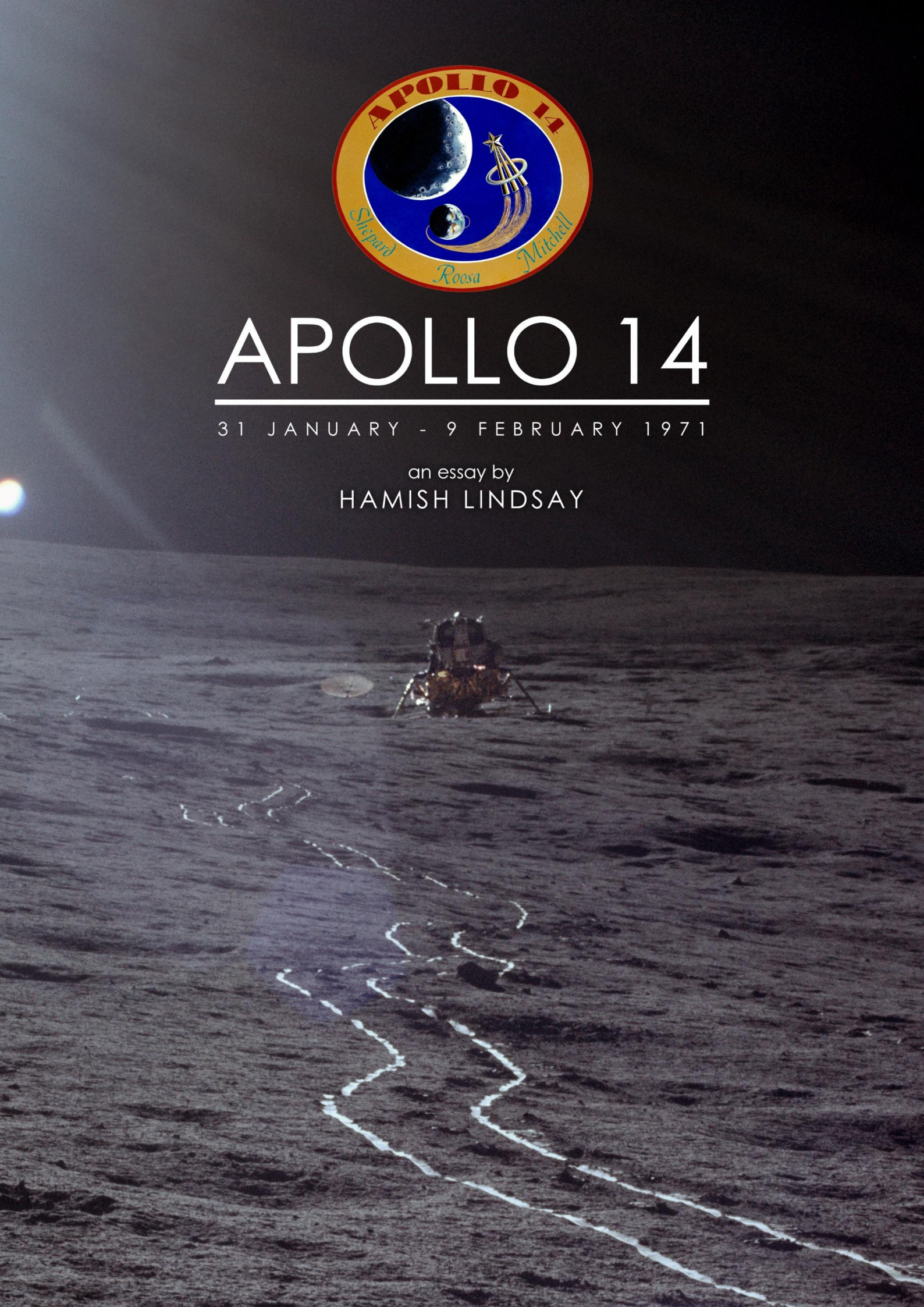

APOLLO 14

31 JANUARY - 9 FEBRUARY 1971

an essay by

HAMISH LINDSAY

“Miles and miles and miles!”

Alan B. Shepard Jr

APOLLO 14

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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 14 mission is based on Hamish Lindsay's excellent book, "Tracking Apollo to the Moon".

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.

Australian Eastern Standard Time (AEST) is included to refer to the time of events in relation to the Honeysuckle Creek Tracking Station, near Canberra, Australia. Though Apollo 14 took place during the Australian summer, Daylight Saving Time in Australia was not re-introduced until September of 1971.

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 14 CREW

Edgar D. Mitchell, Alan B. Shepard Jr, and Stuart A. Roosa
Image: NASA/JSC

AS-509/CSM-110/LM-8 MISSION H-3 NCG 728

PRIME CREW

Commander: Alan B. Shepard Jr
Command Module Stuart A. Roosa
Lunar Module Pilot: Edgar D. Mitchell

BACK-UP CREW

Commander: Eugene A. Cernan
CM Pilot: Ronald E. Evans Jr
LM Pilot: Joe H. Engle

SPACECRAFT

Command Module: **KITTY HAWK** CSM-110
Lunar Module: **ANTARES** LM-8
Saturn V: SA-509

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

Mission Fact Box

Launch
Launch Complex – 39A, Cape Kennedy
Sunday, 31 January 1971
1603:02 US EST / 2103:02 UTC
[Monday, 1 February 1971, 0703:02 AEST]

Mission duration
9 days, 0 hours, 1 minute, 58 seconds

Lunar orbit insertion
4 February 1971, 0659:42 UTC

Lunar orbital data
Lunar orbit – 108.9 x 16.9 kilometres
Total time in orbit – 3 days, 17 hours, 2 mins
Orbits – 34

Landing data
Landing site – Fra Mauro
3.64530°S 17.47136°W
Landing – 5 February 1971, 0918:11 UTC

Extra Vehicular Activities (EVAs)
Total EVAs – 2
First EVA – 4 hours, 47 minutes, 31 seconds
Second EVA – 4 hours, 34 minutes, 41 seconds
Lunar samples collected: 42.8 kilograms
Total time on surface from landing to launch:
33 hours, 30 minutes, 29 seconds

Lunar Module ascent and docking
Launch – 6 February 1971, 1848:42 UTC
Docking – 6 February 1971, 2035:52 UTC
Undocking – 6 February 1971, 2248:00 UTC

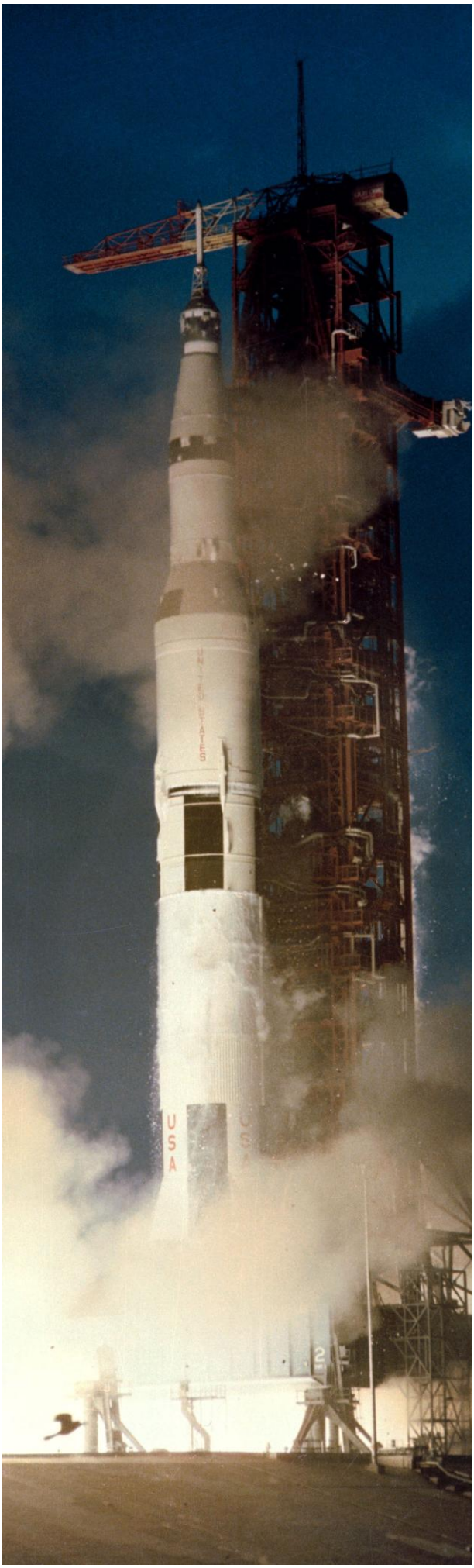
Lunar orbit departure
CSM – 7 February 1971, 1848:42 UTC

Splashdown
CM – 9 February 1971, 2100:00 UTC
[Wednesday, 10 February 1971, 0705:00 AEST]
South Pacific Ocean, 27°1'S 172°39'W
Recovery ship: USS New Orleans

AUDIO FILES

Audio files in this document are made available in two ways: via a clickable URL link in the document or via a scannable QR code using your phone or tablet.

LISTEN	Click this icon for a direct link to the file.
	Scan the QR icon with your phone or tablet to listen to the audio file.



The Apollo 14 crew – Roosa, Shepard, and Mitchell. Image: NASA/JSC

Apollo 14

Choice of a landing site

Before the Apollo 13 disaster Apollo 14 was to investigate a dark mantling deposit thought to be volcanic ash. Two sites were under consideration – Rima Bode II and Littrow. Littrow was selected during a meeting in October 1969, and the Apollo 14 crew began training for this site with a planned date of landing in February 1970. Delays moved the date to July, then October 1970, and ended up in February 1971 due to the aborted Apollo 13 flight. Because the Apollo 13 Fra Mauro landing site was given a high priority by the scientists, it was reassigned to Apollo 14 during a meeting held on 7 May 1970.

It was now looking like Apollo 14 was going to be the last of the 'H' type missions, and Fra Mauro was ideally suited to these simpler missions.

Since November 1963 scientists saw the Fra Mauro Formation as an important site, representing a large part of the lunar surface, and since Imbrium was such a large basin they suspected samples brought back could be from depths of tens, perhaps hundreds of kilometres.

Geologist Don Wilhelms wrote, *"My life would be complete if ever I had some crumbs from the Fra Mauro in my desk drawer."*

Because the first two landings had been easy on flat territory, Fra Mauro was chosen as the first of the more challenging landing sites.

Choice of crew

By May 1969 Alan Shepard had recovered from surgery for an inner ear disorder and passed the physical so was eligible for a flight. Chief Astronaut Deke Slayton's first thought was for Shepard to Command Apollo 13 with Jim McDivitt as the LM Pilot and Stu Roosa as Command Module Pilot. This didn't happen for various reasons, and it ended up with Shepard getting a new crew.

The Saturn V stack and its mobile launch tower sit atop a huge crawler-transporter – 9 November 1970.
A high-angle view at Launch Complex 39, Kennedy Space Center, showing the Apollo 14 (Spacecraft 110/Lunar Module 8/Saturn 509) space vehicle on its way from the Vehicle Assembly Building to Pad 39A.
Image: NASA

Slayton, *"I had perfect confidence in Al, so I felt safe in growing a whole new crew for 13, with Al as Commander, and Roosa as Command Module Pilot. Ed Mitchell was the logical choice for LM Pilot. He was very capable and had done a good job backing up Apollo 10."*

Slayton offered this choice to NASA management who flatly turned it down, as they didn't believe Shepard had enough time to be ready, and hadn't been part of a back-up crew. So, Slayton had no choice but to move Shepard and his crew on to 14, and it was announced to the public on 6 Aug 1969.

So, the crew for Apollo 14 were Alan Shepard, Stuart Roosa, and Edgar Mitchell backed up by Eugene Cernan, Ron Evans and Joe Engle. Slayton had asked Mike Collins if he would like to be back-up commander, which would put him in line for a walk on the Moon's surface, but Collins told him that if Apollo 11 was successful he wanted to get out of the astronaut business.

