to make up for some of the time we spent at stations 6 and 7."

Schmitt found a rock, flipped it over with his boot and it started to roll towards the Rover, veered to the right and slowed up. Schmitt followed it and kicked it to keep it rolling.

He muttered to himself, *"Roll. Look I would roll on this slope, why don't you?"*

Cernan offered a solution, *"Five sixths gravity that's missing."*

The rock landed in a hollow and stopped. Cernan joined Schmitt at the boulder as he scooped up some soil samples from under where the rock had been lying,

"Bag 545 will be soil from under that anorthosite boulder."

They photographed the boulder before Cernan slugged it with his hammer about six times,

"The old hammering hand …" he said as he lifted the hammer above his head.

Schmitt, *"This will be an easy one Gene."*

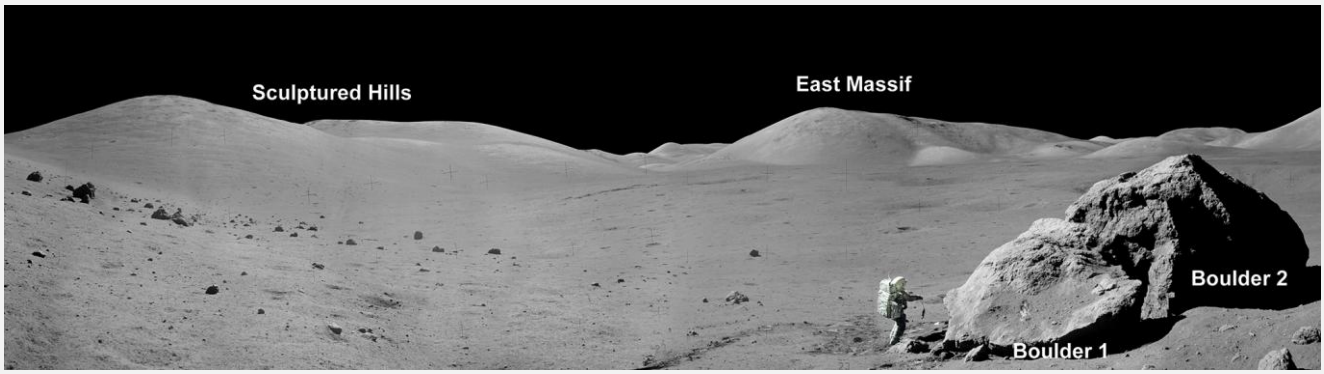
As he hit the boulder, Cernan felt the reverberation through his body, while Schmitt on the opposite side of the rock could feel the impacts through the ground and through his feet, almost like a small moonquake. The rock broke into three fragments and they collected one as Cernan announced, *"Bag 564."*

Schmitt explained, *"Yeah. The fragment got mixed with the local soil. I'm pretty sure that's the bottom."*

Cernan tried more blows to break the rock into smaller pieces, one of them flying away, to be chased by Cernan,

"That's a good one. I'll go get it with my tongs … that one I worked too hard to get!"

After the rock episode, Schmitt tried skiing, adopting a two-footed skiing stance and trying to hop from side to side and making skiing noises,



Sculptured Hills from Station 6. Image: NASA

"Shhh. Shhh. Shhh. Shhh. Shhh. Shhh. Whoo! Can't keep my edges … Shhhoomp. Shhhoomp. Little hard to get a good hip rotation."

There was a discussion on the best way to move about in one-sixth gravity on the lunar surface.

Cernan, *"Whee! Boy when you do this, and you're going downslope, that first step is a long one. This is the best way for me to travel. Uphill or downhill."*

Schmitt, *"What's that?"*

Cernan,
"Like this. Two-legged hop… And on level ground, I can skip. I don't like that loping thing."

Schmitt, *"Oh, the loping the only way to go."*

Cernan, *"Well… see… when I'm on level ground, I can skip. But this two-legged thing is great. Man! I can cover ground like a kangaroo!"*

Cernan decided it was time to have another go at fixing the fender,

"It's fender fixing time; it's camera taking-off time… and I think I'll zap myself with a little cool water."

The TV camera had to come off because Cernan had to get close to it to do his repair, and he didn't want to interfere with the lens.

Cernan commented, *"Boy! Everything is stiff. Everything is just full of dust. There's got to be a point where the dust just overtakes you, and everything mechanical quits moving."*

Three minutes later Cernan feels he has repaired the fender again,

"I'm not sure whether Detroit would like the fender, but it will sure buy the fix. Okay. It's fixed."

Cernan and Schmitt had been working on the hillside, with the Rover parked angled into the hill with Cernan's side slightly uphill. Getting ready to leave, Cernan jumped up to get into his seat in the Rover, fell short, and landed on his back, with his head downslope and – to make matters worse – lying next to the Rover so that, without Schmitt's help, it would have been all but impossible for him to turn around and get his feet downslope.

A concerned Schmitt,
"Hang on. Need some help?"

Cernan, *"Nope."*

Schmitt ignored Cernan's rejection and helped him into a face-down position so that, with a little help from Schmitt pushing backwards on Cernan's helmet, he was able to rotate back over his knees and onto his feet.

Schmitt, *"Go downhill. Get your feet downhill."*

Cernan, *"Yep… Okay."*

Schmitt, *"Let me help you… watch it – there's a crater right behind you."*

Cernan, *"I got it. I got it."*

Schmitt, *"Here. Here. Grab my hand."*

Cernan, *"Okay, now, just push up on my head."*

Schnitt, *"Okay. I'm not going to do it too hard. Going backwards."*

Cernan,
"It's all right; just push up… okay… okay."

Schmitt chuckled, *"Boy, are you… you've got your pockets completely filled with dirt."*

Cernan, *"Well, extra samples!!"*

No specific spot had been nominated to stop at Station 8. Lack of obvious geologic features and shortage of time meant hurrying through the activities and to put their hopes for sampling the Sculptured Hills on a rake sample. Two traverse gravity experiment readings were obtained; rake and trench samples were gathered and panoramic photography taken.

Leaving the north end of Station 8, they set off for Station 9 initially on a heading of 240º (southwest) towards South Massif and Bear Mountain. They were moving along at 10-12 kilometres per hour, but the fender repair was beginning to flap around, letting the dust from the wheel to fall on them.

Schmitt quipped, *"It's starting to rain again."*

At 167:43:00 GET (1336:00 AEDT) they came up on Crater Cochise. Cernan advised Houston,

"Bob, we are on the north eastern rim of Cochise. I'm going to work my way around the other side."

Schmitt: *"Yeah! Cochise is certainly a shallow crater, although we knew that. It doesn't have any...It only has one place I can see that has any blocks on the inner wall of Cochise. Otherwise, it has a surface much like what we're driving on – for walls and for the floor. One place on the south-southeast wall, there is a concentration of blocks much like we saw in Henry or in Horatio. But the rest of the crater seems to be pretty well mantled.* (Pause) *Van Serg is a very blocky rim crater, big blocks up on the rim."*

Parker, *"And you got a bearing and range there at the rim of Cochise?"*

Cernan, *"Okay. We're at 228/3.0, and we're headed south and not quite on the east rim."*

At 167:51:11 GET (1344:11 AEDT) they set a course to make a position bearing of 234° at a distance of 2.1 kilometres from the LM, and Parker reminded Cernan, "And remember we talked about parking on the southeast rim."

At this point they slowed down to pick their way through a boulder field, Cernan commenting, *"With a wander factor of 50%, I had to drive 15 metres to go forward 10."*

They arrived at Station 9 at and parked the Rover on a heading of 330º on the rim of the Van Serg Crater.

EVA-3: STATION 9

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Station 9 [17] – 56m 15s	167:53:10 168:49:25	1346:10 1442:25

[17] Van Serg Crater

At Honeysuckle Creek we could not see the Moon until now and didn't pick up the astronauts until 168:11:00 GET (1404 AEDT) as they were exploring around the Van Serg crater.

Schmitt had named this crater after Harvard Professor Hugh McKinstry, who had used the pen name 'Van Serg' in a series of scientific satires.

Schmitt had trouble releasing his seat belt and Cernan went around to help him, noticing the fender repair was curled under, as well as all the fenders were warped a bit from heating in the Sun.

Schmitt, *"Van Serg looks like a blocky-rim, fresh impact crater right now."*

Parker, *"How about scuffing your feet and seeing if it looks orange underneath?"*

…but Schmitt ignored him, as they got busy dusting the TV camera down, and collected samples from the rim of the crater. Also, the Rover fender repair was beginning to warp as the sheet maps were beginning to soften.

Schmitt began singing, *"Tiptoe through the tulips….du…de...du…du, du…de…."*

Listening to Schmitt singing this popular song, one has to remember that here were two isolated human beings, astronauts, spending 12 hours a day in a suit for three consecutive days, 370,000 kilometres from Earth, 3½ kilometres from the safety of the LM, inside a spacesuit only ten centimetres from instant death from the vacuum outside, and relying on only their picnic food, no food shops, behaving as though they were down in the local park on a sunny day.

Gene Cernan on the north eastern rim of Van Serg Crater at Station 9. Image: NASA

This picture brings out the isolation of an Apollo astronaut – the nearest support 370,000 kilometres away on Earth, over 3 kilometres from the Lunar Module, and relying on a spacesuit and back pack with limited consumables, with instant death a mere 10 centimetres away. Yet they were singing, joking and laughing as though they were down at the local park. As Jack Schmitt commented, *"Human beings and their adaptability is just unbelievable."*

They were also relying on limited supplies of oxygen and fuel, switches, rocket motors, relays, and valves to work without fail to get them back home to Earth.

Yet they said they only thought about their situation when they had to think about it. Cernan commented that the LM had never raised any concern about its reliability – the skin was so flimsy you could stick a pencil through it, and when they pressurized the LM after an EVA it expanded like an oil can, and one realized they were at the mercy of a little tin can with a few motors running and blowers blowing. No stoves, no toilets, no beds, no running water or shower or bath. There was nothing on the sterile Moon to sustain them for even a few seconds. And they were happy. As Schmitt observed, human beings and their adaptability is just unbelievable.

Schmitt stood on the rim of the crater and looked down at the boulders lying on the bottom. He thought there's a lot more crater there than you think there is.

Cernan joined him with, *"Holey Smoley!"* and went over the rim and picked up some rocky fragments that had flaked off with his tongs.

Cernan, *"Jack are you going around that rim of the crater up there?"*

Schmitt, *"I was just looking at rocks."*

They didn't find any orange soil. After half an hour the Capcom advised it was time to go,

"And we'd like to be moving from here in about ten minutes, so we probably better be tending back toward the Rover, unless you're seeing something really great out there."

As Cernan headed back to the Rover he began singing, *"Hippity hopping over hill and dale. Dadadadada. Dada. Dada. Dadadada. Dada. Bob would you tell me what your primary desires are again on the 500* (Hassleblad camera)*, based upon what we have?"*

Parker, *"Okay. The primary desire will be North Massif; the blocks and the boulder trails."*

Cernan, *"Okay."*

Both astronauts agreed they were showing signs of tiredness at the point. Cernan thought it might have been a combination of the amount of work they did on the hillsides and three solid days of working without too much sleep. Cernan also later commented he felt the planners wanted an hour's work in thirty minutes.

Parker, with growing concern,
"17, we're anxious for you guys to get going."

Then, Cernan, *"You with us Bob?"*

Parker, *"Roger. We're with you."*

Schmitt, *"He's mad at us now."* (For overstaying at this station. The Flight Director was beginning to worry about their hands getting tired.)

Parker, *"How'd you guess?"*

Schmitt broke in with,
"Come here quickly, Gene – we can't leave this. This may be the youngest mantle over whatever was thrown out of the craters."

Cernan, *"Take pictures of it. Bob, we've got to take five more minutes."*

Capcom Bob Parker, *"Okay, I copy. I understand. But we'd like to get you going, in case you didn't get the clue."*

Then Parker came back, *"We've had a change of heart. And we're going to drop Station 10."*

Station 9 turned out to be very young (at an estimated 4 million years) and made of rock the astronauts had trouble identifying beneath the dust. It turned out to be regolith breccia where an impact had hit a thick patch of regolith, and the shock had formed a great deal of instant rock. A seismic profiling experiment explosive charge was set, two traverse gravimeter readings taken, samples were gathered, a trench dug, a double-core tube inserted in the regolith and photographs taken. In addition, data was collected from the Surface Electrical Properties (SEP) experiment receiver.

Schmitt, *"I wonder where we stand on time?"*

Cernan looked at his watch, *"Well, we've been out about 5 hours and 20 minutes or so."*

Schmitt, *"Where are we headed now that we are moving?"*

Cernan, *"Well, I'm trying to get out of the block field here, then I'll head back to the southwest."*

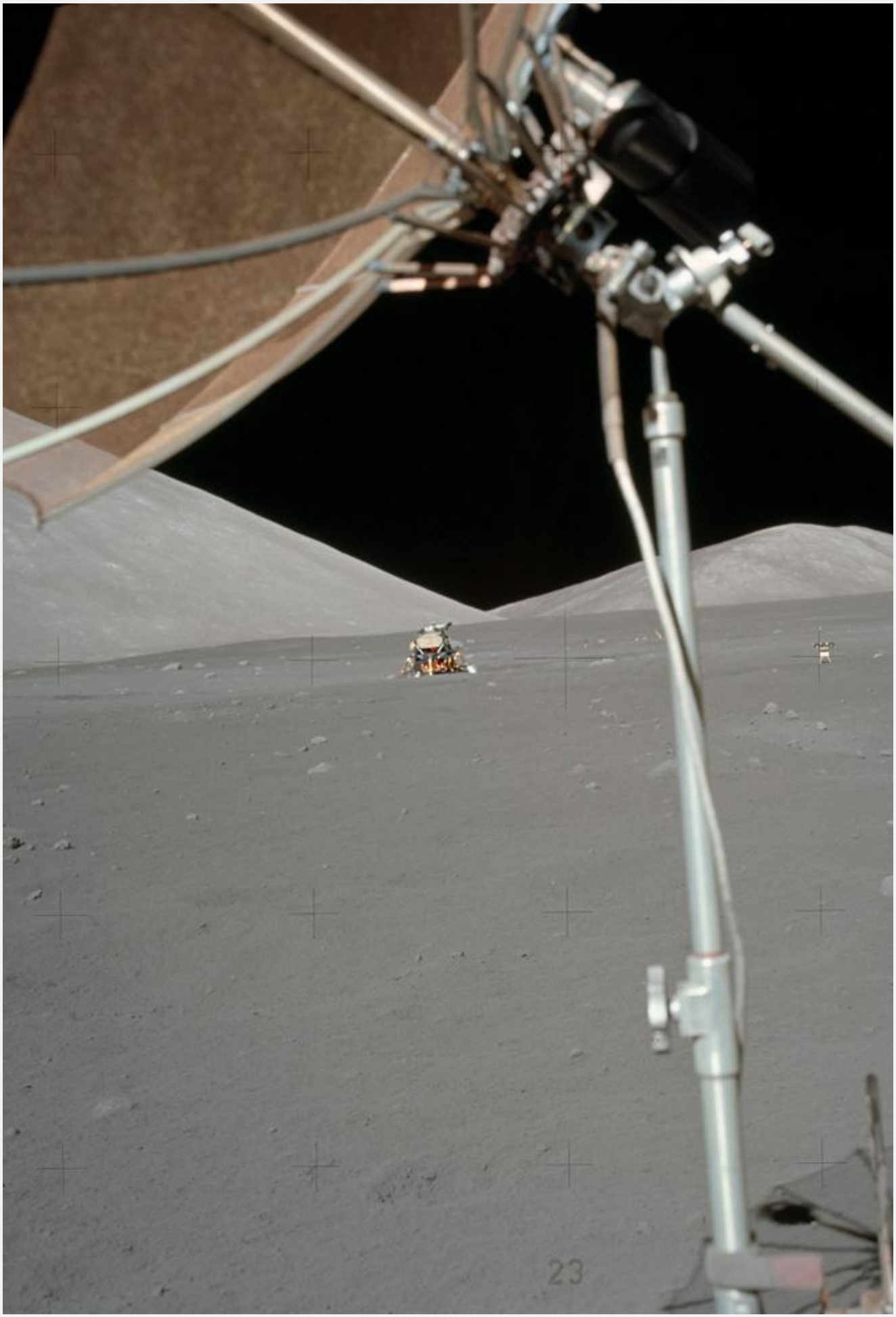
Schmitt, *"We going to Sherlock* (Station 10) *at all, Bob?"*

Parker, *"No, we're going straight home."*

They left Station 9 at 168:49:25 GET (1442 AEDT) bound for the LM, when Parker gave the boys some advice,

"… and if you keep going straight to the LM, you're probably going to run into this crater area around San Luis Rey. You probably ought to head somewhat south of directly back to the LM, so we can at least tip the western edge of Sherlock and pick it up and go from there back to the SEP. It looks like it might be rather rough there in that dotted-line area, if you can look at the backside of your map, Jack."