Our first Australian astronaut, Phil Chapman, was assigned to the support team with Bruce McCandless and William Pogue. Unfortunately, that was the closest our first astronaut came to flying in space. With ten other hopefuls he was chosen to be a scientist Apollo astronaut on 11 August 1967, but by that stage it was obvious they would not be needed for Apollo, which Deke Slayton had to tell them when they reported for work the next month. So, Chapman moved on.

(Dr) Philip Kenyon Chapman
5 March 1935 – 5 April 2021

Rear Admiral Alan Bartlett Shepard Jr

America's pioneer astronaut was born on 18 November 1923 in East Derry, New Hampshire and at the age of 47 became the oldest astronaut, and the only Mercury astronaut, to walk on the Moon's surface. He received a Bachelor of Science Degree from the US Naval Academy in 1944, an Honorary Master of Arts Degree from Dartmouth College in 1962.

During his career Shepard was awarded many honours, including the Congressional Medal of Honor (Space); Awarded two NASA Distinguished Service Medals, the NASA Exceptional Service Medal, the Navy Astronaut Wings, the Navy Distinguished Service Medal, and the Navy Distinguished Flying Cross; recipient of the Langley Medal (highest award of the Smithsonian Institution) on 5 May, 1964, the Lambert Trophy, the Kinchloe Trophy, the Cabot Award, the Collier Trophy, the City of New York Gold Medal (1971), Achievement Award for 1971. Shepard was appointed by the President in July 1971 as a delegate to the 26th United Nations General Assembly and served through the entire assembly which lasted from September to December 1971.

Shepard logged 8,000 hours flying time, 3,700 in jet aircraft, and 216 hours 57 minutes in space.

In 2011, NASA honoured Shepard with an Ambassador of Exploration Award, consisting of a moon rock encased in Lucite, for his contributions to the U.S. space program. His family members accepted the award on his behalf during a ceremony on 28 April at the U.S. Naval Academy Museum in Annapolis, Maryland, where it is on permanent display.

On 4 May 2011, the U.S. Postal Service issued a first-class stamp in Shepard's honour, the first U.S. stamp to depict a specific astronaut. The first day of issue ceremony was held at NASA's Kennedy Space Center Visitor Complex.

Shepard died of leukaemia on 21 July 1998, aged 74, in Monterey, California. After Apollo 15's Jim Irwin, he was the second astronaut who had walked on the Moon, to die.

Colonel Stuart Allen (Smokey) Roosa

Roosa was born on 16 August 1933 in Durango, Colorado and was aged 38 on the voyage to the Moon. He studied at Oklahoma State University and the University of Arizona where he graduated with Honours.

He logged 5,500 hours of flying time, 5,000 in jet aircraft, and spent 216 hours 42 minutes in space.

He was selected as a NASA astronaut with 19 others in April 1966. Among his awards were a NASA Distinguished Service Medal; JSC Superior Achievement Award (1970); Air Force Command Pilot Astronaut Wings; Air Force Distinguished Service Medal; the Arnold Air Society's John F. Kennedy Award (1971); the City of New York Gold Medal in 1971; the American Astronautical Society's Flight Achievement Award for 1971; the Order of Tchad (1973); and the Order of Central African Empire (1973).

He died of complications from pancreatitis on 12 December 1994 in Washington, DC.

Captain (US Navy) Edgar Dean Mitchell

Mitchell was born on 17 September 1930 in Hereford, Texas, but considered Artesia, New Mexico, his home town. He was 40 years old for the mission.

Honours and awards were Presidential Medal of Freedom; USN Distinguished Service Medal; NASA Distinguished Service Medal; NASA Distinguished Service Award; Three NASA Group Achievement Awards; USAF Aerospace Research Pilot School, First in Class Award; Medal of the City of New

York; American Astronautical Society, Flight Achievement Award; Arnold Air Society, John F. Kennedy Award for Space Exploration; Carnegie Mellon University Alumni, Outstanding Man of the Year (1972); Kappa Sigma, Man of the Year Award (1972); Adventurers Club, Gold Medal Award for Exploration; Explorers Club, Lowell Thomas Award for Explorations in Human Consciousness (1980); Drexel University, Engineering and Science Award for Explorations in Consciousness (1974); Space Hall of Fame (inducted 1979); Astronaut Hall of Fam (inducted 1995) and a Nominee for the Nobel Peace Prize (2005).

Mitchell logged 215 hours 48 minutes in space.

He died in West Palm Beach, Florida, on 4 February 2016, the eve of the 45th anniversary of his lunar landing.

Mission Control, Houston

In the Mission Operations Control Room (MOCR), Houston, there were three teams under the Director of Flight Operations, Sigurd Sjoberg:

Shift 1: Orange team
Flight Director: Pete Frank
Capcoms: Gordon Fullerton (Launch, Wake-up and Goodnight), Ronald Evans

Shift 2: Maroon team
Flight Director: Milton Windler
Capcom: Bruce McCandless (EVA-1/LM Launch)

Shift 3: Gold team
Flight Director: Gerald Griffin
Capcom: Fred Haise (Landing & EVA-2)

Spacecraft Names

Roosa named the Command Module Kitty Hawk in memory of the first powered flight by the Wright brothers in 1903, and Mitchell called the LM Antares (Greek for 'rival of Mars.' It is a first magnitude star that looks like a fainter version of the planet Mars) a star in the constellation Scorpius, as it was a significant object visible through their window as they came in to land on the lunar surface.

The only back-up Mission patch

Eugene Cernan, the commander of the back-up crew for Apollo 14, told me this story,

> "We had the only back-up crew patch in the entire space program. After ours, back-up crew patches were outlawed. Ron Evans, Joe Engle and I called ourselves the First Team.
>
> We called the Prime crew: Shepard the Old Man, Mitchell the Fat Man, and Roosa the cute little Redhead. We embodied them all in one character - coyote from the Roadrunner series. We had him coming out of the Earth with a big trail of fire coming behind, and he's looking at the Moon. He's all red, he's got a beard, and he's got a big fat belly – the Old Man, the Fat Man and the cute little Redhead! And there on the Moon is the Roadrunner – the 'Beep beep' guy.

A wide angle overall view of the Mission Operations Control Room (MOCR) in the Mission Control Center at the Manned Spacecraft Center. This view was photographed during the first colour television transmission from the Apollo 14 Command Module. Projected on the large screen at the right front of the MOCR is a view of the Apollo 14 Lunar Module, still attached to the Saturn IVB stage. The Command and Service Modules were approaching the LM/SIVB during transposition and docking manoeuvres. Image: NASA/JSC 31 Jan. 1971

The Roadrunner is sitting there with a big scarf around his neck, his legs are crossed, and he's leaning on an American flag. And this coyote is looking at the Moon, at this First Team, this back-up crew, who got to the Moon before they did.

We put about 20 or 30 of these patches inside both spacecraft so every time they opened a locker in zero gravity one of these patches would float out."

Modifications to the Spacecraft after Apollo 13

A legacy from Apollo 13 were changes to the spacecraft to try and prevent another explosive, cliff-hanging mission. This time there were three oxygen tanks, instead of two, the third isolated, a new spare 4000-ampere LM Descent battery to carry the mission from any point, and additional plastic bags to store potable water. However, this mission came up with new twists to keep the crews and Flight Controllers on their toes, and to remind everyone once again spaceflights can be a hazardous operation. An operational change was to use the SPS motor for the first descent burn down to 50,000 feet (15.2 kilometres) before the LM undocked, leaving the crew with more fuel to pick the best place to land.

An innovation for Apollo 14 was the addition of a collapsible two-wheeled hand cart, dubbed the MET, or Modular Equipment Transporter, to increase the range of exploration, and to carry a heavier load, particularly rock samples. Apart from carrying the samples, it carried tools, cameras, and a portable magnetometer.

That Headset Locker Incident

Sy Liebergot, lead EECOM (Electrical, Environmental, Sequential Systems Engineer) for Apollo 14 and fresh from his Apollo 13 starring role, told a typical Sy funny story in his book 'Apollo EECOM - Journey of a Lifetime'. He noticed that Capcom Bruce McCandless had labelled his headset locker in Mission Control as 'Capcom Locker' to quickly identify his locker among the 48 identical lockers. Sy saw his chance and made 47 additional identical labels and stuck them on all the other locker doors so McCandless wouldn't know which was his.

Bruce was not amused, made worse by Shepard, in on the joke, calling down from space after launch, at 9:04:49 GT (1607:51 AEST) *"Hey, Bruce, we've been wondering if you found your headset all right when you got back to the MOCR?"*

McCandless, *"Yes, I've got it on. I didn't notice anything wrong with it. You may be a little subtle for me."*

Mitchell added, *"You obviously found it. It's working."*

The next day at 27:22:54 GET (1025:56 AEST), McCandless mentioned the headset again,

"Yes, and I found my headset all right this morning too, but there was a little difference from last night."

Shepard, *"Okay, keep us posted on that headset."*

MONDAY, 1 FEBRUARY 1971 - AEST
DAY - 1

LAUNCH

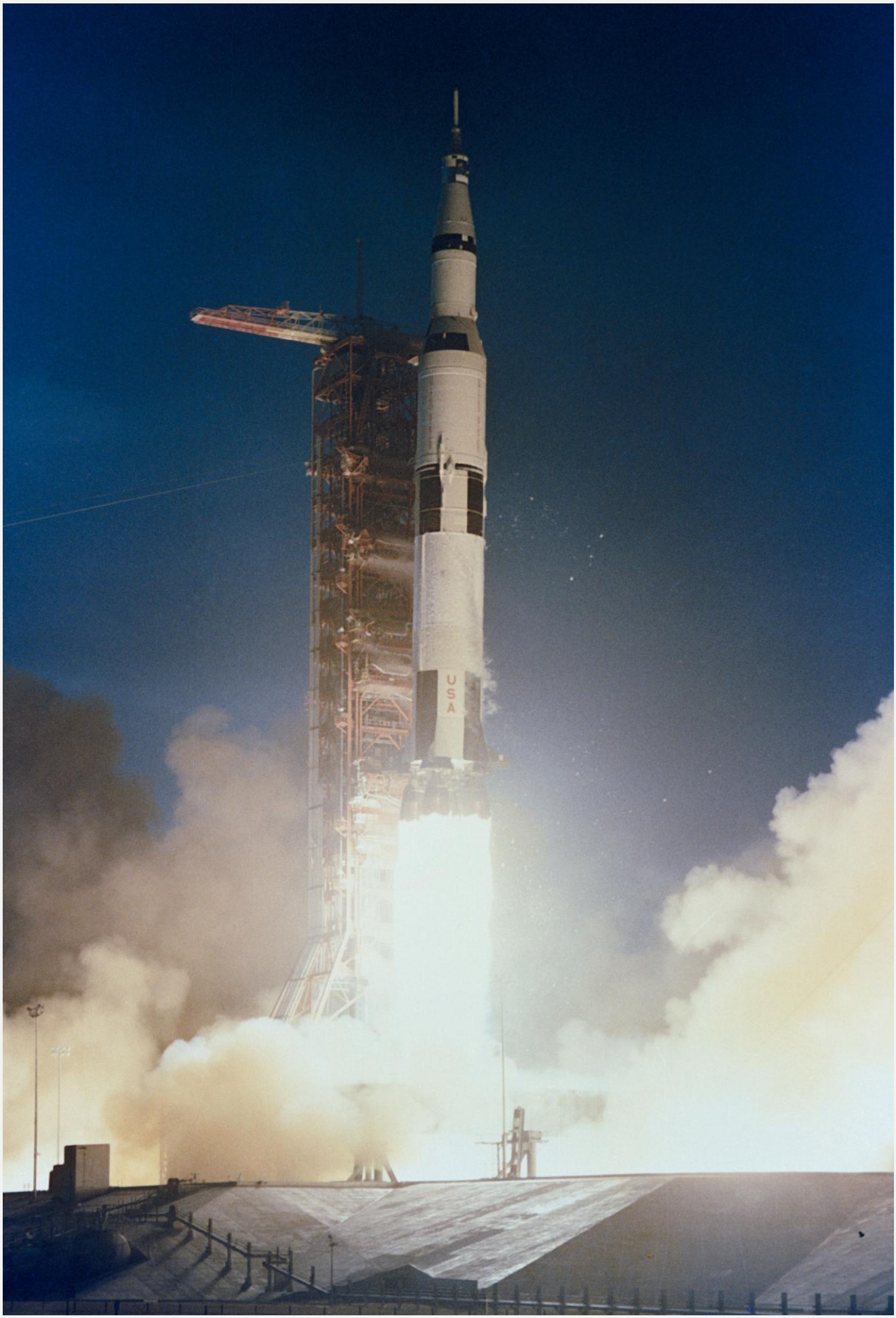
There were some showers around before it was time to launch in the afternoon, but after a brief hold the weather at launch was mild and calm. Light winds of less than 10 knots from the west, at a temperature of 21.7°C with humidity at 86%, drifted off the land. Cumulus clouds with a base of 4,000 feet covered 70% of the sky, with altocumulus above covering 20%.

Across the Atlantic in Spain, the staff at the NASA tracking station at Robledo, about 60 kilometres north west of Madrid, was having trouble getting to work to support the launch. A convoy of about 30 station cars containing a group of Spanish and American technical staff reached the village of Valdemorillo and ran into a religious festival. The attending crowds completely blocked the road.

Station staff member José Grandela remembered the moment,

"The only perceptible sound came from a music band, while more than a thousand persons accompanied them in respectful silence. The traffic police were stopping all the cars until the procession was over. Most of us went out of our cars to watch the religious act but were recognised by some of the assistants to the ceremony. A rumour started to go through the crowd and people started to glance at us and pointed their fingers.

LIFTOFF! Apollo 14 roars away from the pad in this view from the launch tower. Image: NASA/KSC



Liftoff from Launch Complex 39A. Image: NASA/KSC

We then noticed a group of policemen having difficulty getting to us through the mass of people. The officer in charge said he had been told that we belonged to the American base and that the astronauts on the Moon could be at serious risk if we didn't reach the base on time, so he was going to stop the ceremony and allow us to go through the crowd.

I don't remember that any of us replied a single word – we were just astonished. We got back into our cars and drove at walking speed, physically touching the peasants while some comments, almost in a whisper, reached us, *'They are the men of the Moon…they are the men of the Moon.'"*

Lift-off

Present at the launch were Spiro Agnew, the Vice President of the United States, and Prince Juan Carlos of Spain and Sofia his wife, escorted by the acting Director of NASA, George Low. They were introduced to the Launch Director, Walter Kapryan, in the Firing Room. Carlos, in part, said, "We are fans. We came here on our honeymoon in 1962 and met some of you that we saw today – we are very happy to see them again."

After a hold of 40 minutes and 3 seconds at T-8 minutes 2 seconds due to a thick cloud with some rain passing by, at T-4 minutes the spacecraft launch conductor Skip Chauvin heard a confident GO from all the key positions and the Saturn V departed from the LUT (Launch Umbilical Tower) at 1603:02 USEST Sunday 31 January 1971, 2103:02 UT (0703:02 AEST Monday 1 February) and entered a 185.4 x 183.2 kilometre parking orbit with an 88.18 minute period and a speed of 28,052.8 kilometres per hour at 0714:52 AEST.

At plus 5 minutes Mitchell commented, *"Smooth. Just looks like a little side oscillation in the couch."*

Roosa, *"That's all you're feeling; just like a railroad coach in this couch."*

At 0:42:51 GET (0745:53 AEST) Roosa mused, *"Man, that booster's something. Couldn't get over the ice. That was something when the ice came off."*

Mitchell agreed, *"Yes, that really was."*

Roosa went on, *"I expected more vibration."*

Listen to the launch

As recorded from commercial radio in Sydney by Colin Mackellar.

Recording starts at t- 1 minute 57 seconds.

Jack King calls the countdown, up until Tower Clear. After Tower Clear the recording includes Voice of America coverage.

LISTEN

2.4mb mp3 runs for 6 minutes 4 seconds

Shepard joined in, *"I really did, too. I thought it was a really smooth ride – real smooth. Let's keep pressing ahead here; slowly but surely."*

Then, at 43 minutes, the crew came across the first of Gene Cernan's back-up patches. Shepard cursed, *"Oh, these goddam things are going to be all over the place."*

Roosa, *"I knew they'd done that – I mean I didn't know it, but I sus… …right behind your head are two more of those things, Al, if you could reach them."*

Shepard *"Okay – I'll get them. We're probably going to be collecting these patches the rest of the flight."*

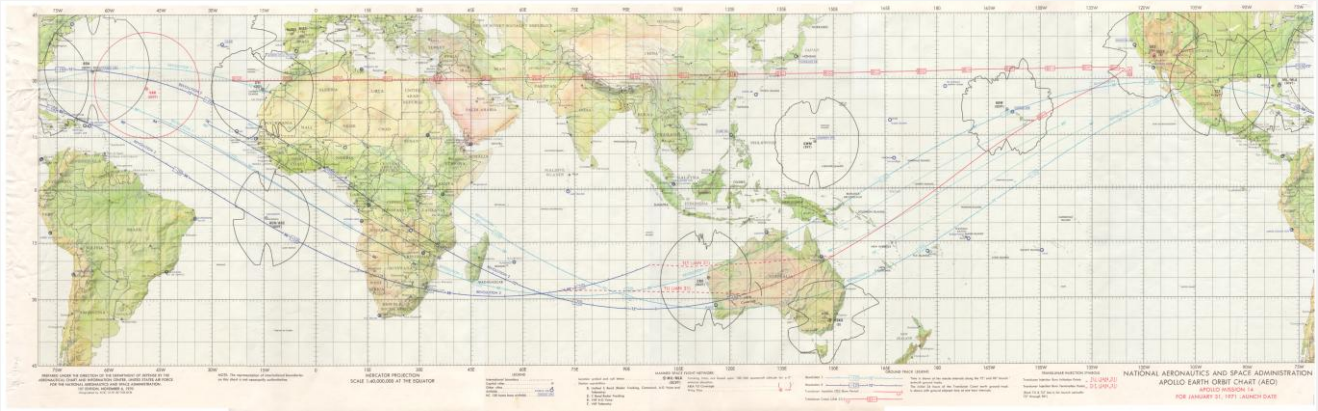
Mitchell, *"Yes. They're going to be hiding everywhere."*

Then, at 44 minutes into the flight Shepard realised he had passed his first Mercury flight time with the comment, *"Son-of-a-bitch –- I tell you. I've already beaten my old record."*

Mitchell laughed, *"You beat your old record at Insertion."*

Shepard, *"I know it. I was just kidding."*

More Cernan patches were discovered, Shepard exclaimed, "… there's one in here too. There must



The Apollo 14 Earth Orbit Chart for a Trans Lunar Injection of 31 January 1971 (as was the case).

Bryan Sullivan preserved this map which was in the Honeysuckle Creek Operations Room.
Scanned by Colin Mackellar. Full size image available at honeysucklecreek.net

be one in every frigging volume – stowage we have."

Mitchell agreed, "Probably."

Roosa, "I think there's going to be."

Shepard continued, *"Yes – they knew. Goddam – they knew we've got to get into all these things."*

At 51 minutes into the flight Apollo 14 rose above Carnarvon's horizon and after the opening conversation Ed Mitchell said, *"….we just burst into sunlight, Gordo - it was quite a sunrise."*

Capcom Gordon Fullerton,
"Roger, Ed, we copy that."

At Honeysuckle Creek we had our usual 6-minute grab at their signal in the first orbit at 1:03:11 GET (0806:13 AEST) with only a request to go to Omni (antenna) Charlie.

During the second orbit Flight Director Pete Frank polled his team to hear all were green to go to the Moon, so Houston was able to give a GO during the second pass over Carnarvon at 2:26:39 GET (0929:41 AEST).

Fullerton, *"You're GO for the Moon. GO for TLI."*

Shepard, *"Roger – GO for TLI."*

Two minutes later Shepard called down, *"We have ignition."*

Fullerton, *"Roger, ignition."*

Shepard, *"Smooth start. Steering is good."*

At 2:28:32.4 GET (0931:34 AEST) a TLI burn of 5-minutes 50.84 seconds over Carnarvon sent them on their way to the Moon, the spacecraft tracking right down the middle of the plot boards in Mission Control. Mitchell commented through the station in Guam, *"We have good signal strength from you now, and I might say here that the Earth is starting to drop away rapidly at this point. Stu and Al have started to change seats. We're going into our pre-prep checklist."*

The LM Docking Problem

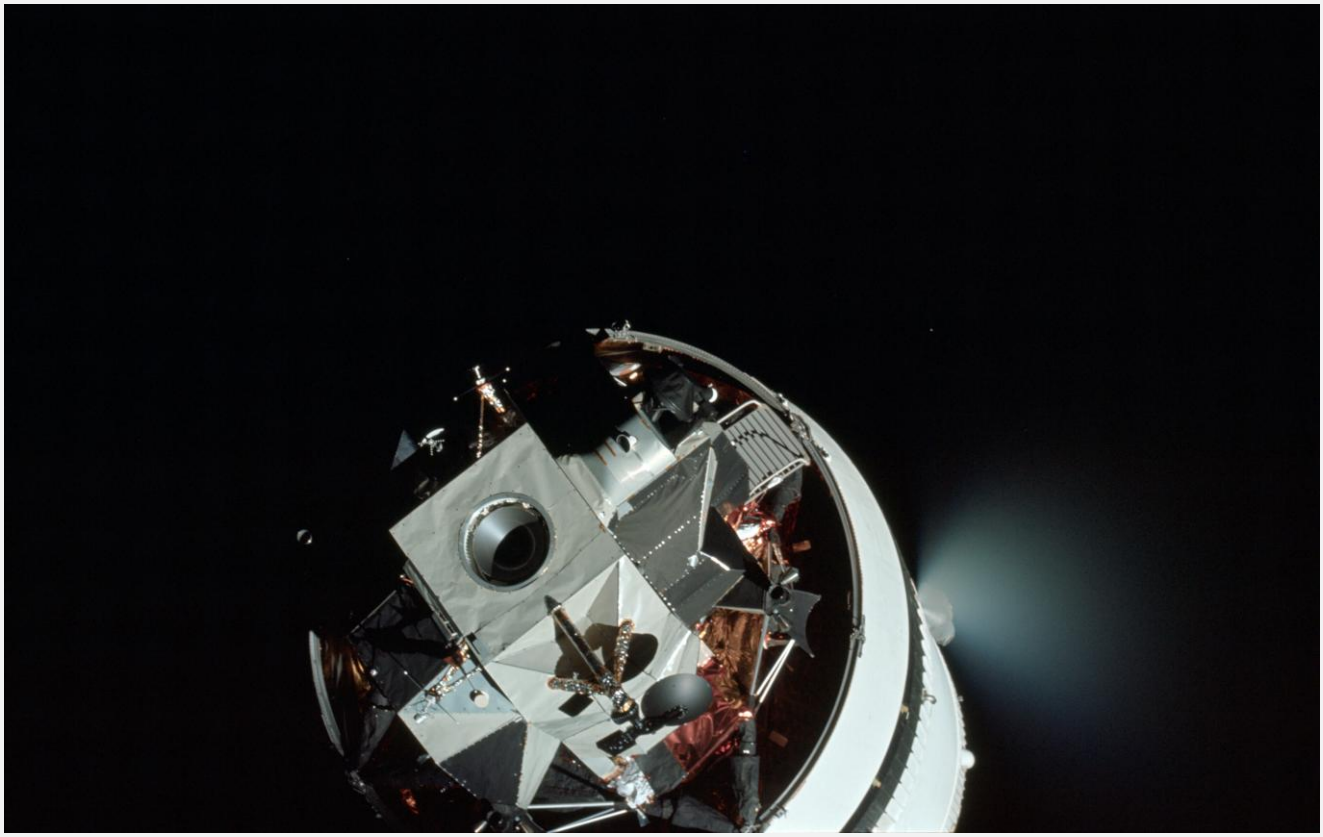
At 3:00:00 GET (1003:02 AEST), 94,578 kilometres above the Earth, there was a handover from Guam to Goldstone, just before transposition and docking at 03:02:29 GET (1005:31 AEST).