Just over 7 minutes after leaving Station 9, at 168:56:39 GET (1449:39 AEDT) they had the Rover bounding along at its highest speed.



The LM as viewed from the Rover. Image: NASA

Cernan took this photo of Schmitt, with the crescent Earth above, towards the end of the EVA. Image: NASA

Cernan, *"How fast do you think we are going, Jack – without looking?"*

Schmitt, *"I think we're going about 18 clicks."*

Cernan, *"Hey, you're just about right… seems like the first time we've been able to go downhill… not really,"* with a laugh.

Schmitt commented later, *"You can push the Rover up to 10 to 12 clicks. But this one time going downhill we had it up to 18 kilometres per hour and regretted it. And we were bouncing."*

This speed of 18 kilometres per hour was the fastest anyone had driven on the Moon, and is the record.

After picking up some samples from the Rover as they drove along, at 169:03:25 GET (1456:25AEDT) they arrived at San Luis Rey crater, and Cernan called,

"We're on the east side of it… Mariner and San Luis Rey… they're shallow and filled with rocks."

Parker, *"As close as we can tell, you're at one or the other of them."*

Return to the LM

They ended the rock hunt with a bit of fun by Cernan bounding down the last slope to the Rover with an exaggerated kangaroo hop while Schmitt tried to ski muttering,

"Schoosh – schoosh – schoosh."

They were getting tired by this time with the exertion of three days of hard work, an emotional roll-a-coaster, and restless sleep periods. Tired as they were, they were reluctant to finish the EVA, aware it was going to be the very last one for Apollo.

Looking back, Schmitt decided, *"This had to be our most physical day. We rode on the Rover for a solid hour getting out to Station 2 on the second day and, here, we only had fifteen or twenty minutes between demanding stations…"*

Cernan joined in, *"…and they were demanding stations. We hadn't had a piece of level ground during this EVA until now, but we did want to drag it out as long as we could."*

At 169:14:33 GET (1507:33 AEDT) they picked up the biggest rock of the mission near the LM during those last moments. Schmitt decided to get off the Rover and use it to lean on while picking the rock up.

Schmitt *"I think it's that one there – that's sort of dark."*

Cernan, *"Up there… straight ahead?"*

Schmitt, *"Yeah."*

Cernan, *"Boot prints are by it. That must be it."*

Schmitt, *"That's it, yeah. Can you swing over so I can lean on the Rover when I pick it up?"*

Cernan, *"Okay. You off?"*

Schmitt, *"Okay… I am now. I'd hate to get run over this late in the game."*

As he bent down to pick up the rock, Schmitt inadvertently kicked it under the Rover,

"Well now, what did I do that for?"

Cernan, with a laugh,
"What did you do? Kick it under?"

Schmitt, kneeling beside the Rover, *"Yeah. Need your oil changed?"*

Cernan,
"While you're under there, would you check my transmission please? … Okay, have you got it?"

Schmitt, *"Yeah, I got it. Hey, Bob… I got my rock! It's half way between the SEP and the LM."*

As Cernan started to drive away, Schmitt called out, *"Wait… wait. Let me put it in the big bag… it's in the big bag."*

Apollo sample 70215, an 8.11 kilogram piece of fine-grained basalt, was the largest rock picked up by the Apollo 17 crew. Four display samples – with a total mass of about 300 grams – were cut from Sample 70215 and can be seen at the Smithsonian, at the International Space Hall of Fame in Alamogordo, New Mexico, at the Johnson Space Center, and as the centrepiece of a travelling NASA exhibition. Pieces of this rock were later put on public display and are the only pieces of the Moon that the public has ever been allowed to touch.

After a 28 minute 26 second drive from Station 9, the Rover pulled up at the LM site at 169:17:51 GET (1510:51 AEDT) and Cernan announced,

"Okay Bob, I'm back at the LM."

Apollo 17 Sample 70215 after transport to Earth.
Image: NASA/JSC via the Lunar & Planetary Institute in Houston.

Parker responded, *"Roger. We have you back at the LM."*

The Rover TV camera was turned on at 169:18:56 GET (1529:14 AEDT) ready for the final moments of the last visit to the Moon.

Cernan, *"You should have TV Bob."*

Parker, *"Rog. We have TV. Thank you."*

The astronauts began unloading the Rover, did some last minute tasks and prepared for departure.

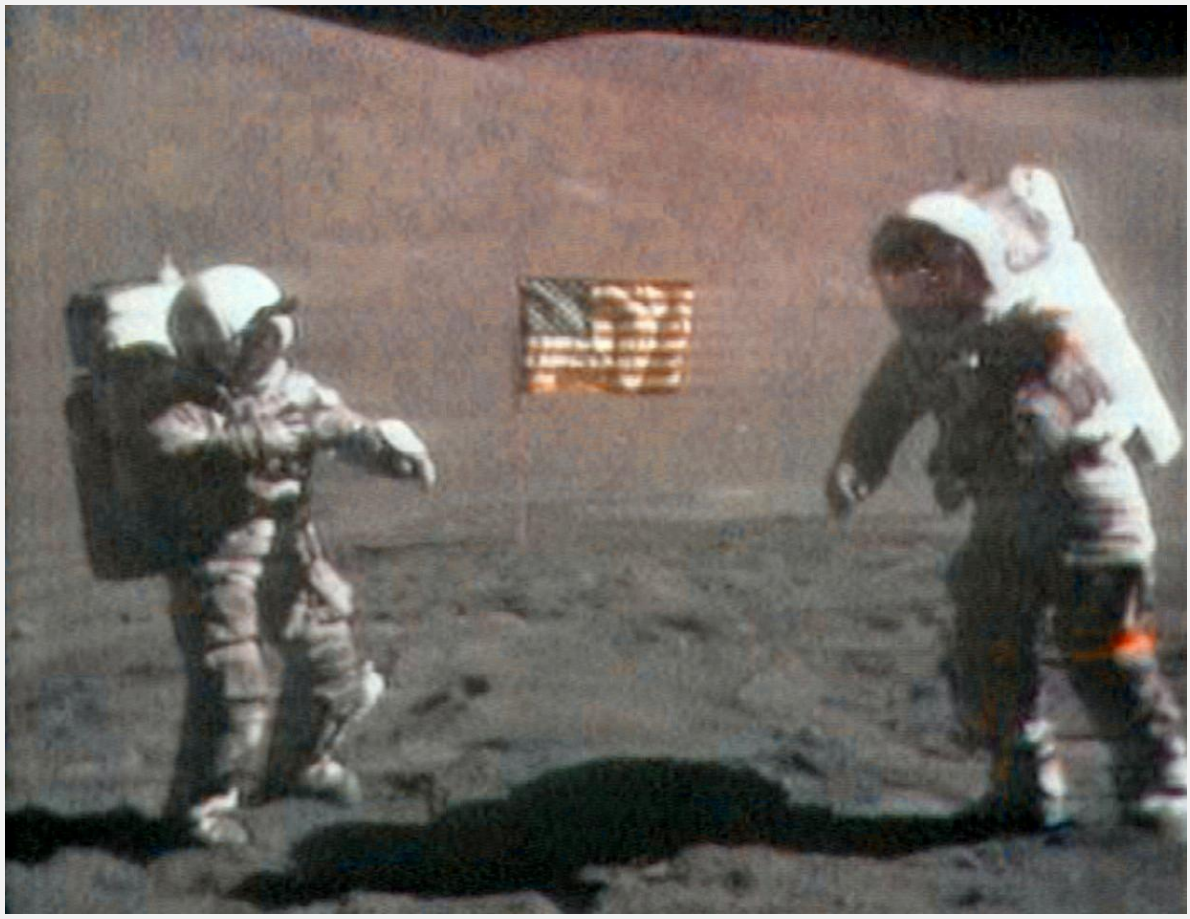
The Goodwill Rock

The astronauts had planned a short close-out ceremony before Cernan parked the Rover for the last time. Needing a rock for the ceremony, Schmitt reached down and picked up a sample rock which became Apollo 17 sample 70017, a 3 kilogram piece of coarse-grained basalt, now known as the Goodwill Rock.

About two minutes before Cernan began his speech there was a 2-way handover from Goldstone to Honeysuckle Creek, and the communications dropped out momentarily.

Cernan and Schmitt set themselves up in front of the TV camera, Schmitt holding the piece of rock he had just picked up, and at 169:43:06 GET (1536:06 AEDT) Cernan began his speech,

"Houston, before we close out our EVA, we understand that there are young people in Houston today who have been effectively touring our country, young people from countries all over the world, respectively, touring our country. They had the opportunity to watch the launch of Apollo 17; and hopefully had an opportunity to meet some of our young people in our country. And we'd like to say first of all, welcome, and we hope you enjoyed your stay.



Above: With the US flag behind them, Jack Schmitt at left,
holds the rock in his right hand as Gene Cernan explains what they are doing.

Images: NASA – Rover camera frames from the downlinked television broadcast.

Below: Gene Cernan holds the Goodwill rock as Ed Fendell in Houston
zooms in the television camera to give viewers a closer look.

Second of all, I think probably one of the most significant things we can think about when we think about Apollo is that it has opened for us – "for us" being the world – a challenge of the future. The door is now cracked, but the promise of the future lies in the young people, not just in America, but the young people all over the world learning to live and learning to work together. In order to remind all the people of the world in so many countries throughout the world that this is what we all are striving for in the future, Jack has picked up a very significant rock, typical of what we have here in the valley of Taurus-Littrow."

Schmitt handed the fist-sized rock to Cernan, who continued,

"It's a rock composed of many fragments, of many sizes, and many shapes, probably from all parts of the Moon, perhaps billions of years old. But fragments of all sizes and shapes – and even colours – that have grown together to become a cohesive rock, outlasting the nature of space, sort of living together in a very coherent, very peaceful manner. When we return this rock, or some of the others like it to Houston, we'd like to share a piece of this rock with so many of the countries throughout the world. We hope that this will be a symbol of what our feelings are, what the feelings of the Apollo Program are, and a symbol of mankind: that we can live in peace and harmony in the future."

Nearly 500 pieces of this rock have been distributed to museums and researchers around the world, making it the most widely distributed of any lunar samples.

At 169:46:38 GET (1539:38 AEDT) Cernan uncovered a small plaque mounted on the ladder, *"…to commemorate not just Apollo 17's visit to the Valley of Taurus-Littrow, but as an everlasting commemoration of what the real meaning of Apollo is to the world,"* and explained what was on the plaque.

The NASA Administrator, Dr James Fletcher, was standing by, and joined in with,

"Gene and Jack, I've been in close touch with the White House, and the President has been following very closely your absolutely fascinating work up there. He'd like to wish you Godspeed as you return to Earth, and I'd like to personally second that. Congratulations. We'll see you in a few days. Over."

Cernan, *"Thank you, Dr Fletcher. We appreciate your comments, and we certainly appreciate those of the President. And whether it be civilian or military, I think Jack and I would both like to give our salute to America."*

Schmitt, *"And, Dr. Fletcher, if I may, I'd like to remind everybody, I'm sure, of something they're aware, but this valley of history has seen mankind complete its first evolutionary steps into the universe: leaving the planet Earth and going forward into the universe. I think no more significant contribution has Apollo made to history. It's not often that you can foretell history, but I think we can in this case. And I think everybody ought to feel very proud of that fact … Thank you very much."*

Fletcher, *"I'll see you in a little bit."*

Schmitt climbed inside the LM to clean up ready for departure, while Cernan drove the Rover to its parking spot east of the LM to video the lift-off. This final parking spot for the Rover was referred to as the VIP site, an association with the close-in viewing stands at Cape Canaveral launch complex reserved for Very Important Persons.

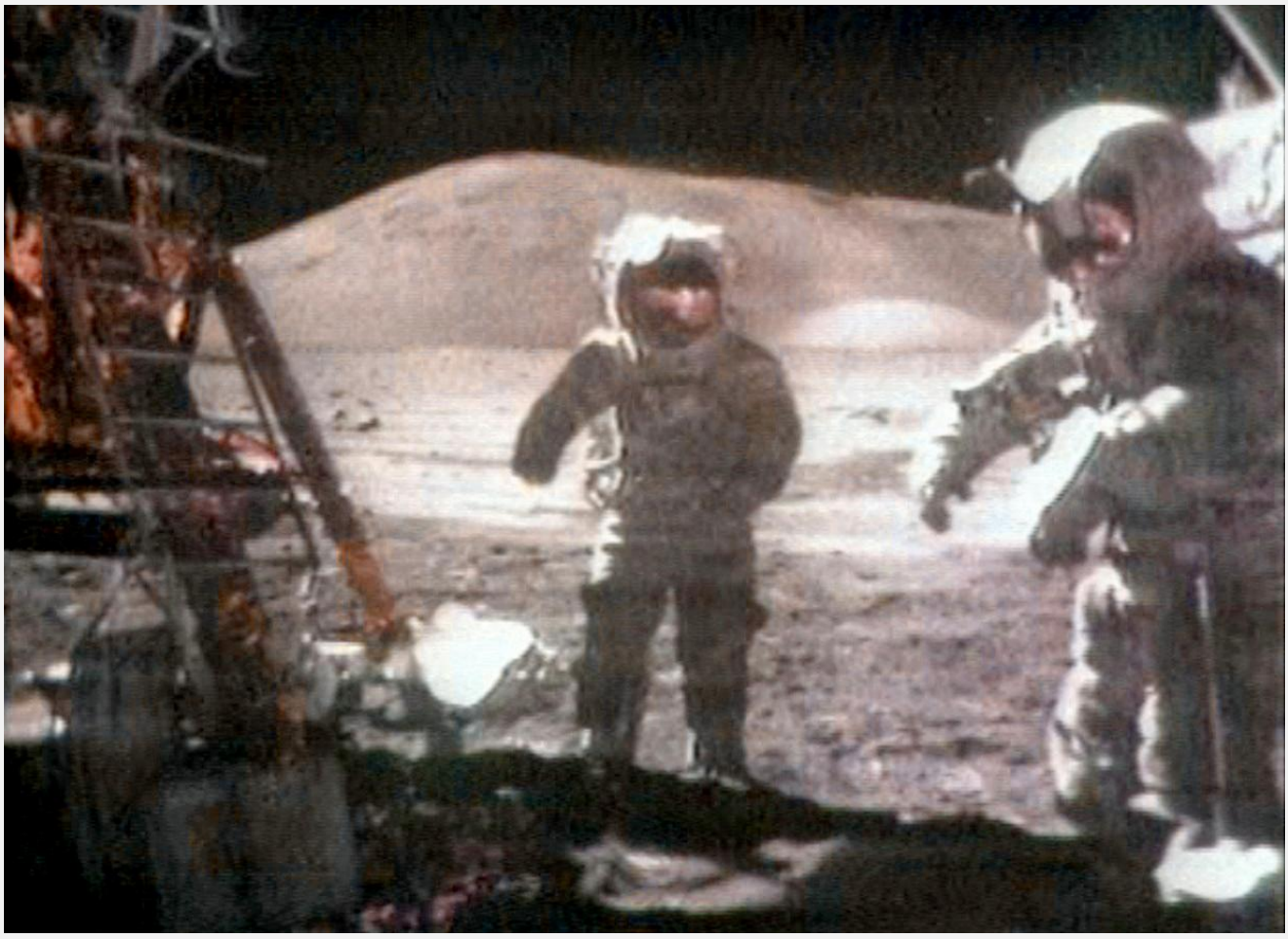
Before setting off for the LM he knelt down and ran his gloved finger through the lunar dust to write his daughter Tracy's initials, TDC, on the Moon's surface.