Ed Mitchell couldn't resist describing what he was seeing,

"I'll chat for a minute. The Saturn IVB is surrounded by millions of particles that came off when we separated and look like little old twinkling stars floating around in a very rampant pattern. The sunlight is shining very strongly off the top of the Lunar Module as we drift into it."

The astronauts followed the normal routine of extracting the LM from its launch housing in the SIVB, turning it around and docking with the Command Module. At 3:13:54 GET (1016:55 AEST) as Roosa brought the CSM in to the LM docking cone, the astronauts confidently waited for the thud of the latches biting and a green light to confirm a hard dock.

To their surprise, even though they appeared to have made solid contact - there were no thuds from the latches and no green light! It was unbelievable. This was the first time the Americans had a docking failure at their first attempt.



The LM sits snug at the top of the S-IVB just before Docking. Image: NASA AS14-72-9920

Roosa: *"Okay, Houston. We hit it twice – sure looks like we're closing fast enough. I'm going to back out here and try it again"*

A puzzled Houston responded with *"Roger."*

Roosa, *"Man, we'd better back off here and think about this one, Houston."*

Mitchell, *"We're unable to get a capture."*

Fullerton, *"Roger, Ed."*

Roosa, *"Okay, Houston, we backed out a little bit, and that last time I hit it pretty good and we're just not getting the capture latches there."*

They prepared to try again, Houston suggesting,

"We suggest that at initial contact that you hold Plus-X for three seconds or so, at least."

Shepard, *"And…a good rate coming in this time."*

Roosa, *"And here we come in again."*

Fullerton, *"Roger."*

Roosa, *"Okay, Houston. I hit it pretty good and held 4 seconds on contact and we did not latch."*

Fullerton, *"Roger. We're seeing it all on TV here."*

Houston asked them to check switches and displays until they had to admit, *"We're about out of ideas here."*

Now there was a hint the mission could be over before it had begun. The Flight Controllers sat up and began to think about possible causes, and how to overcome this new development. They looked around for the specialist engineers, and the engineers began to look for their ground replicas and procedures. If there was something wrong and they were unable to dock, this would be the end of the lunar landing part of the mission, and possibly all further Apollo missions as there were already authoritative voices calling for an end to any more lunar flights in case tragedy struck - quit while ahead!

At the critical moment Mission Control could not find the replica docking system. Director of the Manned Spacecraft Center, Chris Kraft, *"Previously we'd always had a docking probe and drogue available at the Control Center, as well as experts on the system, but now there were frantic calls for assistance, and the absent docking system had to be hurriedly located to understand what might be going on thousands of miles out in space."*

The mock-up was found and back-up Commander Gene Cernan with astronaut John Young, Mission Director Chet Lee and Flight Controller John Llewellyn worried over the replica. It appeared that the latches on the tip of the probe were stuck and weren't operating. Four more times over the next hour and a half they tried docking without success, while the replica in Mission Control never failed. *"It's possible there is some dirt, or debris, in the latches,"* suggested one of the engineers.

Finally back up Commander Gene Cernan came on line with another possible solution. The recommendation was to wait until the probe had time to align the CSM with the LM, then to command the probe to retract while the CSM fired its thrusters to force the main docking collars together so the primary latches would engage.

Cernan called from the Capcom console, *"Hey, Stu. This is Geno. Do you read?"*

Roosa, *"Yes, loud and clear."*

Cernan, *"Okay. We got one more idea down here – Before doing any hard suit work, and – let me throw it out at you, and you come back with your impressions.*

We're thinking of - of attempting to – to dock actually without the aid of the probe, which requires some pretty fine alignment. We're thinking that maybe you could go ahead and go through a normal plus-X and put the probe in the drogue, and while you're holding a – this will help you with your alignment – and while you're holding a plus-X, go ahead and blow a bottle (a bottle of nitrogen gas that activates a pneumatic system that retracts the probe) and try and retract the probe.

Now, if the probe retracts, it should retract well out of your way, so that the actual docking latches, with any luck on the alignment, should mate. Now, if you get one latch, we feel we'll – we'll be fast, and we can get them all. There's one hooker. The configuration that we think you might be in – electrically, there may be a series path broken which doesn't allow us, actually, to retract the probe through blowing one of those bottles. But we feel it sure is worth a chance, or worth a try before we do any hard suit work."

Shepard, *"All right, Geno. Let me see if we understand you on that. Your thought is to blow one of the bottles to retract the probe after we've lined up and just before contact – or wait until we contact, and then thrusting, and then retract the probe."*

Cernan, *"Okay, Al. We're thinking that actually, if you leave the probe extended until you actually contact, that any small, minute misalignment, at least in translation left, right, up, or down, will be taken out as the probe centres in the hole of the drogue. If you can keep a Plus-X going at that time and then retract the probe, hopefully, your alignment will stay fairly close and - and we may pick up a couple of the docking latches. Now, as I said, we've got some reservations. We're not – we're not sure, actually, the probe is going to retract, so you might keep that in mind. But again, if it doesn't retract, we haven't lost a bottle, and if it does retract and you do get a docking latch, we've accomplished what we wanted to."*

Shepard, *"Okay, stand by one."*

Houston could only stand by and listen. Out in space Roosa glanced at Shepard and saw the Icy Commander – angry. By this time Shepard was getting desperate and thinking that if this didn't work and Houston would call the mission off, they would do an EVA and bring the probe inside and try and fix it or even reach through the tunnel to pull the two spacecraft together by hand.

At the sixth attempt the three men held their breath as Roosa gunned his ship and the CSM obediently leapt forward and slammed into the Lunar Module … after a heart-stopping pause the latches dropped into place and a green capture light gleamed at them from the control panel at 4:56:56 GET (1159:58 AEST).

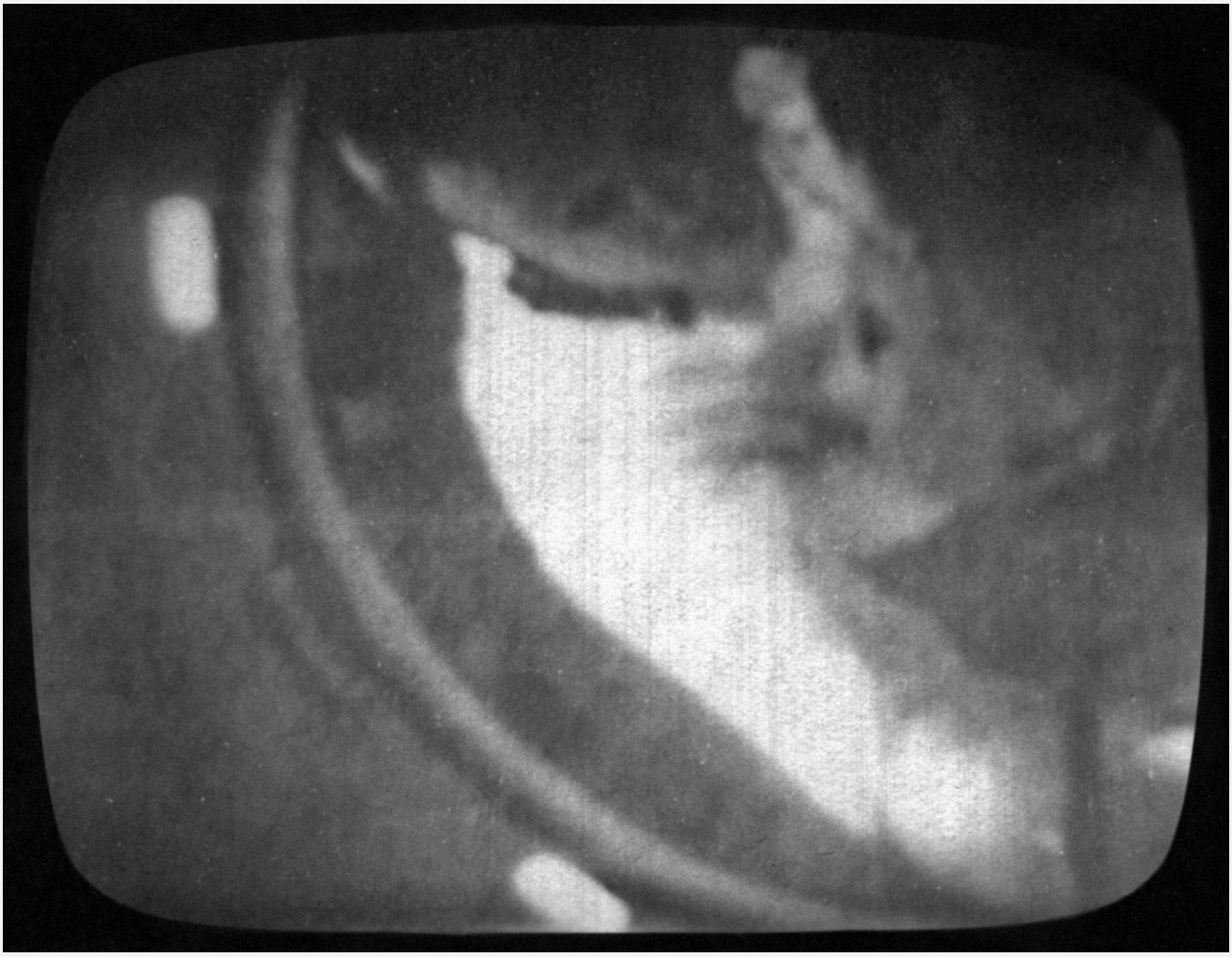
They had spent an hour and forty-three minutes trying to complete the docking manoeuvre.

Roosa, *"We got a hard dock, Houston."*

Fullerton with relief, *"Outstanding!"*

Roosa, *"We got it."*

Shepard described the successful moment to cheers around the Mission Control consoles , *"We noticed no response for perhaps two or three seconds after initiating Prime Retract 1. We then got the barber pole on both – went grey on both at the hard dock."*



Alan Shepard floats through the docking tunnel as seen on television in Sydney. Photo by Colin Mackellar.

Fullerton, *"Roger, Al. That's great. And super job, Stu."*

Roosa, *"Thank you."*

Mitchell, *"It didn't even wiggle when you hit it right in there."*

Another crisis in the Apollo Program passed into history and the mission continued to follow the flight plan until they reached the Moon.

At 9:57:26 GET (1700:28 AEST) Houston decided to inspect the probe, and Capcom McCandless told the crew what they wanted,

"Okay, Ed. Here is what we would like to do on the probe removal – or actually the whole probe inspection shooting match. We'd like to remove the tunnel hatch, of course, and let you make a quick visual inspection there to see if there is anything that looks significantly amiss.

If you see anything, we'd like to photograph it; and, in this whole sequence, we would like to have you power up the television and send a picture down, which we'll receive at Goldstone and record. Although we still have about an hour or an hour and a half before we can be configured to receive the television back here live, and then pressing on from there, if you want to make a couple of notes on a pad, we'd like you to perform the probe removal in accordance with the decal.

And we currently have the lines from Goldstone back to the building up here, so I think that we'll probably be ready to support via TV almost in real time. We'll have Goldstone coverage for about another hour and a half. If there's any problem we can reconfigure to pick up at Honeysuckle."

After a snack they set up a television transmission at 11:00:00 GET (1803:02 AEST) and began to work on the probe at 11:05:32 GET (1808:34 AEST).

Ed von Renouard at the Honeysuckle video console in its Apollo 14 configuration.
Photo: Ed von Renouard. Scan: Colin Mackellar.

Mitchell, *"I got the camera set up and we're starting to work on the tunnel now. When you're configured for television we'll let you have it."*

McCandless, *"We're configured – let her rip!"*

After going through a series of 12 step-by-step items, the only conclusion that the crew was able to reach was there was no obvious defect with the probe or drogue assembly. The drogue was reinstalled in the tunnel area, and the probe was tucked in there to get it out of the way.

During the exercise the real time television signal was transferred from Goldstone to Honeysuckle Creek, finishing at 12:12:00 GET (1915:02 AEST).

The first sleep/rest period began at 15:30:00 GET (2233:02 AEST), 135,974 kilometres from Earth.

Haise, *"Okay, Stu, I guess you can take the rest of the day off."*

Roosa, *"Okay."*

TUESDAY, 2 FEBRUARY 1971 - AEST
DAY - 2

While the astronauts slept they crossed over the half-way point to the Moon in distance, at 27:04:42 GET (1007:44 AEST) at a distance of 202,186 kilometres from Earth.

After the sleep period, the probe investigation continued the next day at 27:49:18 GET (1052:19 AEST) with Capcom McCandless announcing, *"We'd like to pick up the discussion on the docking probe situation now, if you're ready?"*

Roosa, *"Okay, Bruce. I guess we're all hooked up and ready to go."*

After an hour and six minutes of discussion, McCandless summed up the probe investigation at 28:55:43 GET (1158:44 AEST) with,

"Just a little status on the probe situation. We have no further queries on the docking probe at this time. The conclusions of our ground analysis

The S-IVB drifts away, with the LM in the foreground. Image: NASA AS14-72-9928

are that the system is now working nominally, and our current intention is that you are go for the lunar landing and all subsequent events."

WEDNESDAY, 3 FEBRUARY 1971 - AEST
DAY - 3

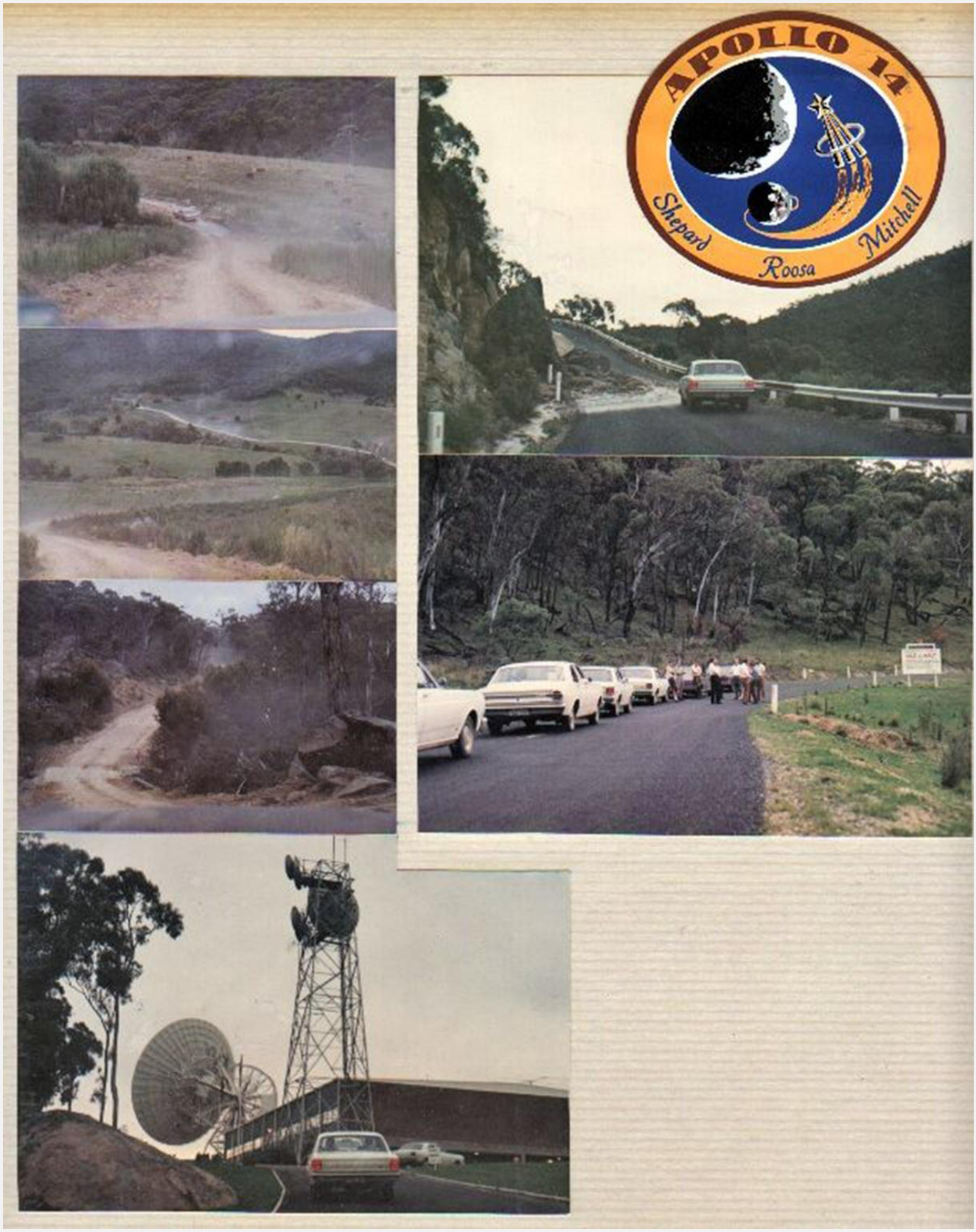
At the beginning of our new day at Honeysuckle Creek, the spacecraft passed the half way mark in time at 40:56:00 GET (2359:02 AEST Tuesday 2 February) at a distance of 263,204 kilometres from Earth and 151,351 kilometres from the Moon. Its velocity at the time was 3951 kilometres per hour relative to the Earth, and 3,579 kilometres per hour relative to the Moon.

The spacecraft's velocity was equal to the Moon and Earth at 47:43:00 GET (0646:02 AEST). Its speed at that moment was 3,526.6 kilometres per hour.

THURSDAY, 4 FEBRUARY 1971 - AEST
DAY - 4

Apollo 14 entered the influence of lunar gravity at 66:09:01 GET (0112:03 AEST) and began falling down at an ever increasing speed towards the Moon. Mission Control displays now switched all its references to the Moon.

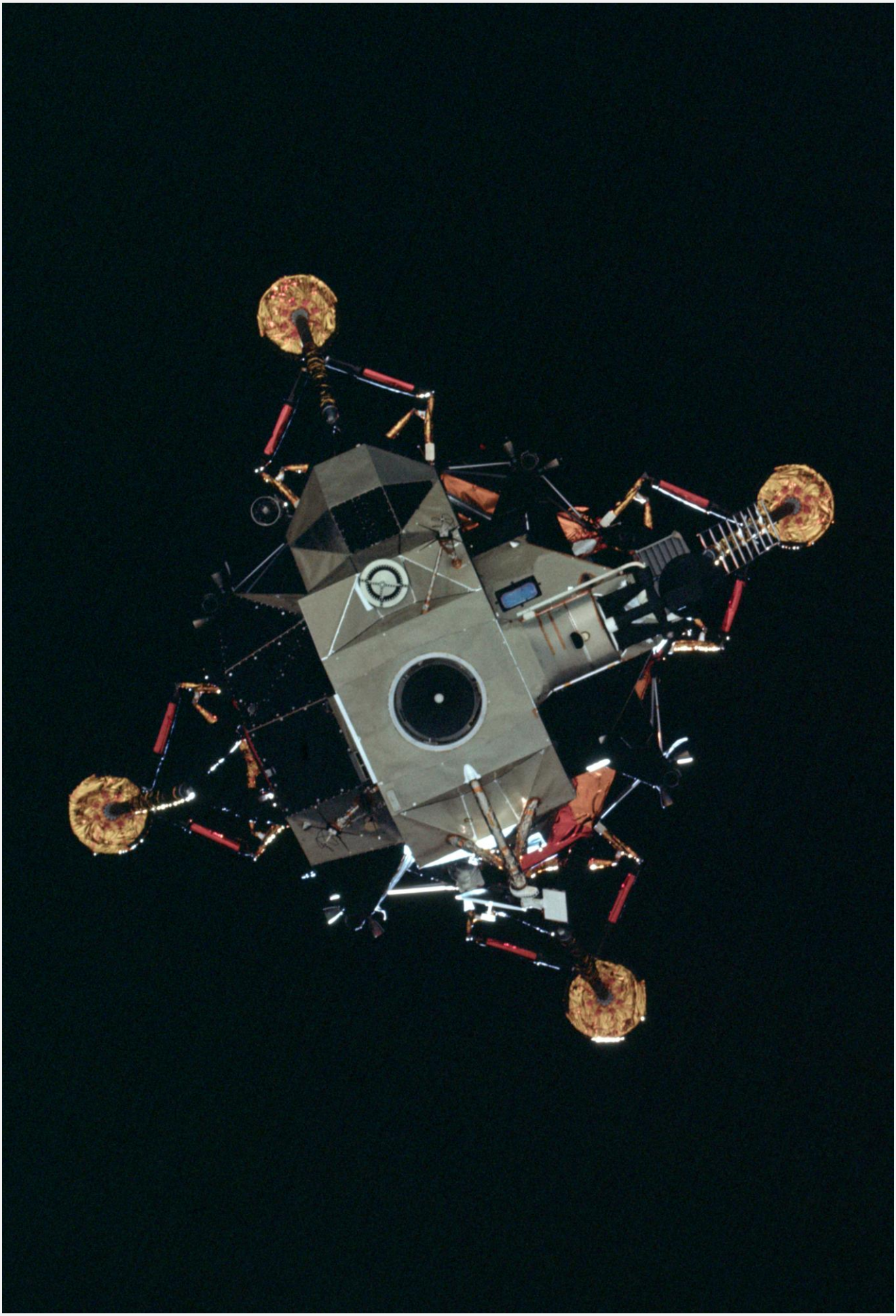
Round about the same time the crew began their second rest/sleep period.



Ed von Renouard kept these photos to show the perils of getting to work at Honeysuckle during Apollo 14. Images preserved by Colin Mackellar.

A boulder and debris across the road to Honeysuckle forced a detour via the old dusty and narrow track built on the side of Deadman's Hill for the construction of the station.

On the photo at centre-right, shift cars wait for clearance to proceed past the "Halt" sign up to the station.



Lunar Module ‘Antares’ after undocking from the Command Module ‘Kitty Hawk’. Image: NASA

Shepard, *"Houston, Fourteen signing off for the evening."*

Fullerton, *"Roger, Al. Pleasant dreams to you all."*

However, sleep was delayed for a while to sort out a high oxygen flow rate, disturbing the passive roll rate. It was resolved that the waste management system was the culprit, so at 67:30:00 GET (0233:02 AEST) they settled down to try sleeping again.

Shepard, *"Houston, Fourteen. If you're satisfied then I'll return my comm. configuration to the sleep configuration."*

Fullerton, *"Let me make a quick check here… …yes, I guess that's all we've got. We'll say goodnight once again."*

The sleep period was extended by 30 minutes, and the crew were back in business at 75:30:00 GET (1033:02 AEST), beginning with a consumable report to Houston.