As Cernan hopped his way back to Challenger he had time to think about the enormity of the situation he was in. He felt that every man and woman that contributed to the space program was at his side, that *"these were the giants upon whose shoulders I stood as I reached for the stars."*

Capcom Bob Parker, looking at the Rover TV picture, said,

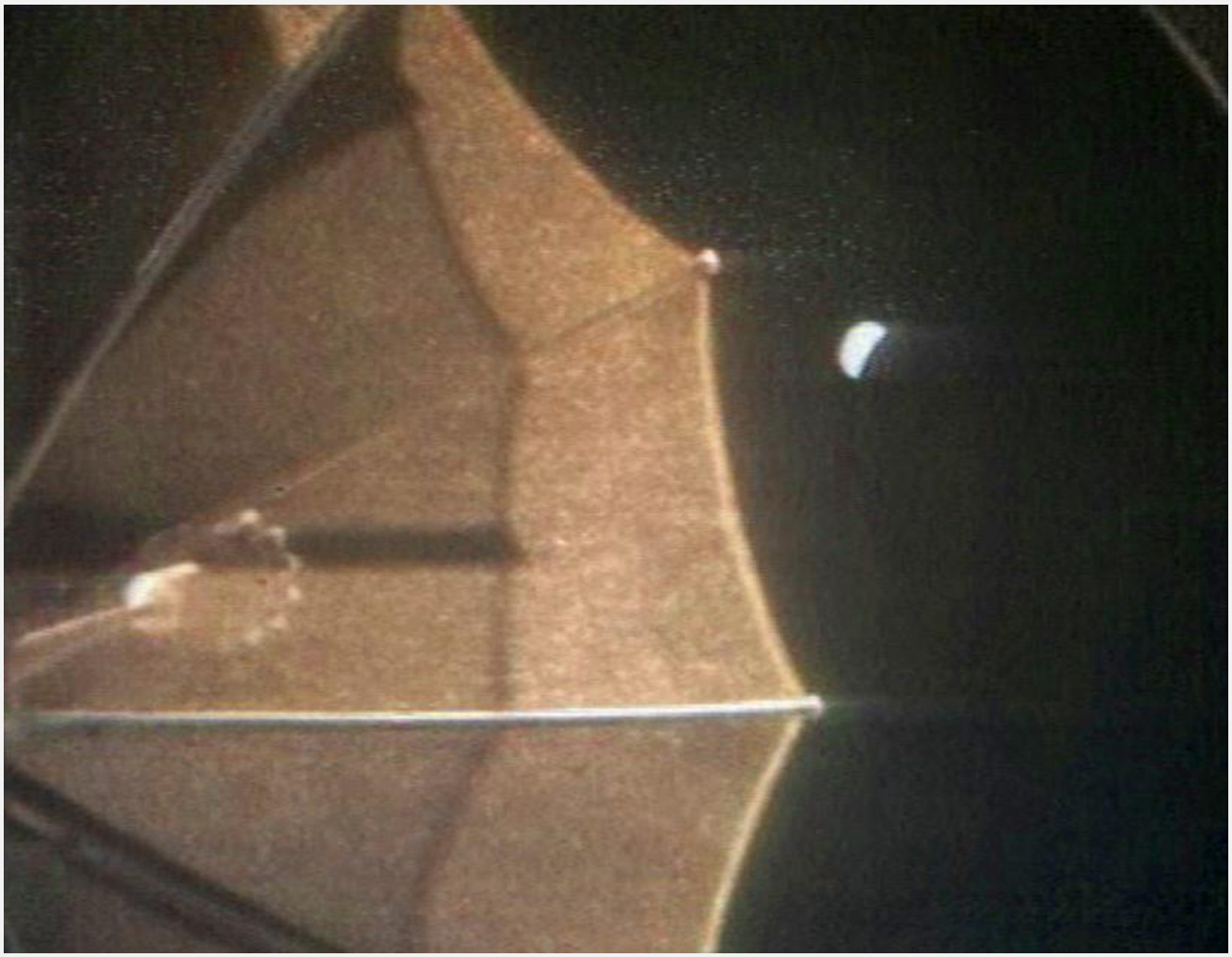
"Okay. And as you guys say farewell to the Moon, we're looking up to the Earth down here where you guys are returning pretty soon."

Cernan took a last look at the Earth floating in the black sky above, grabbed the ladder, and wished he could share this moment with everyone back on his home planet. He felt that he was no longer just an Earthling but had joined a new community now belonging to the far-reaching cosmos.



Above: Gene (left) and Jack at the LM from the Rover TV camera.
Images: NASA
Below: Gene and the plaque attached to the front landing leg.

Jack Schmitt in what is probably the last photo of an Apollo astronaut on the lunar surface. Image: NASA



"…we're looking up to the Earth down here…" Image" NASA – Rover TV

As Ed Fendell turned the TV camera to look at the LM, Cernan made his farewell to the Moon speech,

"Bob, this is Gene, and I'm on the surface; and, as I take man's last step from the surface, back home for some time to come – but we believe not too long into the future – I'd like to just say what I believe history will record. That America's challenge of today has forged man's destiny of tomorrow. And, as we leave the Moon at Taurus-Littrow, we leave as we came and, God willing, as we shall return, with peace and hope for all mankind.

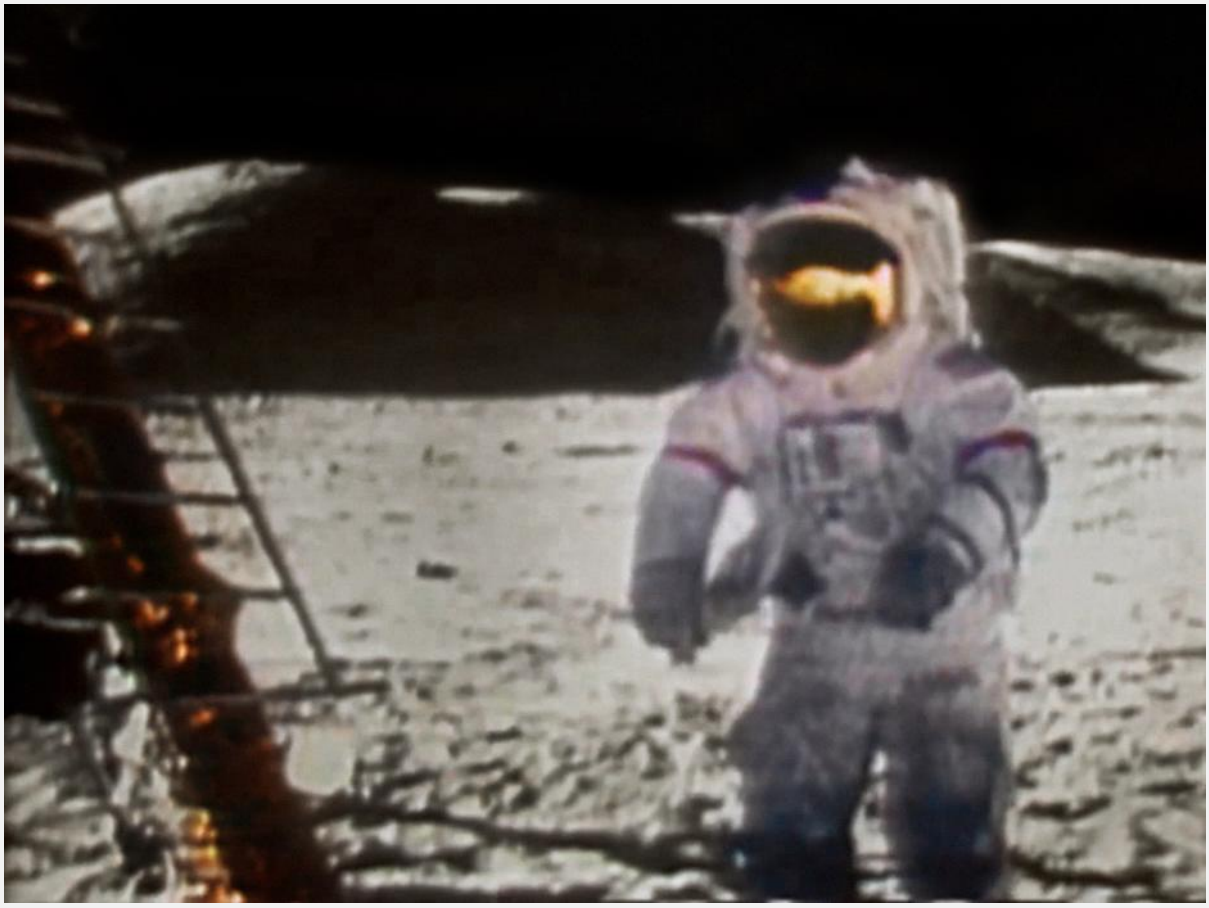
God speed the crew of Apollo 17."

Cernan admitted later, back on Earth, that this short speech was made up on the spot, but the names of the spacecraft, America and Challenger, were not a coincidence but were carefully chosen and he wanted to include those names in his final words.

Cernan described his feelings of the moment to me,

"I felt excited that we had been there, but disappointed that we had to leave. Jack Schmitt and I described that valley that we landed in as our own private little Camelot. We knew once we left we would never come back. It was our home – it was a uniquely historical place no man had ever been before in the history of life on this planet of ours. You were there – you made your imprint. You would think that would be enough, but there was so much to do. Then you do leave and you remember all the things you wished you would have done – little things or big things – or whatever. It was hard to leave but it was time to leave. I always thought that if I knew things were going to go so well I wish I could have stayed another week or two. But you do know the longer you stay the more vulnerable you might become to problems that might come to keep you from getting home."

Above: Cernan (left) salutes with Schmitt beside him near the rover.
Images: NASA – Rover TV
Below: Gene Cernan near the ladder of the Lunar Module.



A dusty Gene Cernan inside *Challenger*. Image: NASA – via the Apollo Image Archive

Cernan, *"Bob, I'm going up the ladder and I'm going to be going through the hatch."*

Schmitt, *"Gene, I've got to get out of your way."*

Cernan, *"Yup."*

Cernan, *"Okay, babe, here I come."*

Schmitt, *"Come on in."*

After checking the seal, they closed and locked the hatch at 170:44:46 GET (1637:46 AEDT); the cabin was re-pressurised at 170:47:56 GET (1640:56 AEDT), still about an hour behind the schedule. So ended the sixth and last Apollo exploration of the lunar surface.

At Honeysuckle Creek we were privileged to witness the last moments of Earthlings on the surface of the Moon in the Apollo program.

Once the astronauts were connected to the LM's environmental system they could take off and discard their Portable Life Support System (PLSS) back-packs.

After weighing the samples, at 171:53:39 GET (1746:39 AEDT), during throwing out excess equipment, Schmitt grabbed Cernan's PLSS with his gloved hands and pushed it through the hatch.

Jack Schmitt inside Challenger after humanity's last manned lunar expedition of the 20th century.
Image: NASA – via Apollo Image Archive

Watching, Cernan wistfully announced,

"Okay, baby … thanks for doing a good job. And that was a back-up PLSS too."

Schmitt, *"Well, that wasn't very good."*

Cernan, *"It walked down the ladder!"*

Schmitt, *"It went down as gracefully as you did."*

Cernan, *"Okay, let's get this out,"*

…as he tried to push Schmitt's back pack through the hatch, but it caught on the porch as there wasn't room to throw them out, and Schmitt suggested,

"Okay, get it down there and then put your foot against it and it'll probably go … The only geologist's PLSS on the Moon,"

…as Cernan had to stretch his leg right out to dislodge the reluctant PLSS.

Charlie Duke (Apollo 16 and back-up crew) joined the conversation,

"Challenger, Houston. From the old back-up crew that followed you every step of the way – super job on EVA you guys."

Cernan thought he was talking to John Young (also Apollo 16 and back–up crew),

"Thank you John. Appreciate the words, Jose. But we also appreciate your helping us get it this far."

Duke tried to get his own back with,
"Roger, Neil."

Cernan picked up his identification error, *"Was that Charlie? I haven't heard your voice since down…"*

Parker, *"Even though you guys were pretty piggy there in bringing the rocks back, we're going to let you keep them all. You only busted the red line* (overweight) *by 40lbs* (18kg)*."*

Schmitt was quick to cover with, *"….and I'll tell you, Gene and I have both lost 20lbs* (9kg) *apiece on this mission."*

They began a meal at 170:49:36 (1922:36 AEDT) and as they were running behind schedule answered a series of questions set by the back-room scientists at the same time. Finally, the lunar day ended with the astronauts climbing into their hammocks for a scheduled 8 hour rest at 175:20:50 GET (2114:20 AEDT). The astronauts' boss, Deke Slayton, joined the conversation.

Cernan, *"Ken, I'm going to take my headset off here and jump into the hammock. What time are we getting up Central Time?"*

Slayton. *"Be about 1215 pm Geno."*

Cernan, *"Okay that sounds great, Deke. We're just cleaning up a few minor things, and we'll actually probably be asleep in the next ten to fifteen minutes."*

Slayton, *"Okay, sleep good. You had a lovely day. Hope tomorrow's as good."*

Cernan, *"Thank you, Boss. Sorry to keep you up so late."*

For Apollo 17's visit to the Moon, the total time spent outside the LM was 22 hours 3 minutes 57 seconds, the total distance travelled in the Rover was 35.7 kilometres, vehicle drive time was 4 hours 29 minutes, and the collected samples totalled 110.52 kg. The farthest point travelled from the LM was 7.63 kilometres.

Schmitt summed up the three days with, *"All the days were good – they were all great. Every day was new with new experiences. I don't draw any comparison between them. Certainly, there were important discoveries made indirectly on the first day through the experiments we deployed and then directly because of the actual human exploration that we undertook."*

The astronauts were completely exhausted and slept well in the rest period before re-suiting and prepared for departure.

On Earth, Mission Control read a statement from President Nixon:

"As Challenger leaves the surface of the moon we are conscious not of what we leave behind, but of what lies before us."

It seems everybody remembers the first step on the Moon – not so many remember the last person to pull his boot off the surface of the Moon.

Astronaut Eugene Cernan. Image: NASA

HSK MISSION DAY 9
THURSDAY, 14 DECEMBER 1972
LUNAR STAY & LM LIFTOFF – DAY 4

Times: AEDT (HSK local time)

EVENT	GET	AEDT
CSM lunar orbits 53 through 58		
LM liftoff	188:01:37	0954:37
CSM/LM docked	190:17:15	1210:15
LM ascent stage jettisoned	193:58:31	1551:31
LM ascent stage impact on lunar surface	195:57:21	1750:21

Prime HSK	Track Duration	AOS/LOS
LM / Rover ALSEPs 1,4,5 P&FS 1	10h 47m 00s	1448:00 16/0135:00

Wing HSKX	Track Duration	AOS/LOS
CSM	9h 12m 00s	1524:00 16/0036:00

DSS43	Track Duration	AOS/LOS
CSM	9h 02m 00s	1534:00 16/0036:00

Parkes	Track Duration	AOS/LOS
LM [18]	6h 01m 00s	1709:00 2310:00

[18] Parkes was released from mission support after LM impact with lunar surface

At 183:29:59GET (0522:59 AEDT) the LM crew were awake and sang in unison to Gordon Fullerton at Houston,

"Good morning to you. Good morning to you. Good morning, dear Gordy, good morning to you."

As the music from *"Also Sprach Zarathustra"* by Richard Strauss filled the airwaves, Fullerton responded,

"Good morning Challenger and thank you for the vocal rendition from the Moon, there."

Cernan, *"Well, we thank you for your kind music. We wanted to let you know we were thinking about you this morning, Gordy."*

Fullerton, *"You just beat us to it."*

Cernan, *"Hey, we've been stirring for about 15 or 20 minutes. We're in the midst of a nice hamburger omelette and assorted accessories."*

Schmitt, *"Hey, Gordy, in honour of one of your comm handovers last night, and in tradition of Apollo 8, I've got a paraphrase of a familiar poem for you."*

Fullerton, *"Okay, go ahead."*

Schmitt, *"Well,*

It's the week before Christmas
And all through the LM,
Not a commander was stirring,
Not even Cernan.

The samples were stowed in their places with care,
In hopes that with you, they soon will be there.

And Gene in his hammock and I in my cap,
Had just settled our brains for a short lunar nap.

But up on the comm loop there rose such a clatter,
I sprang from my hammock, to see what was the matter.

The Sun on the breast of the surface below,
Gave the lustre of objects, as if in snow.

And what to my wondering eyes should appear,
But a miniature Rover and eight tiny reindeer.

And a little old driver so lively and quick,
I knew in a moment, it must be Saint Nick.

I heard him exclaim as over the hills he did speed.

Merry Christmas to all and to you all Godspeed."

Fullerton, *"Did the LM pilot get any sleep, or did he spend all night composing that?"*

Schmitt, *"No, for some reason I really woke up with one of your handovers last night, and that was how I went back to sleep … Gordy, that's one for the kids. They are the future."*

Listen to Schmitt's Poem

Hear Jack Schmitt reciting his Christmas poem from inside Challenger on the lunar surface.

LISTEN

0.9mb mp3 file. Running time – 2m 20s

Listen to *Challenger's* Liftoff

The Apollo 17 mission departs the lunar surface. Recording starts at 6 minutes 15 seconds before liftoff and ending after *Challenger* visually sights *America*.

LISTEN

6.5mb mp3 file. Running time – 26m

In Mission Control the White team led by Gene Kranz had taken up their positions at 0453 AEDT to support the lunar liftoff. Kranz was facing his last moments as an Apollo Flight Director. He donned his famous white vest and tried to relish the moment, momentarily recalling old memories before plugging into the console. He and his team now had to get Apollo 17 off the Moon and safely docked with the CSM. Above the lunar surface, Evans in America was coming round in his 51st orbit and ready to greet his friends in the LM.

Because of slight deviations of the CSM orbit from the planned path, the lift-off was 1 minute 10 seconds early. The countdown proceeded smoothly until 10 minutes to go when the pyrotechnic valves were blown to pressurise the propulsion system. If a tank started to leak it would turn into an emergency liftoff, to take advantage of using as much of the propellant as possible. The flight controllers waited with bated breath until the call came,

> *"Flight, ascent helium is GO – the system is pressurised, there are no leaks," and Fullerton passed on the message, "Okay, Challenger – both tanks look good."*

The count continued.

> Cernan, to Schmitt, *"Take your final look at Taurus-Littrow, except from orbit … Okay, one minute, Houston. We're 50 seconds now, and we're GO."*

Lunar Lift Off

> Cernan, *"Okay…now let's get off."* - though in his book Cernan swears he said, *"Okay, Jack, let's get this muther outta here!"*

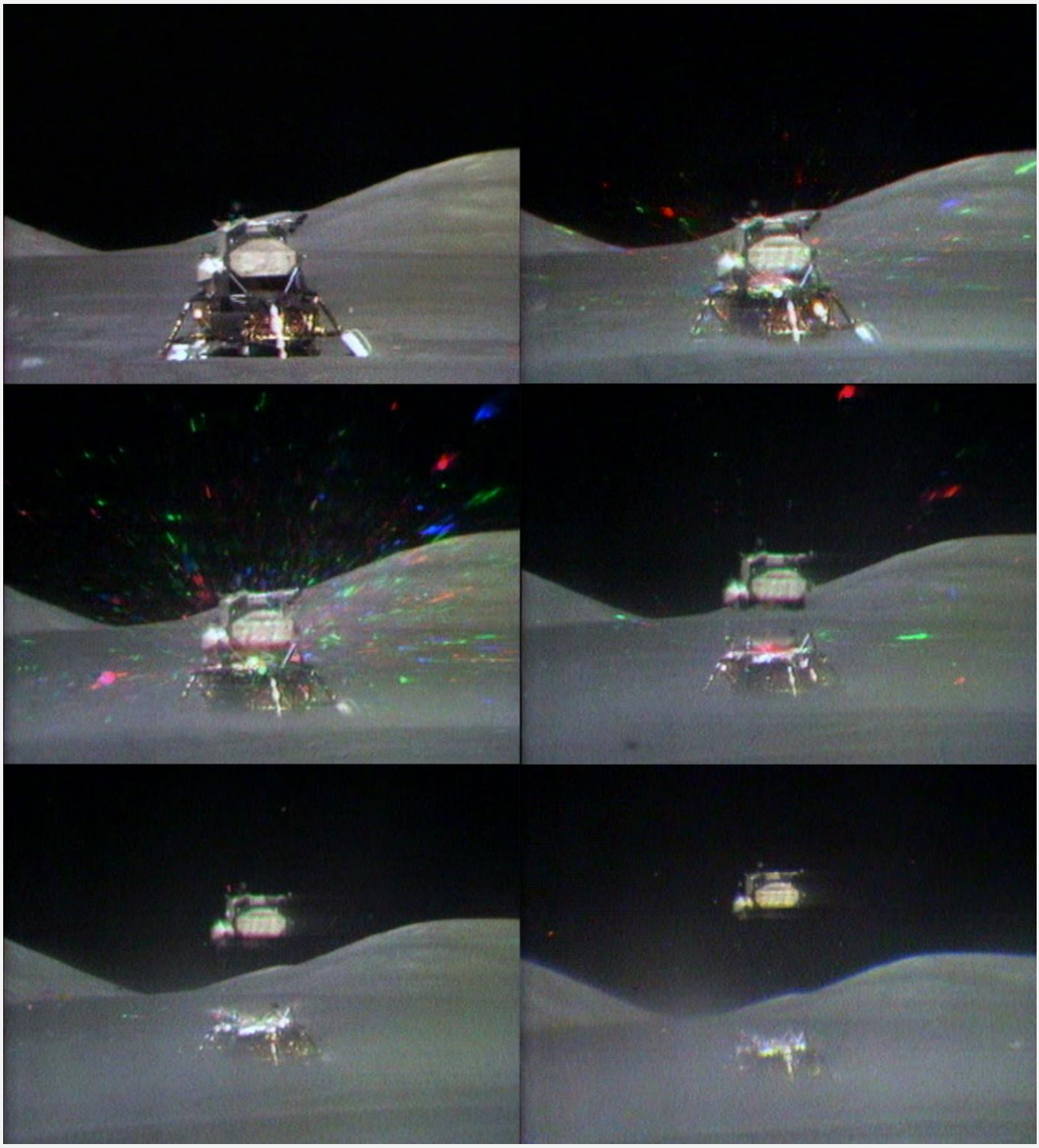
Eric Jones, editor of the ALSJ, says he can't find it on the tapes. It's assumed the more colourful version grew in Cernan's mind, after the mission.

> Schmitt, *"Ten seconds."*

At 188:01:37 GET (0954:37 AEDT) Cernan flicked the yellow ignition switch, and the ascent stage of the Lunar Module shot out of the descent stage frame. Ed Fendell on the Rover camera controls in Mission Control tried to follow the rapidly moving spacecraft, keeping it in sight for 26 seconds, but it still beat him out of the top of the frame at the end.

> Cernan: *"We're on our way, Houston."*

Hot exhaust gases ripped into the lunar surface. Shredded gold foil from the descent stage glinted in the swirling cloud of grey dust shooting from under the engine bell housing. The stars and stripes whipped madly in the rocket's exhaust, then relapsed into a permanent stillness as the little spacecraft rocket's glare dwindled into the blackness above, to wink out. The dust instantly dropped and covered the site, to become a permanent monument to the last visit of the Alien Earthlings to the Moon. The Lunar Module had been on the surface of the Moon for 74 hours 59 minutes 40 seconds.



Challenger's ascent stage leaves the surface and is followed by the Rover's camera in a preplanned motion by Ed Fendell in Houston. In these frames from Rover TV, the colour of the ejecta is an artefact of the spinning RGB colour wheel in the RCA camera. Images: NASA – Rover TV

Right after lift-off, during LM pitch over, on Earth there was a momentary mix up as there was a station handover from Madrid to Goldstone, and two way lock was lost for about 4 minutes, during which time no voice was transmitted to the spacecraft from Houston and tracking data was lost. On board Challenger the crew suddenly heard a lot of loud static in their headphones but were initially unaware of what had happened and that they were unable to hear Houston.

Cernan:
"Awful lot of static, Jack. We break lock?"

Schmitt: *"Yeah."*

Cernan: *"Why don't you get it on omni* (antenna)*, or something?"*

Cernan later commented, *"Jack spent half of the lift-off trying to get comm back."*

A 7 minute 21 second burn was executed to enter an initial orbit of 89.8 x 16.8 kilometres, followed by several minor tweaking RCS rendezvous sequence manoeuvres.

About 18 minutes after launch, Cernan had his first view of the CSM just after they had passed through the darkness of the Moon's shadow. Evans, in the CSM, was still in sunlight, but a few moments later he plunged into darkness and soon spotted the tracking light of the LM. By now they were 180.2 kilometres apart and closing, then at 188:51:37 GET (0955:37 AEDT) they both disappeared behind the Moon.

Evans in *America*,
"I don't care what you look like, come on back. I was going to shave and look nice for you, but I didn't have time to shave either."

Listen to Public Affairs Commentary

Challenger closes on *America*. Listen to Public Affairs discuss the comms dropout.
Audio courtesy of Johnson Space Center.

LISTEN

0.75mb mp3 file. Running time – 2m 20s

Rendezvous and Docking

By the time they had reappeared 45 minutes later they were only 1.3 kilometres apart and closing at 32.9 kilometres per hour. Cernan and Schmitt had their backs to the Moon, looking straight up at the CSM above them. When they were only 30.5 metres apart Cernan stopped his craft while Evans did a slow rotation of the CSM and they inspected each other, before docking occurred at 190:17:15 GET (1210:15 AEDT) at an altitude of 112.2 kilometres.

The final manoeuvring was performed by the Command Module as Evans had better visibility from his windows.

Cernan, *"Here he comes. Bang – good old two barber poles."*

Evans, *"You got what?"*

Cernan, *"Okay, just great – I mean that's better."*

Evans, *"Sounded good in here."*

Cernan, *"Okay Houston, we're hard docked."*

The LM had been away from the CSM for 79 hours 49 minutes 19 seconds.

At 190:51:00 GET (1244:00 AEDT), 33 minutes 45 seconds after docking, the two spacecraft, now locked together, went round behind the Moon to begin America's 53rd orbit.

Due to the high day time temperatures on the lunar surface the camera on the Lunar Rover failed 36 hours after the LM's departure, having been used for a total of 15 hours 22 minutes.

A message from President Nixon was read up to the spacecraft just after they docked,

"As Challenger leaves the surface of the Moon, we are conscious not of what we leave behind, but of what lies before us. The dreams that draw humanity forward seem always to be redeemed, if we believe in them strongly enough and pursue them with diligence and courage. Once we stood mystified by the stars; today we reach up to them. We do this not only because it is man's destiny to dream the impossible, to dare the impossible, and to do the impossible, but also because, in space, as on Earth, there are new answers and new opportunities for the improvement of, and the enlargement of, human existence.

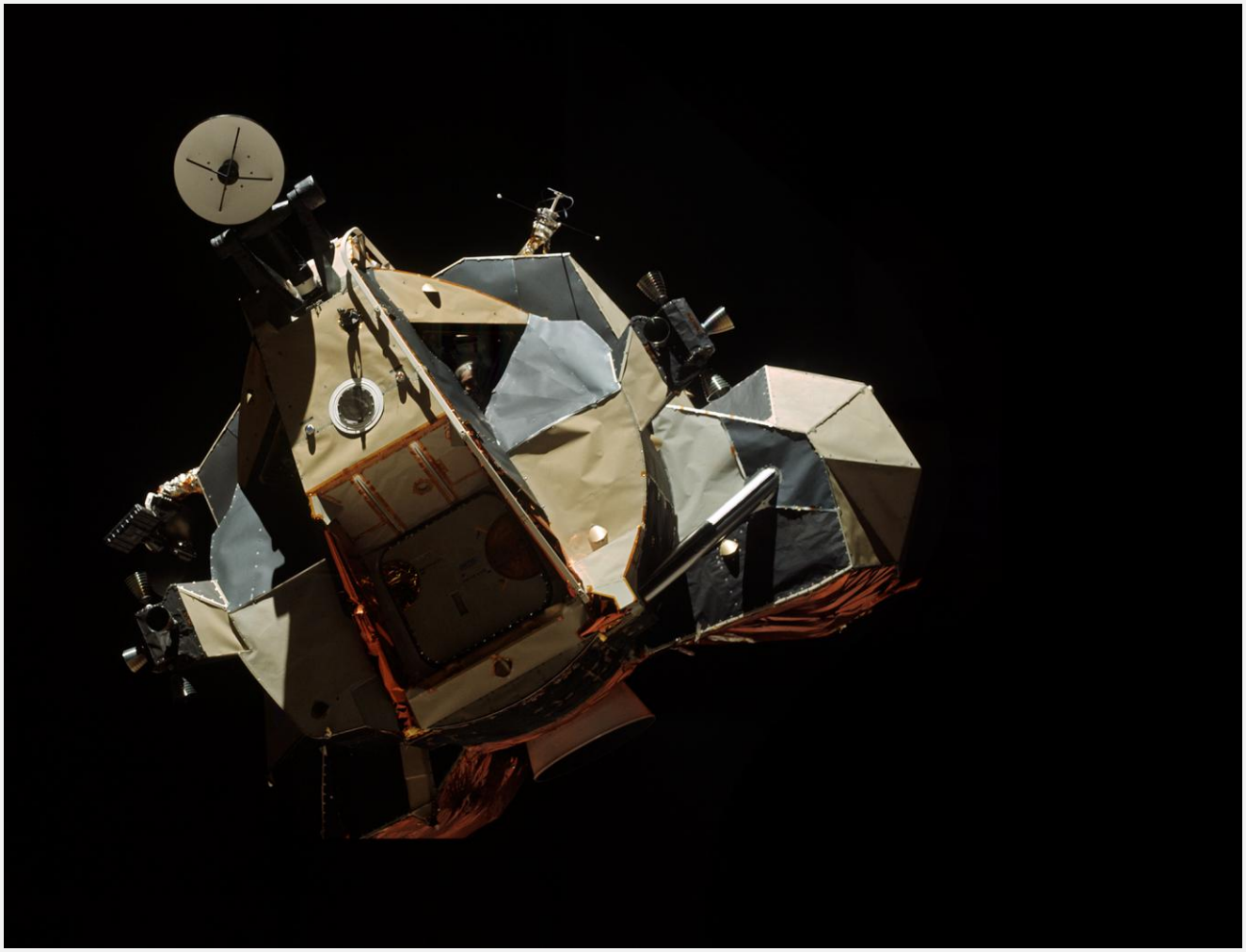
This may be the last time in this century that men will walk on the Moon, but space exploration will continue, the benefits of space exploration will continue, and there will be new dreams to pursue, based on what we learned. So let us not mistake the significance or miss the majesty of what we have witnessed. Few events have ever marked so clearly the passage of history from one epoch to another. If we understand this about the last flight of Apollo, then truly we have touched a 'many splendored thing'. To Gene Cernan, Jack Schmitt, and Ron Evans, we say God speed you safely back to this good Earth."

View of the CSM during rendezvous. Image: NASA

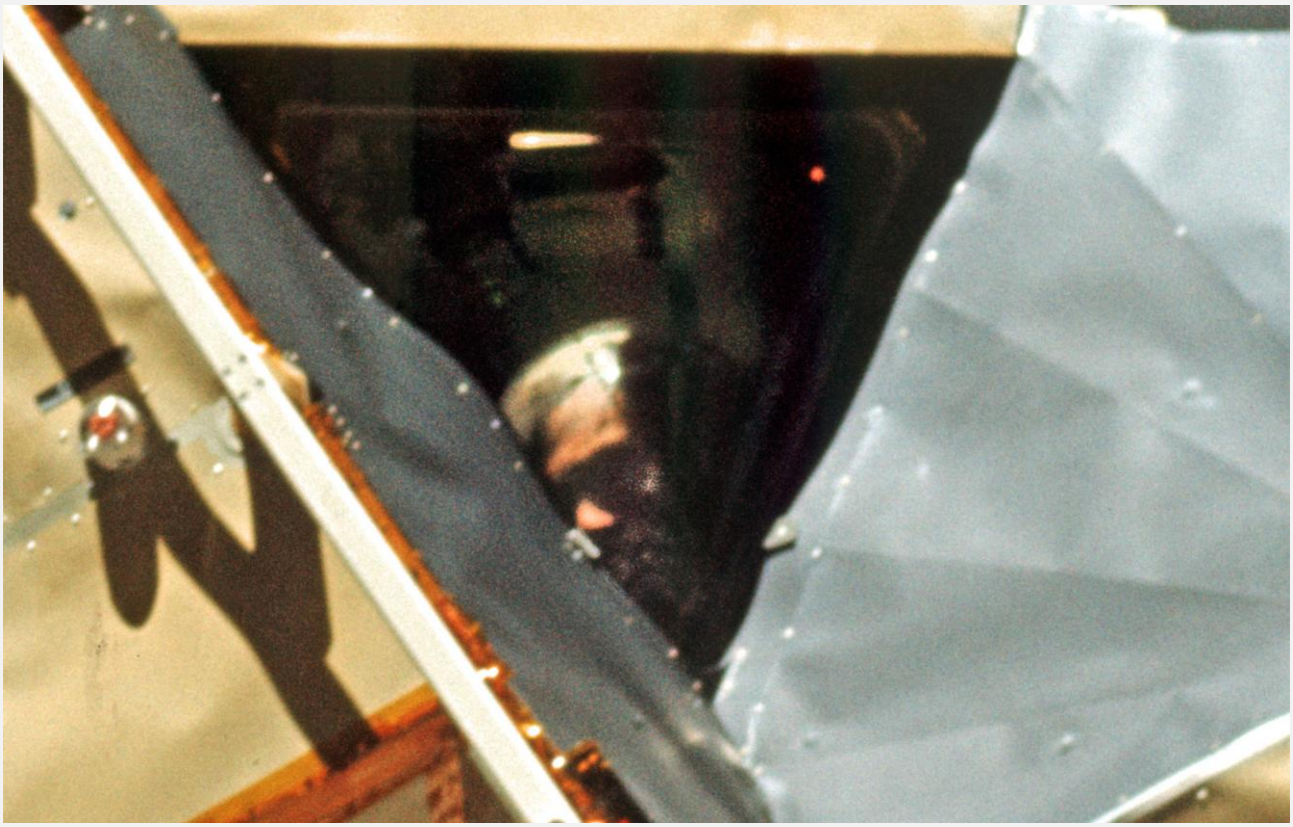
At Honeysuckle Creek we picked up the action at 192:50:00 GET (1448 AEDT) in the 54th orbit while they were preparing to dump the LM. After transfer of the crew and samples to the CSM, the spacecraft was so full of 'stuff' that the astronauts were keen to get rid of their rubbish bag they had been filling for the last three days.

Just before they closed the hatch for the last time, they tossed the bag into the empty cabin of the LM. At 193:58:31 GET (1551:31 AEDT), the latches locking the two spacecraft together were released so the pressure in the tunnel could nudge them apart. Then, under remote control from Houston, Challenger headed for a crash landing on the eastern flank of South Massif.