Then, McCandless wondered, *"Are you all eating breakfast up there now?"*

Spacecraft, *"We're starting. The cooks are in the kitchen at the moment."*

Arrival at the Moon

After spending 79 hours 28 minutes 18 seconds crossing the void, at 81:56:40.7 GET (1659:42 AEST) the SPS motor was fired for 6 minutes 10.84 seconds to insert Apollo 14 into a lunar orbit of 313 by 107.6 kilometres.

The SIVB impact on the Moon was at 82:37:52 GET (1740:54 AEST).

Descent Orbit Insertion (DOI) burn

Descent Orbit Insertion (DOI) to prepare for undocking was at 86:10:52.97 GET (2113:55 AEST) with a 20.81 second SPS manoeuvre to establish the descent orbit of 108.9 by 16.8 kilometres.

On previous missions the DOI manoeuvre had been performed with the LM descent propulsion system, but because this landing site was more rugged than the previous missions, a greater margin of LM propellent was provided.

At 91:09:00 GET (0212:02 AEST) the crew of Apollo 14 began a rest/sleep period with Roosa announcing, *"We'll see you tomorrow."*

Capcom Fullerton, *"Okay. Goodnight."*

FRIDAY, 5 FEBRUARY 1971 - AEST
DAY - 5

The rest period ended at 99:15:00 GET (1018:02 AEST) during the ninth orbit with the Roosa calling, *"Good morning Houston. Fourteen here."*

McCandless, *"Apollo Fourteen. This is Houston. Good evening, Stu."*

Roosa, *"Good evening? It's good morning, Bruce baby."*

McCandless, *"Roger. How'd you all sleep?"*

And the spacecraft reported everyone managed six hours of sleep, finishing the status report with, *"We went to bed all healthy, no medication, and we're getting up the same way."*

Shepard and Mitchell climbed into the LM at 101:20 GET (1223:02 AEST) for initial checks to prepare for undocking.

Down in Mission Control the new Gold shift entered the room and Fred Haise sat at the Capcom's console. It was rather quiet as the flight controllers discussed the upcoming checkout of the LM. Goldstone was acquiring the spacecraft at 102:25:44 GET (1328:46 AEST).

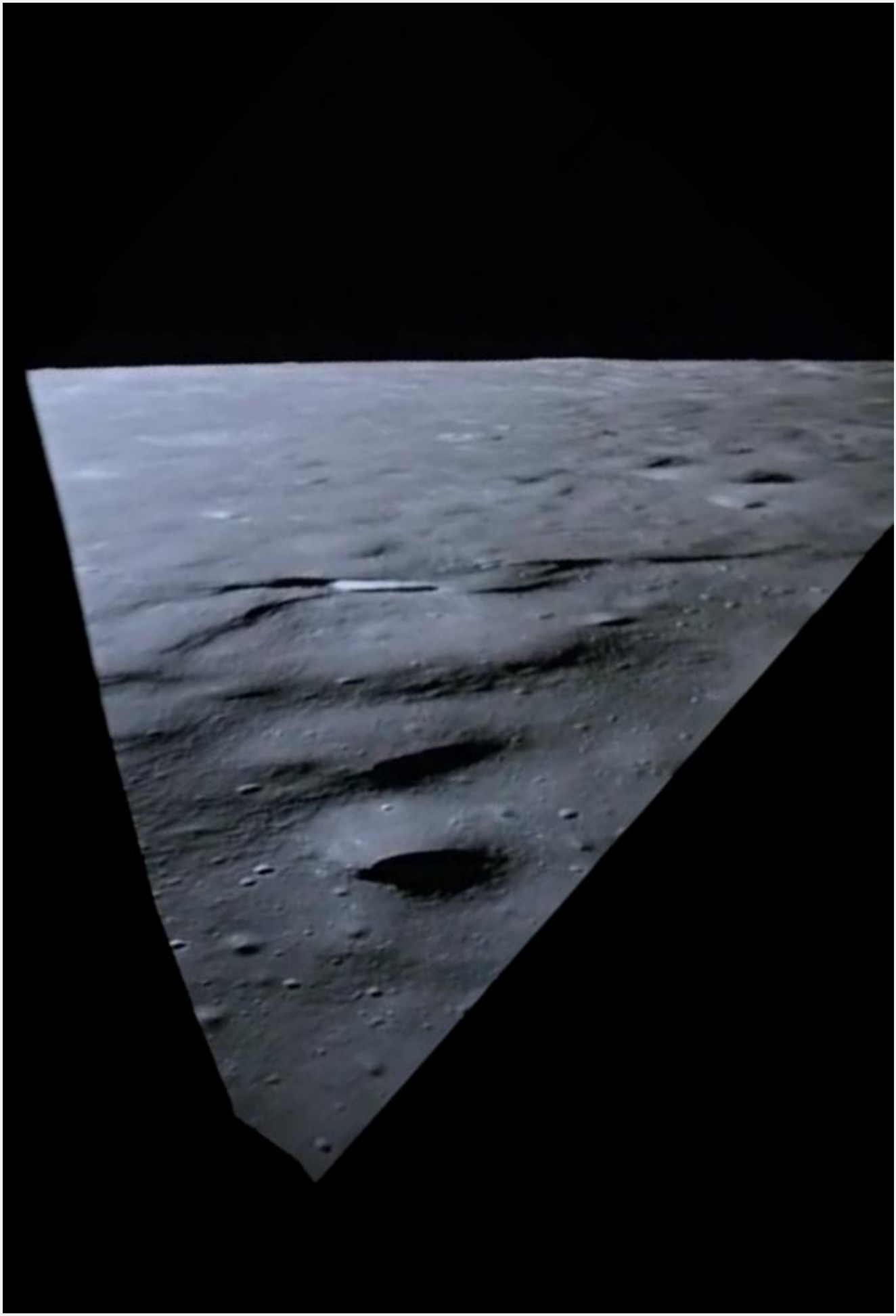
Undocking – Leaving the Command Module Kitty Hawk for the lunar surface

Undocking and separation occurred during orbit 12 at 103:47:41.6 GET (1450:43 AEST) with a 2.7 second burn of the Service Module RCS and the LM entered a 111.5 by 14.4 kilometre orbit.

A 4.02 second manoeuvre by the CSM Kitty Hawk at 105:11:46.11 GET (1614:48 AEST) circularised its orbit to 118.3 by 103.7 kilometres, out of reach of the LM.

The Abort Switch Problem

Following normal procedures, the crew initiated a computer practice run for PDI (Powered Descent Initiation) to begin their descent to the lunar surface. The computer program started all right, but then without any warning the AGS (Abort Guidance System) triggered, beginning emergency procedures to ditch the descent stage and return back to Kitty Hawk without landing. The Houston flight controllers noticed the on board computer was receiving a signal indicating the abord switch was closed and had flung itself into an abort mode to return back to Kitty Hawk without landing.



Frame from the 16mm film taken during the LM’s final approach to the Fra Mauro landing site. Image: NASA

Shepard: *"Hey, Houston, our abort program has kicked in!"*

Every try produced the same result, and every check could find no errors. When Mitchell tapped the panel with the switch, the errant signal disappeared. The lunar landing was put on hold while engineers conducted ground trials and evaluations, finally deciding the problem must be a stray sliver of solder in the Abort switch.

In case the problem occurred again, they yanked computer specialist Donald Eyles out of bed in Massachusetts to write a new program to accommodate this faulty switch and transmitted it up through the tracking stations to the spacecraft circling the Moon. With only minutes to go to ignition Mitchell keyed in the changes while Shepard, itching to be doing something but only able to wait, anxiously watched. When Mitchell finished at 107:58:23 GET (1901:25 AEST) he called, *"Okay, Houston, it's in."*

A relieved Shepard called, *"And Antares is standing by for a PDI Go."*

Haise, *"And Antares, you're GO for Fra Mauro."*

Mitchell, *"Good show, Freddo. Thank you."*

Shepard, *"Thank you – you troops do a nice job down there."*

It was close. There were just over four minutes left to the PDI burn. Four minutes before having to abort and return to Kitty Hawk without landing. After the switch problem and they went behind the Moon, they got ahead of the checklist schedule because they knew they were going to be short on time before they started to burn to go to the surface.

Mitchell, "We had to do changes in both the main computer and the abort system computer, and I was the guy who changed them. Al flew the spacecraft and I did the programming changes that could not be done from the ground. So, we departed from normal procedures during this period and, basically Al was getting the spacecraft ready for descent, and I was getting the computers ready for the descent as well."

Ed Mitchell and Fred Haise (Apollo 13) knew the Lunar Module better than anyone else at the time, as they had helped assemble it in the Grumman factory, and had a lot of practical experience in the simulators. So, coming in to land at Fra Mauro Antares had two very skilful pilots at the controls, with Mitchell having the edge over Shepard with his specialised knowledge and experience with the LM systems.

Mitchell, "We double checked everything all the way down the line. He (Shepard) knew what I was doing and I knew what he was doing, and we just double checked each other all the way."

Shepard, *"All righty, it's a beautiful day to land at Fra Mauro."*

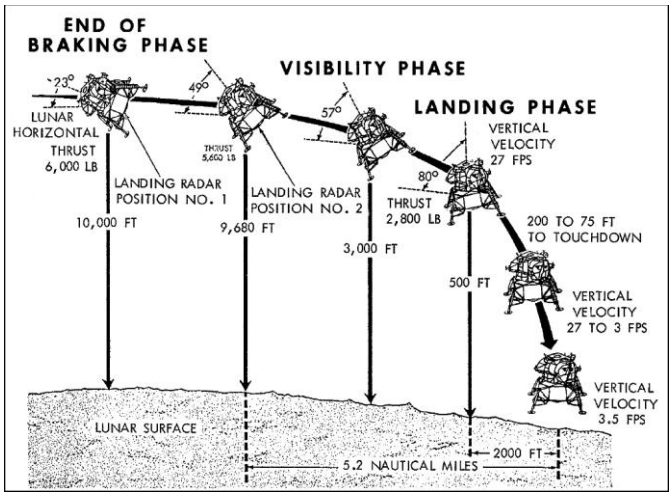
Powered Descent Initiation (PDI)

The Powered Descent Initiation (PDI) of a 12 minute 44.61 second burn was started at 108:02:26.52 GET (1905:29 AEST) at an altitude of 14.4 kilometres.

Shepard, *"And we have auto ignition."*

Mitchell, *"Okay, that. Good….. good ignition."*

Haise, *"Roger, Antares."*



The Landing Radar baulks

The mission continued, Antares dropping below 32,000 feet (9.75 kilometres) at 108:06:33 GET (1909:34 AEST). Mitchell quickly checked the on-board landing radar had locked on to the lunar surface. He looked at the warning altitude and velocity lights shining away in dismay – it should have locked on by now. The problem was the radar was working in a short range mode when it should have been in a long range mode, so wasn't receiving return signals from the lunar surface.

Mitchell, *"Houston, we still have altitude and velocity lights."*

Haise, *"Roger."*

Shepard, *"I'll bet they know that."*

Another threat to the mission! If the radar had not locked on by 10,000 feet (3.05 kilometres) Houston would have had to call an abort to the landing.

Luckily Houston had a quick fix.

Haise, *"We'd like you to cycle the landing radar breaker."*

Shepard cycled the circuit breaker and announced, *"Okay – it's cycled."*

Mitchell pleaded with the radar, *"Come on…"* then, *"…Okay,"* as the radar suddenly locked on to the lunar surface and displayed good data at 18,000 feet (5.49 kilometres).

Shepard, *"Velocity light is out. How does it look Houston?"*

Houston checked the radar data with their ground tracking data, and it agreed close enough to accept into the main computer. Mitchell asked Houston, *"Can we accept?"*

Haise, *"Okay. We'd like to accept the radar."*

Shepard, *"Okay proceed."*

Mitchell breathed with relief, *"Great. Phew – that was close."*

Once again Houston's on-the-job expertise had saved the mission. The landing radar problem had been a side effect of the faulty Abort Switch bypass fix.