A 12-second manoeuvre was made at 194:03:31 GET (1556:31 AEDT) to separate the CSM from the LM ascent stage which resulted in an orbit of 118.3 by 113.3 kilometres. A 1 minute 56 second de-orbit firing at 112 kilometres altitude depleted the ascent stage propellants and LM impact occurred at latitude 19.96° north and longitude 30.50° east at 195:57:21 GET (1750:20 AEDT). The impact point was 1.75 kilometres from the planned point and 9.9 kilometres southwest of the Apollo 17 landing site. The impact was



Above: View of the Lunar Module ascent stage during rendezvous.
Images: NASA
Below: In this enhanced version of above, Gene Cernan is clearly visible inside the LM.



faithfully recorded by the Apollo 12, 14, 15, and 16 ALSEP seismic stations.

Although Ed Fendell trained the Rover's TV camera at the expected point of impact on South Massif, no sign of the crash was seen. However, up in America the astronauts eagerly studied their valley for any signs of the little spacecraft's grave. Three minutes after the LM struck the surface, Evans called down,

"Hey, Houston, I can see a bright spot on the South Massif – on the top of the South Massif."

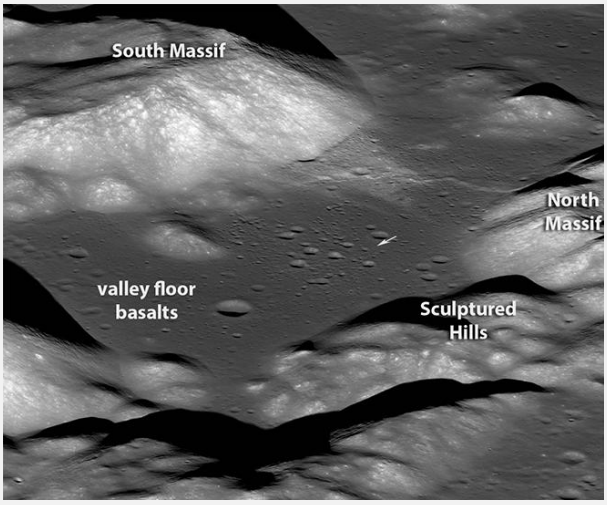
Houston asked Evans to repeat his call,

"Okay, this is America. I can see a bright spot on the top of the South Massif and – let me see – I guess if you come from the east, it's the second ridge from the east, and right on top of the ridge is a bright spot. I don't know how big a crater it should make."

Then using a photomap Evans described in detail where he could see the 'new' crater, calculated to be 17 metres across.

The Parkes Radio Telescope was released from support at this stage.

The first two of eight explosive packages placed by the crew on the lunar surface were detonated at 210:15:14.56 and 212:44:57.11. Both events were picked up by the lunar seismic profiling geophones, and the resulting flash and dust from the second explosion were seen on television. After the eight explosive charges were fired off, together with the LM impact and data from the traverse gravimeter revealed a solid subsurface interpreted as a slab of subfloor basalt as thick as 1.4 kilometres.



HSK MISSION DAY 10
SATURDAY, 16 DECEMBER 1972
CSM LUNAR ORBITS

Times: AEDT (HSK local time)

EVENT	GET	AEDT
CSM lunar orbits 66 through 71		
Rover TV – powered up		1643:00

Prime HSK	Track Duration	AOS/LOS
CSM Rover ALSEPs 2,3 & 4 P&FS 1	9h 55m 00s	1535:00 17/0130:00

Wing HSKX	Track Duration	AOS/LOS
CSM	9h 12m 00s	1524:00 16/0036:00

Handovers	AEDT
CSM 2-way from GDS – 8h 56m	1555:00 17/0130:00
CSM to GWM	17/0051:00

DSS43	Track Duration	AOS/LOS
CSM	8h 37m 00s	1711:00 17/0148:00

During their final day orbiting the Moon the crew spent most of the time doing out-of-the-window geology. Because of the discovery of orange soil at Shorty Crater, they spent a lot of the time looking for colour at various places where the scientists thought though they might see pyroclastic deposits. As they passed over their landing site Evans noted the orange colour was no longer evident. Because they were following the same ground track every orbit, they had a chance to think about what they were seeing, make hypotheses and on the next pass see if the hypotheses made sense. The same applied to the scientists on the ground at Houston. Repeated passes over the landing site gave them a chance to see the gradual fading of the orange

colouration around Shorty Crater, probably due to changing lighting conditions.

At 219:26 GET (1959:00 AEDT) Houston advised the spacecraft, far away from any weather,

"I'll have you know it's clear down here. We saw the Moon for the first time since launch day. It's getting bright. It looks like you might be somewhere over the terminator on Imbrium."

Cernan, *"Is that right?"*

Overmyer, *"First time we've seen the Moon since launch day."*

Evans, *"That's beautiful. Your weather has been that bad, huh?"*

Overmyer, *"That's affirm. Fog and drizzle and rain and rain and rain."*

While the astronauts were getting ready for their last sleep period in orbit, just before they went behind the Moon on orbit 67, Houston said goodnight, and Overmyer told the crew that while they were sleeping the Old Orange Team would be sitting around the fireplace singing Christmas carols.

Robert Overmeyer, Ronald Evans, and geologist Farouk El-Baz during lunar orbit geology training for Apollo 17. Image: NASA/JSC

HSK MISSION DAY 11
SUNDAY, 17 DECEMBER 1972
TEC – DAY1

Times: AEDT (HSK local time)

EVENT	GET	AEDT
TEI	236:44:33	1037:33
Sleep period start		1705:00

Prime HSK	Track Duration	AOS/LOS
CSM ALSEPs 3 & 4 P&FS 1	9h 58m 00s	1636:00 18/0234:00

Wing HSKX	Track Duration	AOS/LOS
CSM	8h 50m 00s	1727:00 18/0217:00

Handovers	AEDT
CSM 2-way from GDS [19] – 7h 45m	1753:00
CSM to MAD	18/0138:00

[19] Between 1922:00 and 1933:00, 14 commands were uplinked locally from HSK due to a Houston computer problems. HSK received 25 on-board recorder voice/data dumps during this period.

DSS43	Track Duration	AOS/LOS
CSM	8h 24m 00s	1727:00 18/0151:00

At 228:10:00 GET (0202:59 AEDT) at the end of orbit 71, the wake-up music for the last morning in orbit was the appropriate 60's song *"Light my Fire"* by the Doors with a line *"The time to hesitate is through."* Evans slept right through it, even though he was supposed to be on duty and wearing his earpiece.

Overmyer, *"Time to put your feet on the floor and a smile on your face and face another day in lunar orbit – the last one."*

Schmitt, *"They're there but the fellow on watch is still asleep."*

Then at 229:21:00 GET (0313:59 AEDT) came recognition of the tracking network from Cernan,

"And our hello and thank you to the tracking team. We sure have been able to work well with them – and communications have been super."

Overmyer, *"That's real great. I'm sure those words will be appreciated up at Goddard, and around the world, of course."*

Cernan, *"Well, like a lot of other people – you can't do without them."*

The television assembly and lunar communications relay unit failed to operate when attempts were made to command the Rover camera on at 221:00 GET (1853 AEDT 16 December), 237:44 GET (1137 AEDT 17 December), and 237:53 GET (11:46 AEDT). It was later determined that the relay unit experienced an over-temperature failure.

Trans Earth Injection

The Trans Earth Injection (TEI) burn was performed behind the Moon about 8 hours after they were woken up. Following a 2 minute 23.69 second SPS burn at an altitude of 115 kilometres, TEI (Trans Earth Injection) was achieved at 236:44:32.87 GET (1037:32 AEDT), at a velocity of 9,189 kilometres per hour. The CSM had completed 75 lunar orbits lasting 147 hours 43 minutes 37 seconds.

America appeared from behind the Moon at 236:55:00 GET (1048:00 AEDT), tracked by Madrid and Goldstone, at an altitude of 620 kilometres and shooting rapidly away from the Moon, all the while beaming dramatic television pictures back to Houston.

Cernan reported, *"America has found some fair winds and following seas, and we are on our way home."*

America climbed rapidly away from the Moon,

"Climbing out like a ding bat"

…as the crew reported, giving the crew a spectacular sight of the crater Tsiolkovsky, and the next time they saw Taurus-Littrow they were 3,219 kilometres away, and Schmitt said he could just see the landslide area at the base of South Massif. From now on there was little to do apart from Evans' spacewalk.

Cernan became pensive at 237:30 GET, (1122:59 AEDT) and feeling the moment was special, made the following profound statement,

"You know I think it worth noting while we are looking back at the entire Moon as we see it here and you're seeing it there, that America could be proud of the Apollo heritage it's left here. I know we in the program believe that it's really and truly been a heritage that will prove itself to be one of man's most beneficial things that has happened to mankind in quite some time, although none of us can really predict the future. But I think that everyone that has been part of this program has been taught of its accomplishments. I know we have. We're looking back at someplace, I think, we will use as a stepping stone to go beyond someday. It's a faith I truly and dearly have. And I think we will all see it in our lifetime, not just as a nation, but as a world.

I think the Apollo program not only has given us the first step to that sort of impossible dream but has also given us an opportunity to make the first step of bringing the world together as one unit so that we can make that step together. It's been a privilege sharing the program - that part of it we've been in – with as many people as we have, and as many people as we can, because I have often thought, and I've often said before, that anything that's worthwhile doing, and doing well, is certainly worthwhile sharing with others. This is history being made in our time, while you and I are alive – not a hundred years ago, or a thousand years ago, and it's sort of the real thing happening right now. You're living it, not just us. We hope that you're getting as much out of it – not just a feeling of pleasure and excitement - but that of accomplishment as we are."

Fullerton, *"Thank you Gene. Speaking for the ground, as part of the Apollo team, we second those thoughts, which you put very well."*

Cernan,
"Well, Gordy, it's not our accomplishment. It's the accomplishment of a nation."

Schmitt, *"Gordy, in that vein I think a couple of words I'd like to more or less reiterate was I tried to say as we finished our third EVA, and that was that the valley of Taurus-Littrow and the orbit of*

the spaceship America saw the completion of mankind's first steps – first evolutionary steps from the planet Earth into the Universe. I think it's important that in doing so we established a tradition of peace and freedom within the solar system. From that larger home, now, we move to greet the future."

Evans, *"Well, you know, Houston, and America, and the world. This is the Command Pilot of the spaceship America, and I just feel quite honoured and proud to have been a part of this Apollo Program. The Moon itself is magnificent – it's a dynam….well, I hate to use the word dynamic because it's really not dynamic, but it's a marvellous planet. It has all the wonderful opportunities for exploration. Man must explore. We will continue to explore, and I hope someday we may all have the opportunity to see mankind enjoy the benefits of the exploration of the Apollo Program."*

Fullerton,
"Thank you very much for the great TV show and your final words. We enjoyed every bit of it."

Schmitt, the prolific space weather man on the way out had to admit, *"Gordy, I'm afraid the weather reports on the way back of the only planet that really has much weather visible, will be a little repetitive."*

Fullerton, *"Jack, we're heartbroken!"*

Schmitt, *"For your first report you can just play the recording back – it's sunny and clear."*

Fullerton, *"Except that you left out the fact that it's cold here."*

Schmitt, *"Gordy, you didn't listen. I can't see the Earth. I'm talking about that other planet."*

At 243:08:47 GET (1701:47 AEDT) the spacecraft closed down for a rest/sleep period of 7 hours and 21 minutes.

HSK MISSION DAY 12
MONDAY, 18 DECEMBER 1972
TEC – DAY2

Times: AEDT (HSK local time)

EVENT	GET	AEDT
TEC – Trans Earth Coast		
EVA – cislunar by Ron Evans	257:34:40 258:20:00	0727:40 0813:00

Prime HSK	Track Duration	AOS/LOS
CSM ALSEPs 1, 3 & 4 P&FS 1	10h 31m 00s	1655:00 19/0326:00

Wing HSKX	Track Duration	AOS/LOS
CSM	8h 29m 00s	1732:00 19/0201:00

DSS43	Track Duration	AOS/LOS
CSM	8h 07m 00s	1732:00 19/0139:00

The next spacecraft morning the wake-up song at 250:30:01 GET (0023:01 AEDT) was *"Home for the Holidays"* by Jerry Vale. Houston reminded the astronauts that this day (spacecraft time, 17 December) marked the 69th anniversary of Wilbur and Orville Wright's first powered flight.

A few minutes later, at 250:37:00 GET (0030:00 AEDT), 62,638.3 kilometres from the Moon and 317,790 kilometres from Earth, they left the Moon's gravity, passing through the equigravisphere. Houston advised them,

"And America, you're now in Earth's control. We passed it two minutes ago."

Cernan, *"What was our velocity going through the changeover?"*

Overmeyer, *"Geno, you had 3,851 feet per second* (4,225.6 kilometres per hour relative to Earth) *going through the crossover."*

"Hey, this is great," he laughed, "Talk about being a spaceman – this is it!"
Ron Evans retrieves film canisters from the SIM bay during his EVA. Image: NASA

Perhaps another statistic of interest is when the velocities referencing the Moon and Earth matched (equalled each other) occurred 17 hours 48 minutes later at 268:25:00 GET (1811:01 AEDT) with a speed of 2,017.9 kilometres per hour.

After about two and a half hours preparation, at 257:34:40 GET (0727:40 AEDT), the CM pilot, Ron Evans, began an EVA to retrieve the SIM bay data.

Unfortunately, at Honeysuckle Creek we missed the whole event, only Madrid was tracking and saw the event live.

Cernan,
"Okay, babe. When you get out there, just take it nice and slow and easy. You got all day long."

Schmitt: *"Nice day for an EVA, Ron. Go out and have a good time."*

Evans, *"Go now? Am I clear?"*

Cernan, *"You're clear, baby – go."*

Evans, *"Okay. Hot diggety dog!"*

Accompanied by an escaping felt-tipped pen, as Evans climbed through the hatch and mounted a TV camera on the side of the hatch. He noticed

some paint on the side of the spacecraft had blistered but otherwise everything looked fine. He could see the full Moon behind him to the right, and ahead to the left just outside the hatch, was a crescent Earth.

"Hey, this is great," he laughed, "Talk about being a spaceman – this is it!"

"Man, it's dark out here. It is really dark. Wish there were some more handles, I'd go around the other side of the spacecraft."

In the press conference later, he described how he felt,

"You're out there in the deepness of space with nothing there but your spacesuit on, and you're doing this job that has to be done. And we're riding around in space out there, and this is in a capsule – it's a solidly built vehicle and you get the zero g effect on the thing, but you don't get the feeling of really getting out and walking in space. Once I became accustomed to what it was like in the EVA environment, then you relax and you take it easy. I think I really enjoyed it."

In three trips to the scientific instrument module bay he retrieved the lunar sounder film, panoramic camera, and mapping camera cassettes. While having a brief rest he noticed the TV camera and looking at the lens said *"Hi"* to his mother, wife and family.

Schmitt was looking after Evans from the hatch,

"The previous missions didn't have a camera and I decided early on, before we left the Earth, that we would bring one of our EVA cameras back from the lunar surface so Ron Evans would have a photo documentation of his activities – that's why we see nice pictures of Ron Evans!"

After 45 minutes 20 seconds outside the Command Module the hatch was closed at 258:20 GET (0813 AEDT) to bring the total extravehicular activity for the mission to 23 hours 9 minutes 41 seconds.

Their penultimate rest/sleep period in space began at 268:19:00 GET (1812:00 AEDT) 250,412 kilometres from Earth.

HSK MISSION DAY 13
TUESDAY, 19 DECEMBER 1972
TEC – DAY3

Times: AEDT (HSK local time)

EVENT	GET	AEDT
TEC – Trans Earth Coast		
[20] Last track of the Honeysuckle Creek Complex (HSK – HSKX) and DSS43 for the Apollo 17 mission and for the Apollo Moon Program.		

Prime HSK	Track Duration	AOS/LOS
ALSEPs 1, 3,4 & 5 [20]	8h 58m 00s	1935:00 20/0433:00

Wing HSKX	Track Duration	AOS/LOS
CSM [20]	6h 24m 00s	1832:00 20/0056:00

DSS43	Track Duration	AOS/LOS
CSM [20]	6h 24m 00s	1832:00 20/0056:00

The song *"We've only just begun"* sung by The Carpenters was beamed up to the spacecraft at 275:00:00 GET (0053:00 AEDT) to rouse the crew after a 6 hour 41 minute break.

A hunt for Evans' wayward scissors was conducted with Houston passing up ideas where they could have lodged, but with no luck, and there was another optical light flash experiment.

The big event of the day, 180,500 kilometres from Earth, was a 26 minute 30 second press conference held at 284:00:00 GET (0953:00 AEDT), appropriately right at the beginning of Goldstone's tracking period. Questions were set by the media in attendance at Houston and passed on to the crew by the Capcom Fullerton.

A couple of the more interesting questions were:

Fullerton, *"Here's one addressed to all three crewmen. What will you remember most about this mission?"*

Gene Cernan cleans his fingernails during Trans Earth Coast. Image: NASA

Cernan, "*Boy, that's a loaded question, Gordy. There's so many things, but I think probably the thing that – when I think about it – that will stick with me most is the same thing that stuck with me for my last two missions – not so much being there, but it's getting the chance to get home and share what you've seen and what you've done, with other people."*

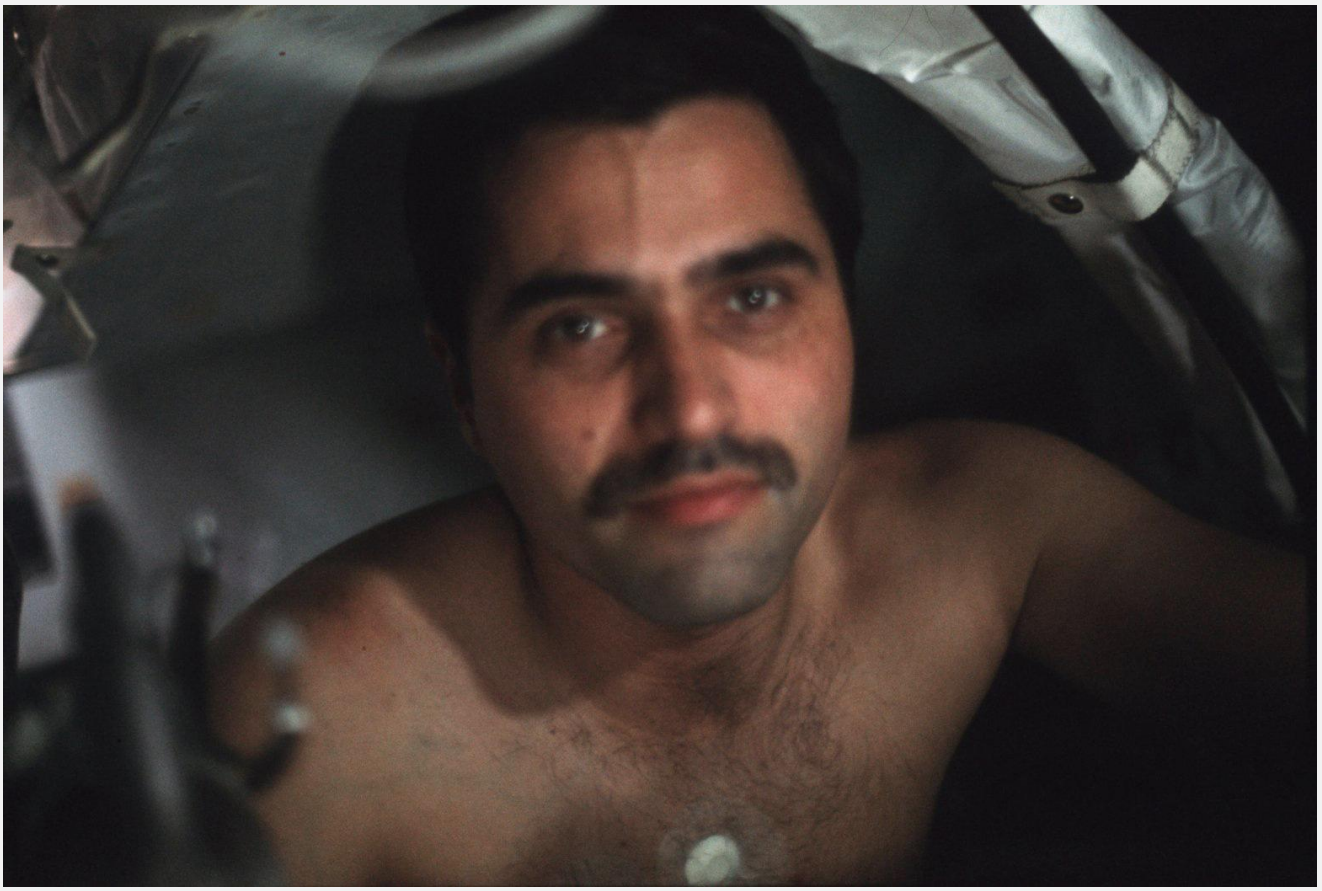
Evans, *"I think in my case the lift-off itself was something brand new for me. It's something beyond – the booster ride itself was something beyond what I could really comprehend. So, I think that's … oh, a very important part of it. I will always remember that part of it. But I'm kind of like with Gene; I feel that even though the three of us have been up here and had the opportunity to observe the Moon, look at what we could find and that type of thing. I think that we have an obligation to share our experiences with the rest of the people."*

Schmitt, *"Well, Gordy, that is a difficult question. It has been a fascinating experience from so many detail aspects. I guess, generally speaking, the thing I carry back with me, I hope, is an increased perspective not only for the history of the solar system but hope for the future of mankind within that solar system."*

Fullerton, *"Question 11 is for Jack. Do you think the United States waited too long to send a geologist to the Moon?"*

Schmitt, *"We're grinning because I think we predicted that question. Gordy, I think the United States waited too long to go into space in the first place, and I think they're probably going to wait too long to go back. I will always feel that way no matter who goes or what qualifications he may have or may think he has. I think that the most important thing that maybe I have done is to – to be able to show that we can build a transportation system that allows you to fly people of a wide variety of disciplines. And I think that we have shown that, and I think that it's occurred at about as soon as possible within the Apollo Program."*

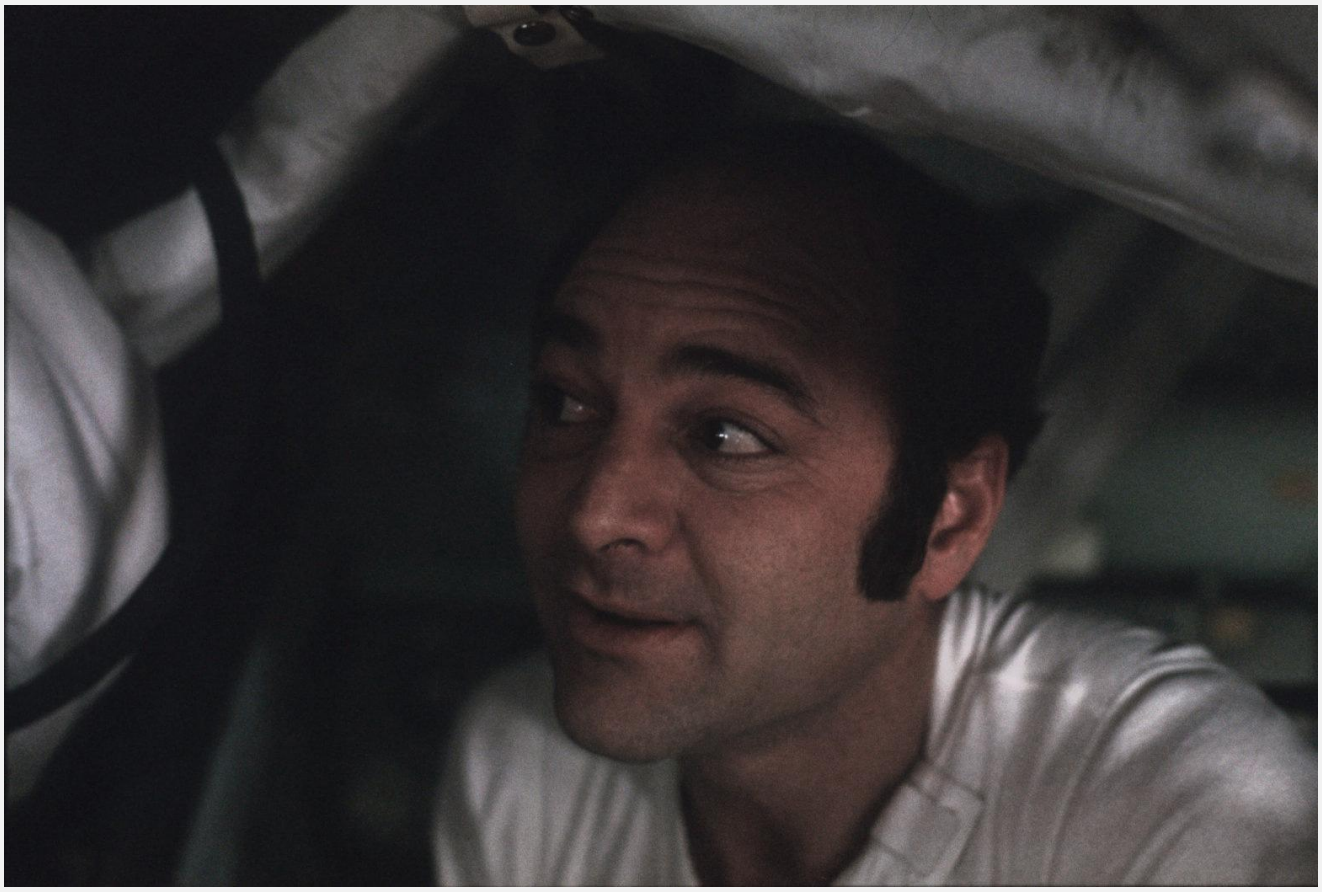
Their last rest/sleep period in space began at 291:08:00 GET (1701:00 AEDT), now 135,733 kilometres from Earth. In Mission Control Pete Frank's Orange Team had taken over control and Bob Parker sat in the Capcom's seat.



Above: Schmitt tries out a moustache after shaving off his beard during Trans Earth Coast.

Images: NASA

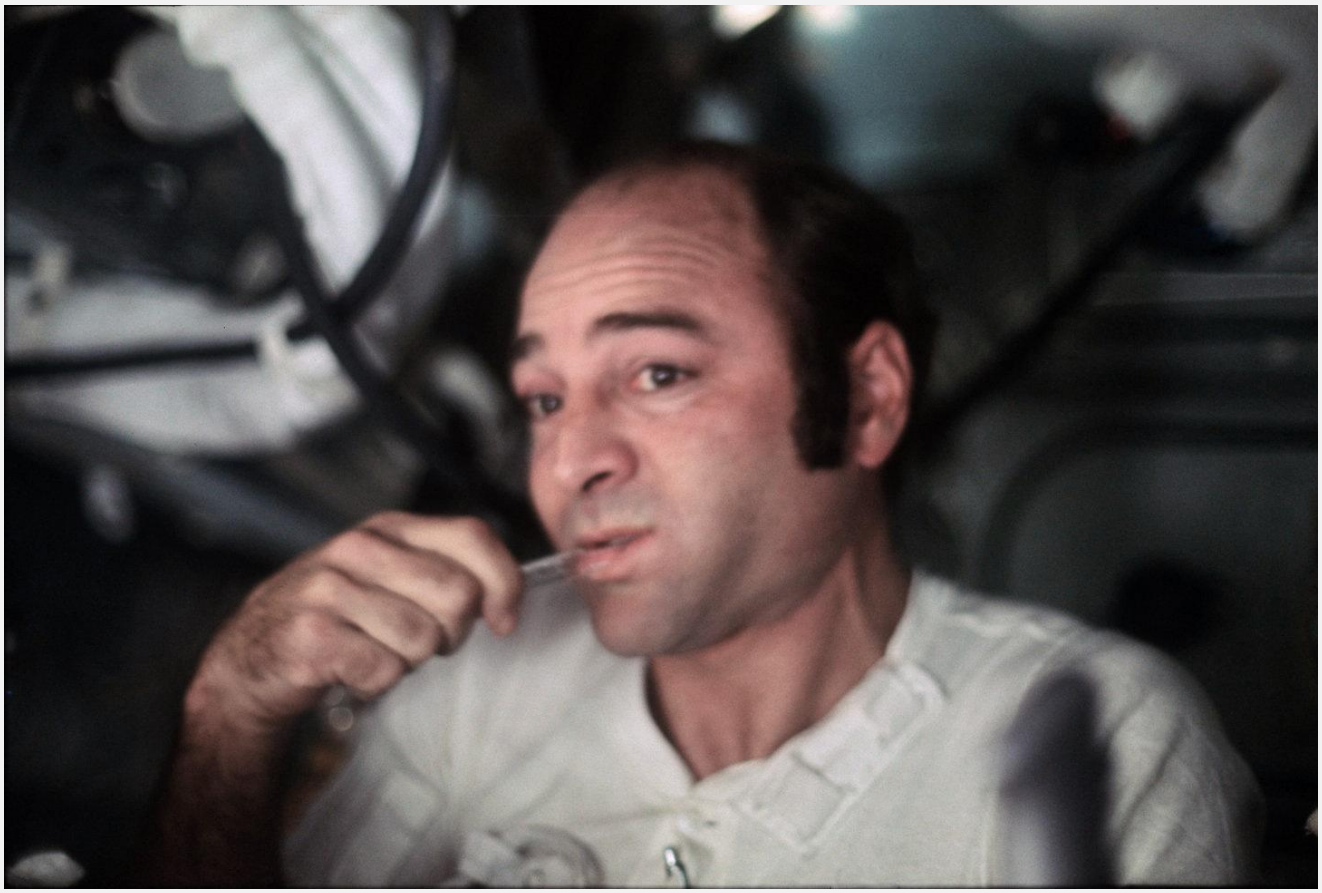
Below: Off goes the moustache.



Above: Ron Evans during Trans Earth Coast.

Images: NASA

Below: Ron Evans brushes his teeth during Trans Earth Coast.



Cernan, *"Houston America."*

Parker, *"Alright – go ahead."*

Cernan, *"We bid you hello, Bob, and at the same time goodnight."*

Parker, *"What can I say, I'm cryin'."*

HSK MISSION DAY 14
WEDNESDAY, 20 DECEMBER 1972
TEC – DAY3

Times: AEDT (HSK local time)

EVENT	GET	AEDT
Service Module jettison	304:03:49	0556:49
Command Module re-entry	304:18:38	0611:38
Splashdown [21]	304:31:59	0624:59
Astronauts on recovery ship USS Ticonderoga	305:24:00	0717:00

[21] CM splashed down at 1324:59 US Central Time on Tuesday, 19 December 1972.

At 298:00:00 GET (0311:10 AEDT) the music of *"Anchors Aweigh"* and the American National Anthem filled the earpieces of the sleeping astronauts to begin their final day in space. Evans woke up and responded with,

"Hey, Houston, this is America, that's mighty fine."

Houston, *"Roger America. It's Houston. We're ready for you to come home today."*

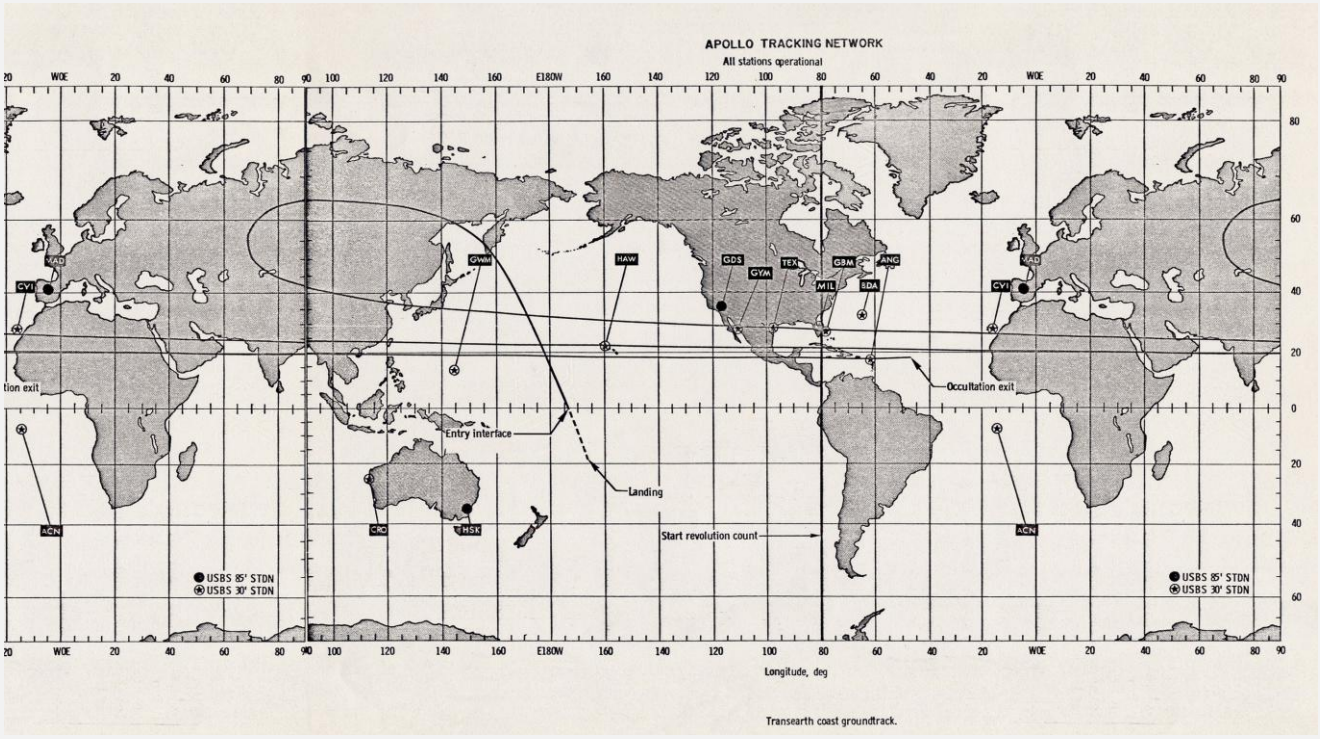
Evans, *"We're all set too."*

Evans, *"We've been waiting a long time for 'Anchors Aweigh'. And we've missed it. You want to play it again?"*

Only one Reaction Control System 9 second mid-course correction burn was needed at 298:38:01 GET (0311:01 AEDT) 46,330.2 kilometres from Earth to guide the spacecraft to the critical atmosphere entry point.