Lunar touchdown

Shepard then executed the most accurate landing of the Apollo program by putting Antares down a mere 46 metres from the planned target point, 1.4 kilometres south west of Cone Crater at 3° 38' 43.58"S x 17° 28'17"W (Davies et al) at 108:15:11.4 GET (1918:13 AEST) on 5 February, ending up with an 8° tilt. At engine cut-off, approximately 68 seconds of firing time remained.

Shepard commented, "The landing site was rougher on direct observation than the photos had been able to show. So, I looked for a smoother area, found one, and landed there."

Chief Astronaut Deke Slayton suspected that Shepard deliberately landed the LM 50 metres short of the target point to shorten their walking distance to Cone Crater.

Meanwhile, Kitty Hawk passed by overhead on its 14th orbit.

Sitting on the lunar surface the thought passed through Shepard's mind that one moment he was grounded with no hope of reaching the Moon, and now suddenly, "Hey - here I am on the Moon!" For a moment he savoured a feeling of self-satisfaction and a tremendous sense of accomplishment.

SATURDAY, 6 FEBRUARY 1971 - AEST
DAY – 6 LUNAR STAY – DAY 1

FIRST EVA

Apollo 14 was the first mission to have an emergency system to rescue an astronaut whose PLSS (Portable Life Support System) had failed. Known as the BSLSS (Buddy Secondary Life Support System), it had a set of hoses allowing the astronauts to share their cooling water in the event one of the backpacks failed.

Mitchell's comment on it was, "It wasn't that terribly complicated. The complicated part would have been how to walk together and move together like Siamese twins."

The first EVA began at 113:39:11 GET (0042:13 AEST) when they swung the hatch door open. To get out of Shepard's way, Mitchell turned around and backed right up against the instrument panel so that the door could come open and Shepard could turn around and back his way out through the hatch.

Mitchell, *"Half a pound* (34.5 hPa) *in the cabin. You might be able to get the door open partly."*

Shepard, *"Yeah."*

Shepard tried to open the hatch, but it didn't budge. It had to be less than 0.2 psi (13.8 hPa) pressure to be able to open it.

Mitchell, *"Better let it drop a little more. It's a pretty heavy pull there."*

McCandless, *"You got a lot of surface area on that hatch."*

Shepard, *"Yeah, okay, there's a quarter of a pound* (17.2 hPa)*. Still tight, huh? Let her drop. Rest a minute. Let her drop…….okay, it should be almost zero now."*

McCandless, *"Okay, we're showing about a tenth of a pound* (6.9 hPa) *right now."*

Mitchell, *"There it comes…"*

Lunar Module ‘Antares’ on the surface of the Moon. Image: NASA

Alan Shepard on the surface, as seen by Ed Mitchell through the LM's starboard window. Image: NASA

With the hatch open, Shepard leaned against the left cabin wall, knelt down on his left knee, then his right knee, and turned around to back out the hatch feet first. Mitchell was watching all the time, guiding him. The available space for this exit manoeuvre was 140 cm wide by 91 cm from the hatch door to the mid-step of the LM.

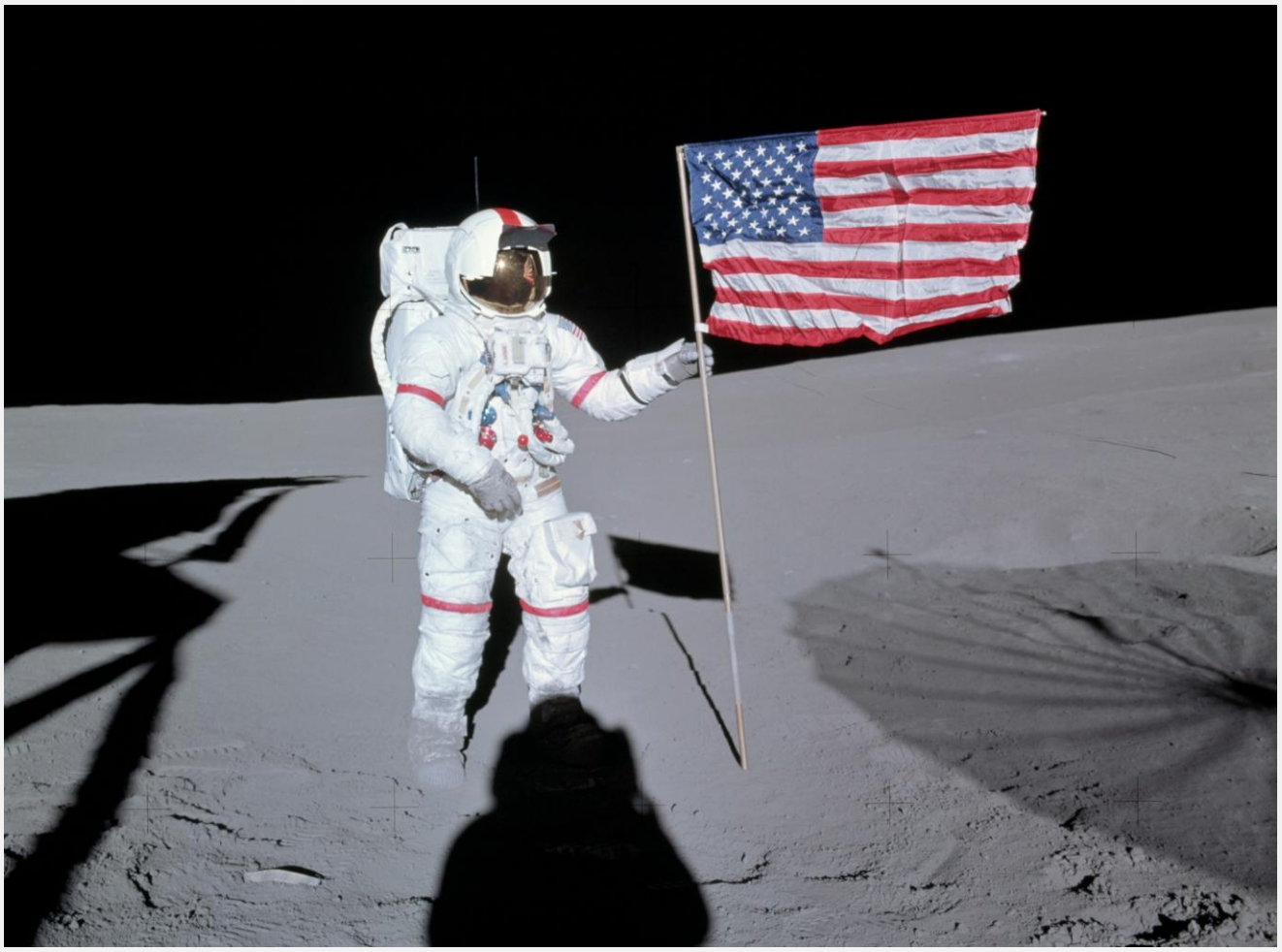
Shepard to Mitchell, *"Would you hold it* (the hatch) *for me, please?"*

Mitchell, *"Yep, I got it."*

After Shepard pulled the MESA (an equipment locker mounted on the LM) down, the TV came on at 113:50:00 GET (0053:02 AEST)) and Houston watched Shepard climb down the rest of the ladder.

McCandless, *"Roger… …Okay, Al. Beautiful! We can see you coming down the ladder right now. It looks like you're about on the bottom step… …and on the surface. Not bad for an old man."*

At 47 years, Shepard was by far the oldest of the astronauts to walk on the Moon during the Apollo Program, as well as the only Mercury astronaut. As he stepped on its surface at 113:51 GET (0054:02 AEST) there was no profound statement this time, just, …



Above: Alan Shepard. Below: Ed Mitchell. Images: NASA

"Okay, you're right, Al is on the surface. And it's been a long way, but we're here… …well, I can see the reason we have a tilt is because we landed on a slope. The landing gear struts appear to be about evenly depressed."

With Shepard out, Mitchell closed the door to get himself into position then opened it wide and backed out to join Shepard 5 minutes later with,

"That last one (step) is a long one… (hopping back up to the first rung of the ladder) *Ascent check. Very easy to do. A little push and just spring right up."*

The US flag was set up at 114:41:00 GET (0144:02 AEST), about 6 metres from the LM. Mitchell said to Shepard,

"Okay, I'll take the camera while you get the flag set up. I'll go off to the left over there – it will be on television."

Shepard, *"It will be the best place I guess."*

McCandless, *"I think it would look a lot better if you could bring it over closer towards the TV."*

Mitchell, *"Put it right here in front of us, Al."*

McCandless, *"There you go, beautiful."*

As Mitchell hammered the pole into the lurain, he commented, *"Going in very easily."*

At 115:01:09 GET (0204:11 AEST) Director of Flight Crew Operations, Astronaut Deke Slayton, passed up a message from President Nixon,

"Okay. We were very pleased a few minutes ago to receive a phone call here in Mission Control from President Nixon. He asked me to extend to you and Stu his best congratulations. He said that, like millions of people all over the world, he is an astronaut watcher at this time. The picture is coming in very well at the White House, he said.

The President said he knew how many thousands of people had worked on this mission without whom men would not be walking safely on the moon. He asked that I wish the entire Apollo team well. The President said he was proud of you and proud of them.

He sent you a wire just before the flight wishing you Godspeed, and he wishes you well on your return flight.

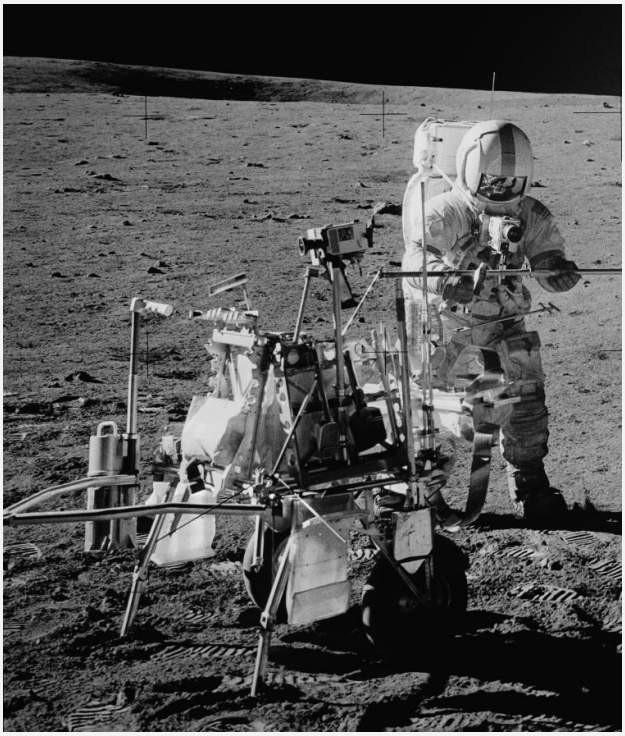
The President also asked me to invite you to the White House for dinner and to spend the weekend at Camp David with your families after the mission is completed. Over."