Re-entry

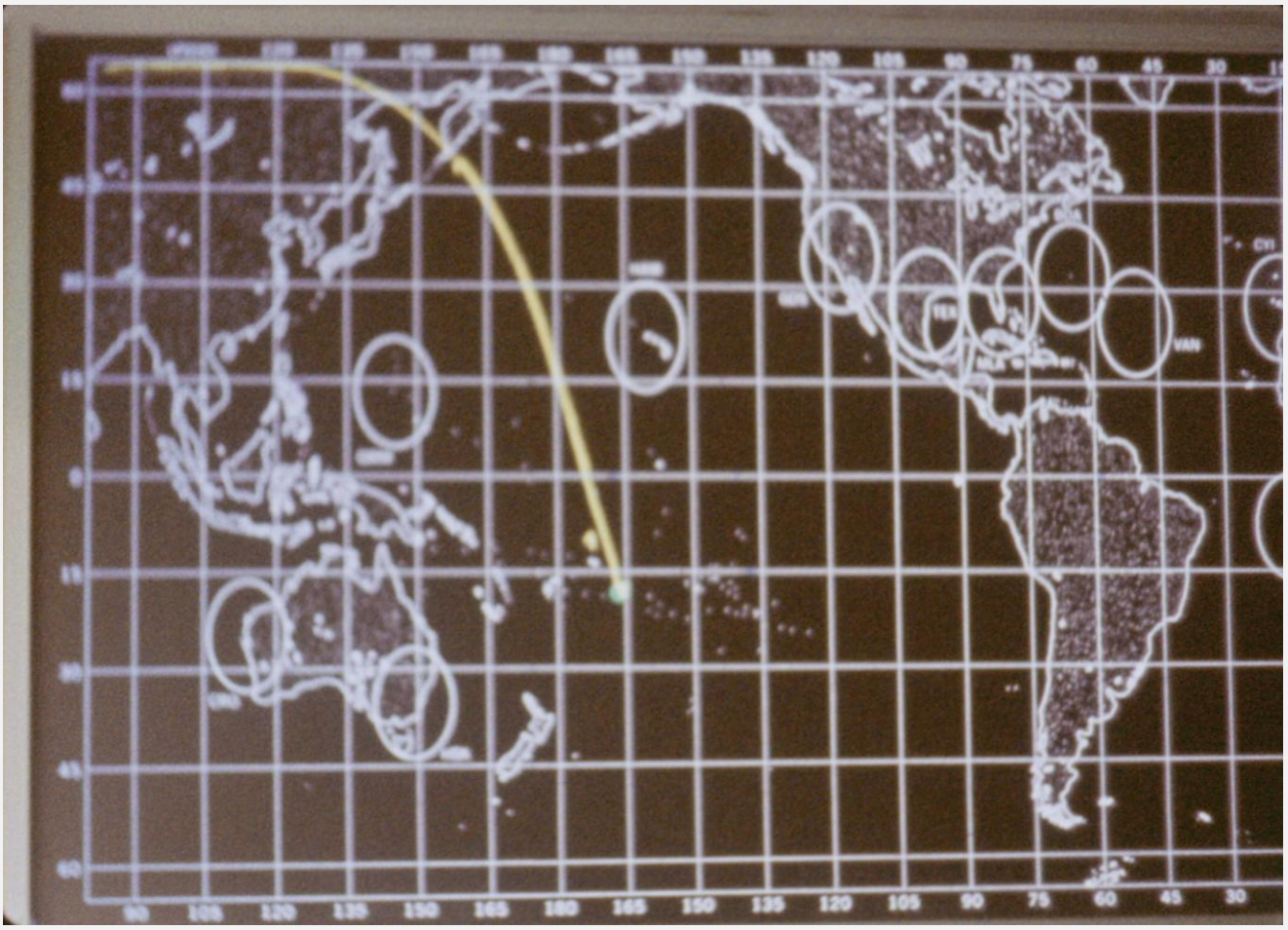
The Service Module was jettisoned at 301:23:49 GET (0556:49 AEDT), and the Command Module entry followed a nominal profile. It re-entered Earth's atmosphere (400,000 feet altitude, or



Apollo 17 Trans Earth Coast and Re-entry groundtrack.

The path begins at acquisition as the spacecraft is reacquired after the TEI burn. Note the 'foldback' / 'groundtrack reversal' over Central Asia as Apollo 17 accelerates towards Re-entry, three days later.

Scanned and processed by Hamish Lindsay. Edited by Colin Mackellar.



The plotboard in Mission Control shows the path of Apollo 17 to splashdown.

Screenshot by Colin Mackellar from footage supplied by Stephen Slater.

121.9 kilometres) at 301:38:38 GET (0611:38 AEDT) at a velocity of 39,600.8 kilometres per hour, after a TEC (Trans Earth Coast) of 67 hours 34 minutes 05 seconds.

Overmyer, *"Okay, the weather is good – 10 miles visibility; wind is 130 at 10; wave heights 2 to 3 feet; the prime recovery ship is the Tico, call sign 'Tico.' Closest recovery will be – aircraft will be a helicopter, call sign "Recovery" and back up will be call sign "Swim."*

Cernan*, "Okay we got 'Tico' and prime recovery chopper is 'Recovery.' Back up is 'Swim."*

Overmyer,
"Geno, with weather like that even a Navy captain like you should make a good landing."

Cernan, *"We'll hang in there. You know nobody likes a pitching deck, not even a Navy captain."*

Splashdown and End of the Mission

For this final splashdown Gene Kranz continued a tradition he started at the end of Gemini IX, putting on his white vest, but this time his wife, Marta, sewed a special creation,

"…made of metallic thread with broad red, white and blue stripes, the colours of our flag and also the colours of the first three flight directors. For me the vest stood for America, President Kennedy, outer space, the many firsts, and the brotherhood of Flight Control," he wrote.

The parachutes dunked the Command Module into the Pacific Ocean at 301:51:59 GET (1924:59 UT on 19 December or 0624:59 AEDT 20 December). Mission duration from launch was 12 days 16 hours 31 minutes 59 seconds. They landed 2.1 kilometres from the target, 6.5 kilometres from the recovery ship, the aircraft carrier U.S.S. Ticonderoga.

The splashdown location was latitude 17.88° south and longitude 166.11° west.

The Command Module America, under its main three parachutes, heads towards splashdown in the Pacific Ocean. Image: NASA

After splashdown, the CM assumed an apex-up flotation attitude. The swimmers arrived alongside at 0635 AEDT and the crew stepped onto the carrier's deck at 0717.

Schmitt remembers, *"Splashdown was just about what we expected. We didn't stay very long in the capsule. The Navy frogmen were in the water almost immediately and had the inflation collar around the spacecraft so we wouldn't tip over. Within an hour, as I recall, they were knocking on the hatch and saying they were going to open it. I released the safeties so they could, and we were outside and in a helicopter on the way to the carrier."*

The last men to travel to the Moon speak to the crew onboard the USS Ticonderoga about an hour after splashdown.

Apollo 17 was welcomed back to a big party on the carrier USS Ticonderoga and entered the record books with the longest manned flight to the Moon, the heaviest swag of lunar samples; the longest activity time on the lunar surface, the longest time in lunar orbit, and the only Saturn V night launch.

Above: Applause in Mission Control.
Left to right: Chris Kraft, and Flight Directors Gerry Griffin, Chuck Lewis and Gene Kranz.
The man visible behind Chris Kraft appears to be Bill Tindall.

Screenshot by Colin Mackellar from footage supplied by Stephen Slater.

Below: Chris Kraft lights Max Faget's cigar.

As he emerges from the Command Module, Gene Cernan is welcomed back to Earth by a U.S. Navy pararescueman. Preserved by Hamish Lindsay, scanned by Colin Mackellar.

Images: NASA – US Navy

With the astronauts safely on the USS Ticonderoga, the capsule awaits its ride back to the ship.

Cernan, Evans and Schmitt arrive on the USS Ticonderoga. Image: NASA – US Navy

The last men to travel to the Moon during the Apollo program,
speak to the crew onboard the USS Ticonderoga about an hour after splashdown.

On the dais, left to right:
Gene Cernan; Capt. Norman Green, Commanding Officer of the Ticonderoga; Rear Admiral John Butts, Jr., Commander, Task Force 130, Pacific Recovery Area; Ron Evans; Harrison Schmitt; Major General David Jones, Commander of the Air Force Eastern Test Range [therefore in charge of the ARIA fleet].

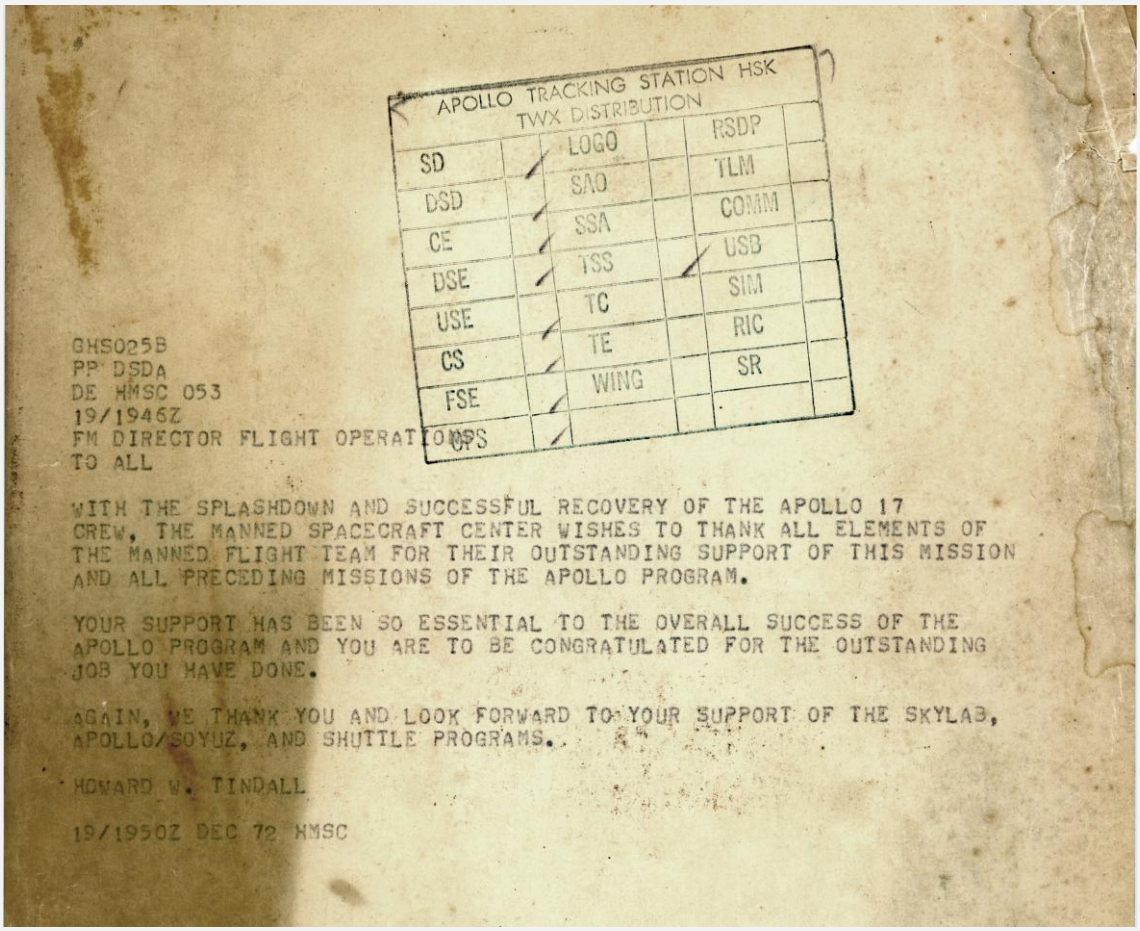
Image: NASA. Preserved by Hamish Lindsay, scanned by Colin Mackellar.

Apollo 17 was also the first time DSS 43, the brand new Deep Space Network's 64 metre dish antenna was used at the Canberra (Tidbinbilla) Deep Space Communications Complex.

Apollo 17 was the most productive and trouble-free manned mission to the Moon. There were no surprises with the health of the astronauts after the mission, they all recovered back to their normal state within 72 hours. At 24 hours Evans was the quickest to recover of all the CM pilots. Cernan lost 4.3 kilograms during the flight and Schmitt and Evans each lost 1.1 kilograms. The estimated distance travelled for the mission was 2,391,486 kilometres.

Perhaps the last word should go to one of the key men responsible for all the successes of Apollo. Looking at the deserted Apollo 17 site through the Rover's camera, Director of Flight Operations Chris Kraft said,

"To realise, my gosh, that's the end – that's the bitter end."



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WITH THE SPLASHDOWN AND SUCCESSFUL RECOVERY OF THE APOLLO 17 CREW, THE MANNED SPACECRAFT CENTER WISHES TO THANK ALL ELEMENTS OF THE MANNED FLIGHT TEAM FOR THEIR OUTSTANDING SUPPORT OF THIS MISSION AND ALL PRECEDING MISSIONS OF THE APOLLO PROGRAM.

YOUR SUPPORT HAS BEEN SO ESSENTIAL TO THE OVERALL SUCCESS OF THE APOLLO PROGRAM AND YOU ARE TO BE CONGRATULATED FOR THE OUTSTANDING JOB YOU HAVE DONE.

AGAIN, WE THANK YOU AND LOOK FORWARD TO YOUR SUPPORT OF THE SKYLAB, APOLLO/SOYUZ, AND SHUTTLE PROGRAMS.

HOWARD W. TINDALL

19/1950Z DEC 72 HMSC

Twenty-five minutes after splashdown, Howard (Bill) Tindall, Director of Flight Operations at the Manned Spacecraft Center in Houston, sent this message to “All”.
Preserved by Hamish Lindsay, 2021 scan by Colin Mackellar.

At Honeysuckle Creek, a special lunch was put on for Wednesday 20th December – to mark the end of the Apollo lunar missions. Photo by Hamish Lindsay, 2021 negative scan by Colin Mackellar.

From left: **?* (back to camera); Tony Gerada; Jerry Bissicks; **?* from the Powerhouse; **?* from the Powerhouse; Dick Bamford. Thanks to Tony Gerada for the names and references.
** If you happen to recognise these HSK personnel, please contact Colin Mackellar – email.

The Results

Prior to the Apollo missions scientists suspected the large mare-basin craters were partly filled with lava flows, originating from vents and lava fountains around the mare-basin margins. On Earth, cinder cones mark these vents and fountains.

It seems the Taurus-Littrow valley had been the site of intense volcanism some 3.72 billion years ago. The subfloor was found to be a lava flow, which the seismic charges revealed was 1.85 kilometres thick. Fragments found in the regolith on the dark valley floor came from the sub-floor. Fragments in the light mantle are various types of breccias derived from South Massif. Schmitt noted that the dark mantle was fine crystals mixed in with the regolith, proving to be a homogeneous basaltic composition.

The 'orange' soil at Shorty was found to be chemically identical, but in the form of microscopic beads, orange because of the iron–to-titanium ratio (just as the high magnesium content of the glass found at Hadley-Apennine made it green.) implying it is gas rich magma spewed out by a fire fountain with trace amounts of sulphur, zinc, lead and some other elements.

A block from Shorty Crater's rim turned out to be excavated bedrock, probably from the very top of the sub-floor. The avalanche was probably triggered by a distant impact.

So, in the end, there was no evidence of recent volcanism. The samples collected at Shorty Crater provided information about lava fountains and told the complete story of volcanism on the Moon. Volcanic material was found on the Moon, but no volcanic craters.

During December 1968 Frank Borman, Jim Lovell and Bill Anders were the first humans to set off for the Moon – only four years later, during December 1972, Gene Cernan, Jack Schmitt and Ron Evans were the last, ending one of the most amazing exploration feats in all human history. Any further manned adventures in space will only be an extension of the Mercury, Gemini and Apollo efforts.

NASA built history's greatest rockets and spacecraft, developed a highly trained and polished support team on the ground – then promptly scrapped them all and consigned the Apollo achievements to the dustbin. For example, an exercise to locate the data tapes recorded during Apollo, in particular the original tapes from Apollo 11, found they were probably destroyed so we don't have any best quality original images from the telemetry data magnetic tapes.

According to the post mission report, the tracking network performed flawlessly, the only hitch being Goldstone requiring a four minute period to acquire the spacecraft two-way at the beginning of the first lunar orbit due to an antenna pointing error.

At the end of the mission this message was sent to all the tracking stations from NASA headquarters on 21 December 1972:

"BT UNCLAS T-351
Congratulations for your exemplary support of the Apollo 17 flight, completing an unprecedented era of exploration and adventure for this nation and the world. The dedication and competence of all our people has been long demonstrated by the success record of the network throughout the course of the entire manned flight program. While this flight marks the end of the historic Apollo program, its legacy of technology and science promises an abundance of benefits in other areas of space exploration, and we can look forward to a continuing series of increasingly interesting flight missions.

Again, thanks for a job well done and to each of you and your families Merry Christmas and best wishes for the New Year.

Gerald Truszynski.
Associate Administrator
for Tracking and Data Acquisition."

Dr. Harrison Schmitt signs the master signature sheet in the canteen during his visit to Honeysuckle Creek on 3 May 1973.

Standing L–R: (obscured **?), Gerry Spear, Jim Kirkpatrick, Bill Waugh, Les Paal, Les Hughes, Martin Geasley, Don Gray (Station Director), Bernard Smith. Seated L–R: Bryan Sullivan, Cyril Fenwick, Tony Gerada. Photo: Hamish Lindsay. Scan: Bryan Sullivan. ** If you recognise this person, please contact Colin Mackellar – email.

The Manned Space Flight Network looks to a Future without Apollo Lunar Landings

With no more lunar missions in the foreseeable future, the Manned Space Flight Tracking Network, in particular the three 26 metre sites at Goldstone, Honeysuckle Creek and Madrid, designed especially for tracking spacecraft at lunar distances, now had no reason to exist.

In 1972, the MSFN was amalgamated with the STADAN, to become the STDN and supported the Skylab mission.

Honeysuckle Creek became a part of the Satellite Tracking and Data Network.
Photo: Hamish Lindsay. Scan: Colin Mackellar

Postscript

At a panel discussion in the Adler Planetarium in Chicago, celebrating the 40th anniversary of the Apollo 17 flight, Gene Cernan summarised his mission,

"It's not about Jack, it's not about Ron Evans, it's not about me. It's not simply about Apollo 17 or the final footsteps of Apollo – it's about what happened in this country almost a half century ago that started with Alan Shepard, the first American in space, who made those first steps in space, well, actually as footsteps to the Moon, before we even knew we were going to the Moon.

That whole period of time, which included all the pathfinders of Gemini – the Schirras, the Glenns, the Coopers and the Carpenters, and the rest of them. The Gemini Program, the things Jim [Lovell, who was also present] and those of us who had a chance to fly Gemini, all the way to Apollo to the final conclusion of Apollo – I look at it as December 14th. We came home on December 19th, but December 14th, to me, concluded an era in American history that exuded American exceptionalism.

That's what we are really celebrating tonight; that's what's important."

Jack Schmitt, also present, added,

"Apollo people's average age was in their twenties. The Apollo Program was a program that young people did. Everyone wants to realise that. When you want to do great things, peacefully, or not so peacefully, you depend on young people.

It's their courage, it's their stamina, it's their motivation that makes it possible to get those things done, for no other reason that they don't know how not to succeed. Apollo, and other major things this nation has done, was done by young people, so we ought to keep that in mind as we think of what we might do in the future."

Essay by Hamish Lindsay, 2012-2014.
Personal interviews with:
Gene Cernan and Harrison 'Jack' Schmitt.
Images, illustrations and captions by
Hamish Lindsay, Colin Mackellar, and Glen Nagle.
Unless specified, audio and video recorded,
edited and encoded by Colin Mackellar.
PDF formatted by Glen Nagle.

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by Don E. Wilhelms

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by Gene Kranz

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by Chris Kraft

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by Andrew Chaikin

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by Christopher Riley, David Woods, and Phil Dolling.

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- dated 26 November 1972

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- dated 4 December 1972.

Internet sources

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edited by Eric Jones.

ACRONYMS
Official acronyms used in this text:

AEDT	Australian Eastern Daylight Time
ACN	Ascension Island Tracking Station *- in the south east Atlantic Ocean*
ALSJ	The Apollo Lunar Surface Journal *- every word spoken on the Moon*
ALSEP	Apollo Lunar Scientific Experiments Package *- equipment left behind by the astronauts to measure physical characteristics of the Moon*
AOS	Acquisition of Signal *- from the spacecraft (downlink)*
Capcom	Capsule Communicator *- the voice of Mission Control, always an astronaut*
CRO	Carnarvon Tracking Station *- Western Australia*
CM	Command Module
CSM	Command and Service Module
DOWNLINK	Receive - *signal sent from the spacecraft back to tracking stations on Earth*
DPS	Descent Propulsion System
DSKY	*Guidance computer keypad*
DSS43	Deep Space Station 43 – 64 metre *- antenna at Tidbinbilla*
EVA	Extra Vehicular Activity *- a space walk outside the spacecraft or on the lunar surface*
GDS	Goldstone Tracking Station *- in California, USA*
GET	Mission Ground Elapsed Time *- time in hours/minutes/seconds from the moment of launch*
GWM	Guam Tracking Station *- northwest Pacific Ocean*
HSK	Honeysuckle Creek Tracking Station, *Canberra, Australia*
HSKX	Canberra Deep Space Communication Complex *- Tidbinbilla, also called the Wing*
IU	Instrumentation Unit *- electronic system part of the Saturn IVB rocket*
JPL	Jet Propulsion Laboratory *- Pasadena, California, USA*
LM	Lunar Module

ACRONYMS
Official acronyms used in this text:

LOI	Lunar Orbit Insertion
LOS	Loss of Signal *- from the spacecraft*
LOX	Liquid Oxygen
MAD	Madrid Tracking Station *- Robledo de Chavela, Spain*
MOCR	Mission Operations Control Room *- Houston, Texas, USA*
MESA	Modular Equipment Stowage Assembly - *part of the LM*
MSFN	Manned Space Flight Network *- worldwide network of tracking stations for human spaceflight*
NET-1	*Phone line between Mission Control, Capcom and astronauts in their spacecraft*
OMNI	Omni-directional antennas *- multiple antennas around the spacecraft*
PGNS	Primary Guidance and Navigation System
PKS	Parkes - 64 metre radio telescope *- Parkes, New South Wales, Australia*
PLSS	Portable Life Support System *- the backpacks supplying their physical needs, e.g.: air, water*
PSI	Pounds per square inch - *pressure*
PTC	Passive Thermal Control *- spinning the spacecraft to even temperatures around it*
RCS	CSM Reaction Control System *- controlling spacecraft attitude*
S-IC	Saturn IC - *first stage of the Saturn V booster rocket*
S-IVB	Saturn IVB - *third and final stage of the Saturn V launch rocket*
SIM	Scientific Instrument Bay *- a cluster of instruments in the CSM to scan the lunar surface*
SEP	Surface Electrical Properties *- experiment to study lunar regolith*
SLA	Spacecraft LM Adapter *- panels to protect the LM during launch and Earth orbit*

ACRONYMS
Official acronyms used in this text:

SPS	Service Propulsion System *- Service Module rocket motor*
SRT	Site Readiness Test *- tracking station equipment tests before each group of passes*
STADAN	Satellite Tracking and Data Acquisition Network
STDN	Satellite Tracking Data Network
TEC	Trans Earth Coast *- the voyage back to Earth*
TEI	Trans Earth Injection *- the rocket motor burn to send Apollo back to Earth*
TLC	Trans Lunar Coast *- the voyage out to the Moon*
TLI	Trans Lunar Injection *- the rocket motor burn to send Apollo off to the Moon*
VAB	Vehicular Assembly Building *- located at the Kennedy Space Center, Florida USA*
UPLINK	Transmit - *signal sent from the tracking station up to the spacecraft*
USCDT	US Central Daylight Saving Time - also spacecraft time
USEDT	US Eastern Daylight Saving Time

Harrison Schmitt - Awards

Among his long list of awards are –

1957-1958
Fulbright Fellowship in Norway

1958-1959
Kennecott Fellowship in Geology at Harvard Uni

1959-1969
Harvard Fellowship

1961-1962
Parker Travelling Fellowship at Harvard University

1963-1964
National Science Postdoctoral Fellowship, Department of Geological Sciences, Harvard Uni

1970
Johnson Space Center Superior Achievement Award

1973
NASA Distinguished Service Medal
California Institute of Technology, Distinguished Graduate
Honorary Fellow of the Geological Society of America
Arthur S. Fleming Award;
Honorary Doctorate of Engineering from Colorado School of Mines;
Republic of Senegal's National Order of the Lion;
Honorary Life Membership of New Mexico Geological Society;
Honorary Member of Norwegian Geographical Society;
Honorary Fellow American Institute of Mining, Metallurgical and Petroleum Engineers

1973-1974
Fairchild Fellow, Caltech

1974
Honorary Fellow of The Geological Society, London

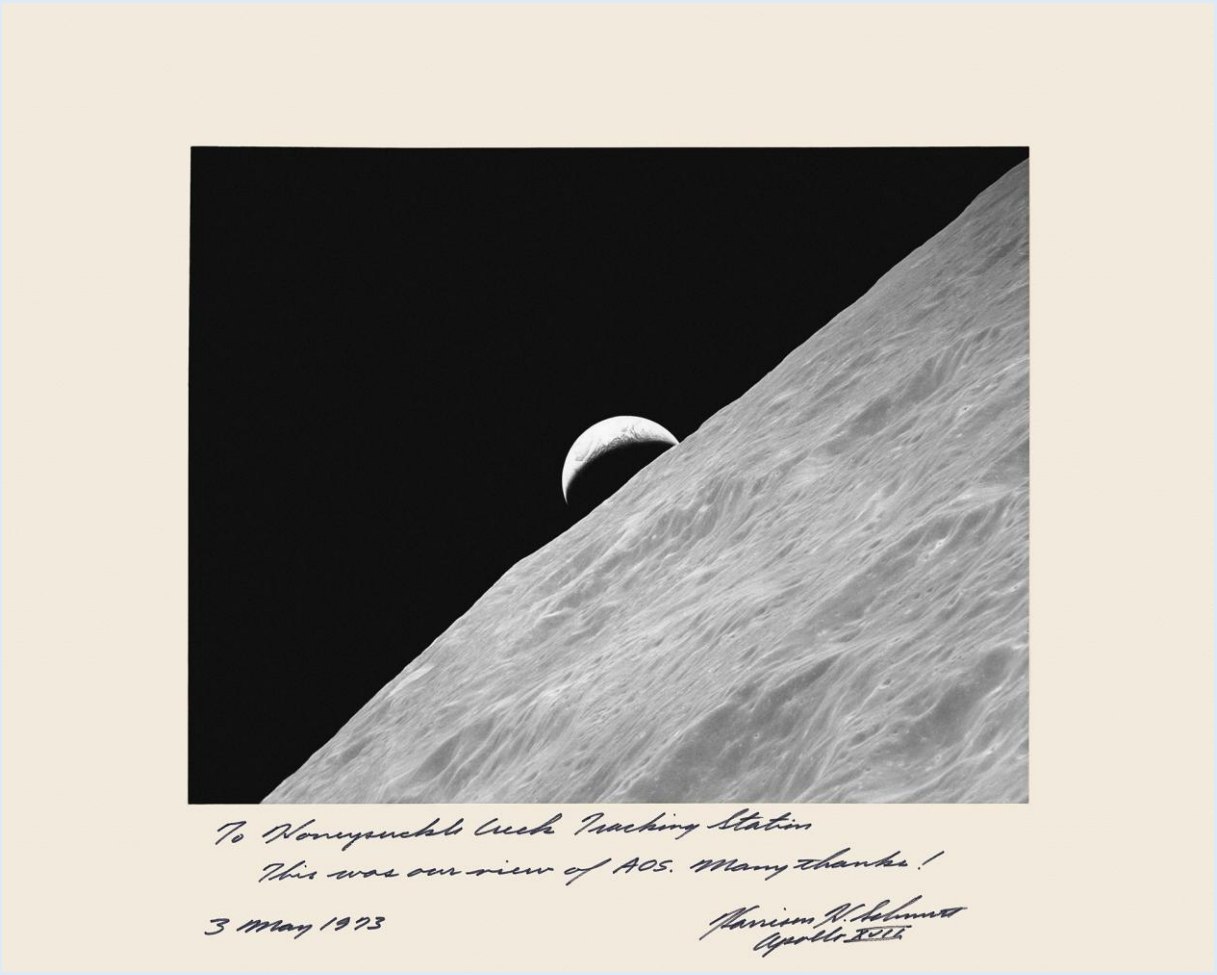
1975
Honorary Doctorate Degree from Rensselear Polytechnic Institute

1977
Honorary Doctorate Degree from Franklin and Marshall College;
International Space Hall of Fame;
Fellow American Institute of Aeronautics and Astronautics

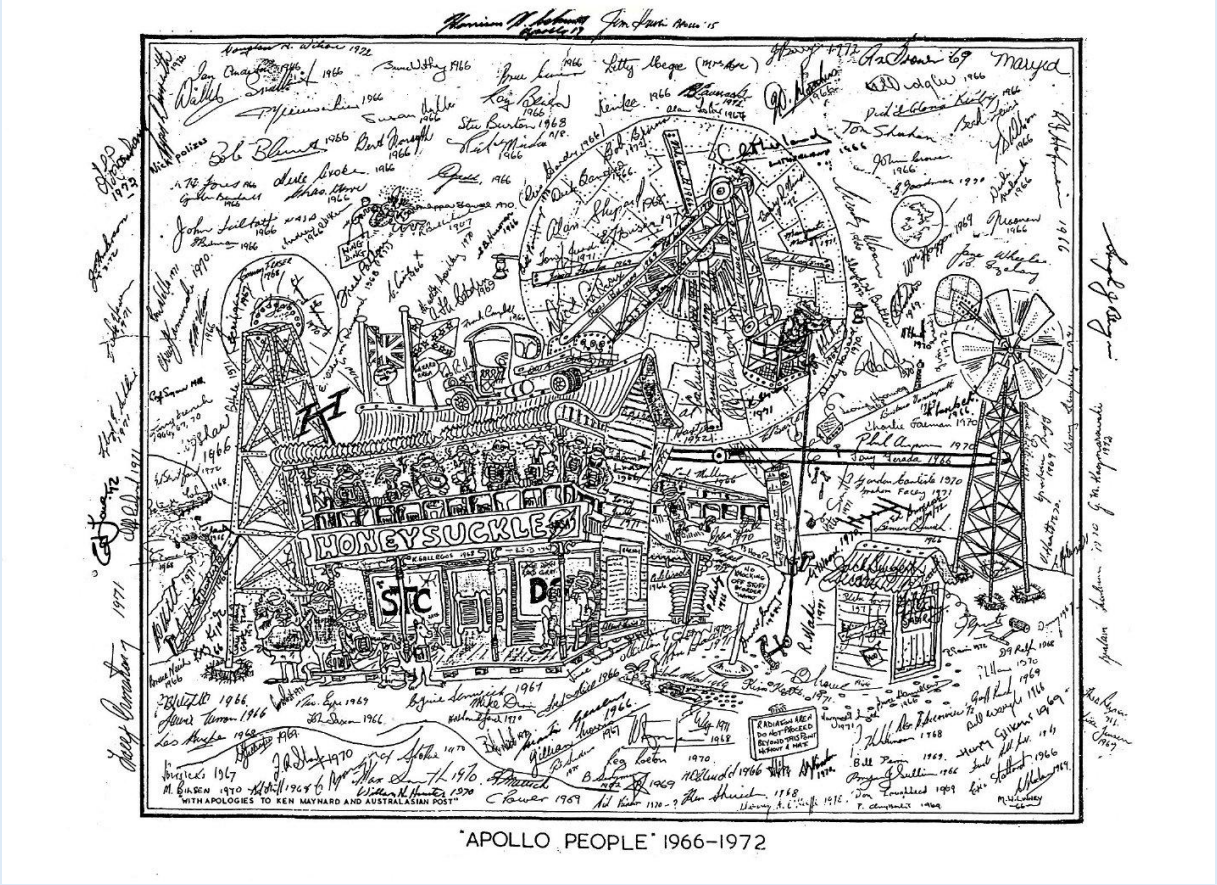
1981
Engineer of the Year Award, National Society of Professional Engineers, Legislative Recognition Award;
National Security Award, Highest Civil Defense Award

1982
Honorary Doctorate of Astronautical Science from Salem College

1989
NASA Distinguished Public Service Medal
Lovelace Award, Society of NASA Flight Surgeons;
G. K. Gilbert Award, Planetary Geology Division, Geological Society of America (1989).



"To Honeysuckle Creek Tracking Station, This was our view of AOS. Many thanks!"
Harrison H. Schmitt, Apollo XVII, 3 May 1973



"APOLLO PEOPLE" 1966–1972

ABOUT THE AUTHOR

Hamish Lindsay (1937-2022) worked at the Muchea, Carnarvon and Honeysuckle Creek space tracking stations between 1963 and 1981.

He wrote many essays on the history of human spaceflight, and was the author of the book, Tracking Apollo to the Moon.