Shepard, *"That's fine, Deke. Thanks very much, and we appreciate those kind words."*

Mitchell, *"Thank you, Deke. And convey our thanks to the President, please."*

Slayton, *"Roger, will do. I don't think Stu (Roosa, orbiting the Moon in the Command Module) got this, but we'll see he gets it later."*

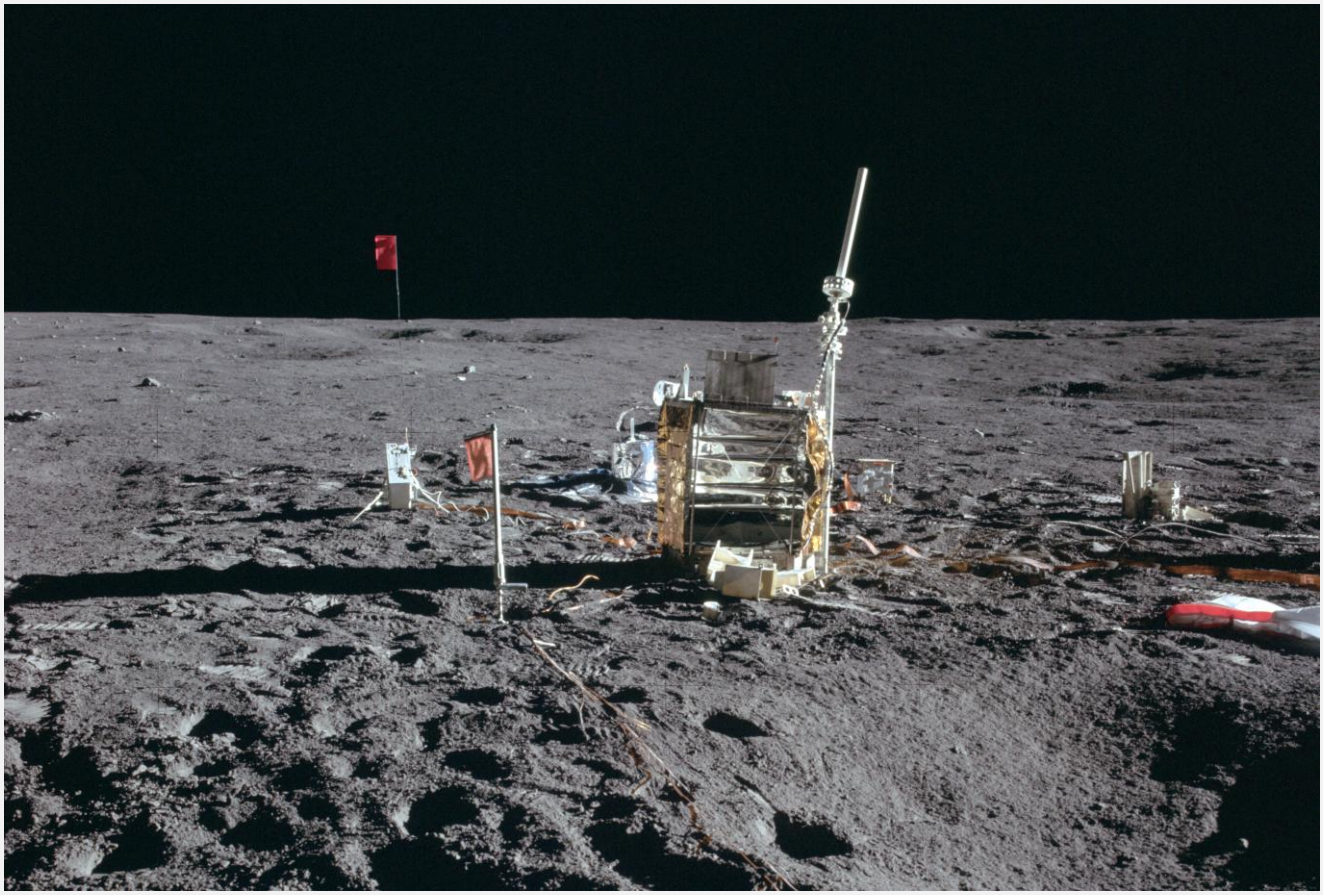
Straight back to business, Shepard to Mitchell, *"Okay, you ready? Get the wheels first."*



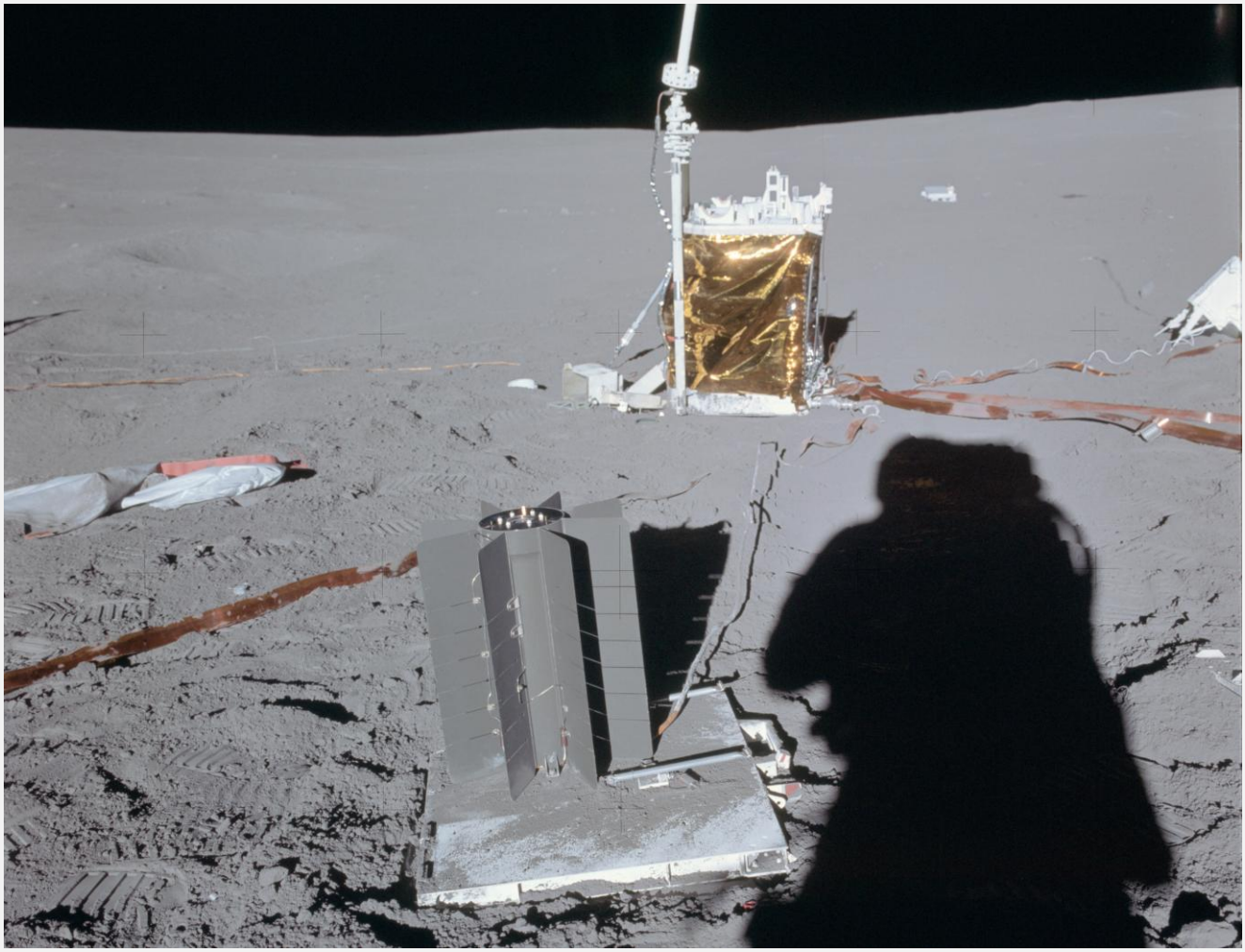
Shepard with the MET. Image: NASA

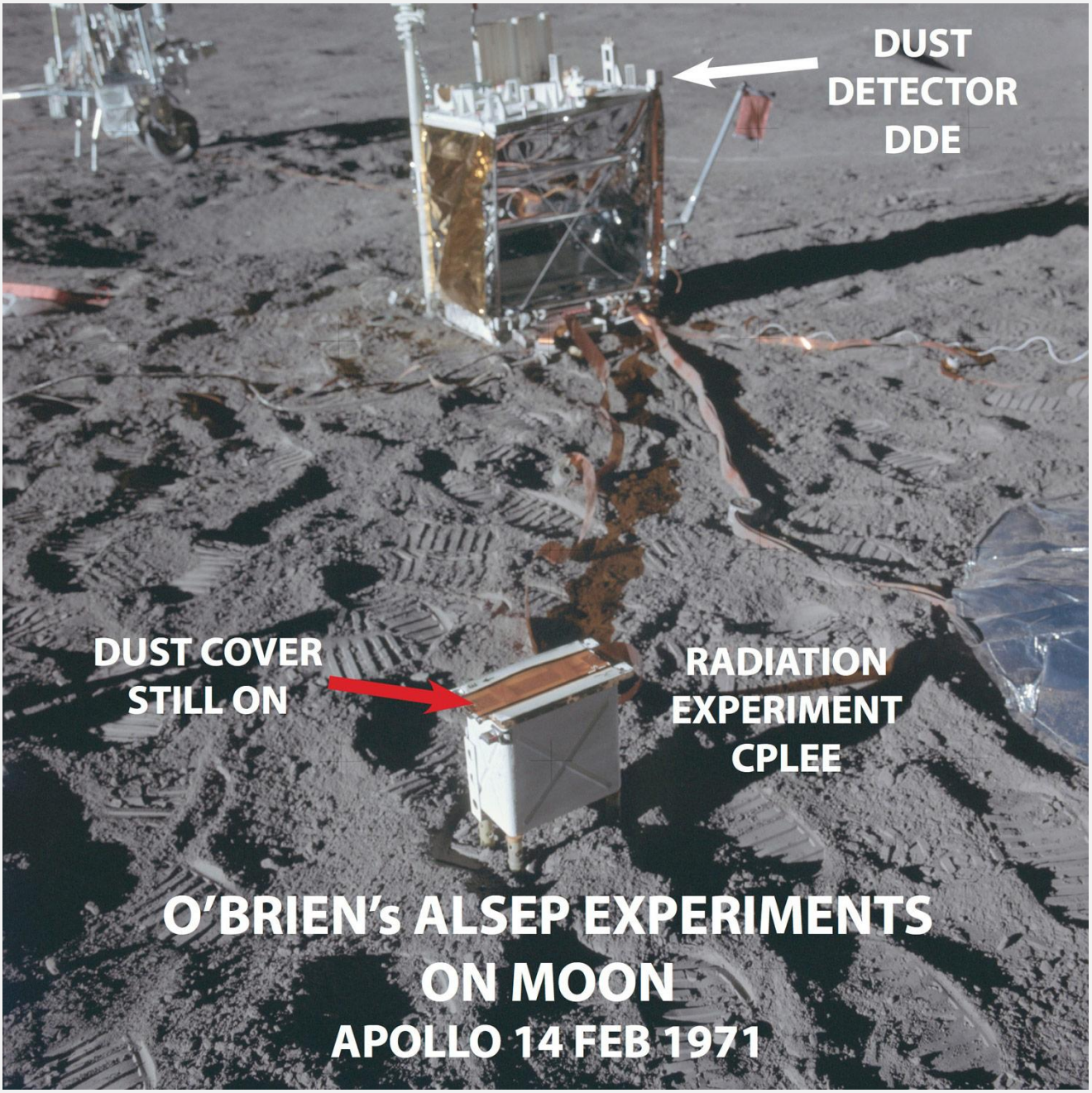
The first job was dismounting the Modular Equipment Transporter (MET) from the MESA at 115:00:00 GET (0203:02 AEST). The MET was a handcart the astronauts dubbed the "Lunar Rickshaw" for hauling equipment, tools and rock samples over the lunar surface. Although it was useful for carrying heavy gear, it tended to be unstable in one-sixth g, bouncing around and flopping over when the astronauts tried to hurry along.

This time the TV camera had the protection of a lens cap and worked well. For us on the ground it was great to be able to see what was going on again. Shepard pointed the camera toward



ALSEP experiments deployed on the surface. Below: The radio-isotope thermos-electric generator. Image: NASA





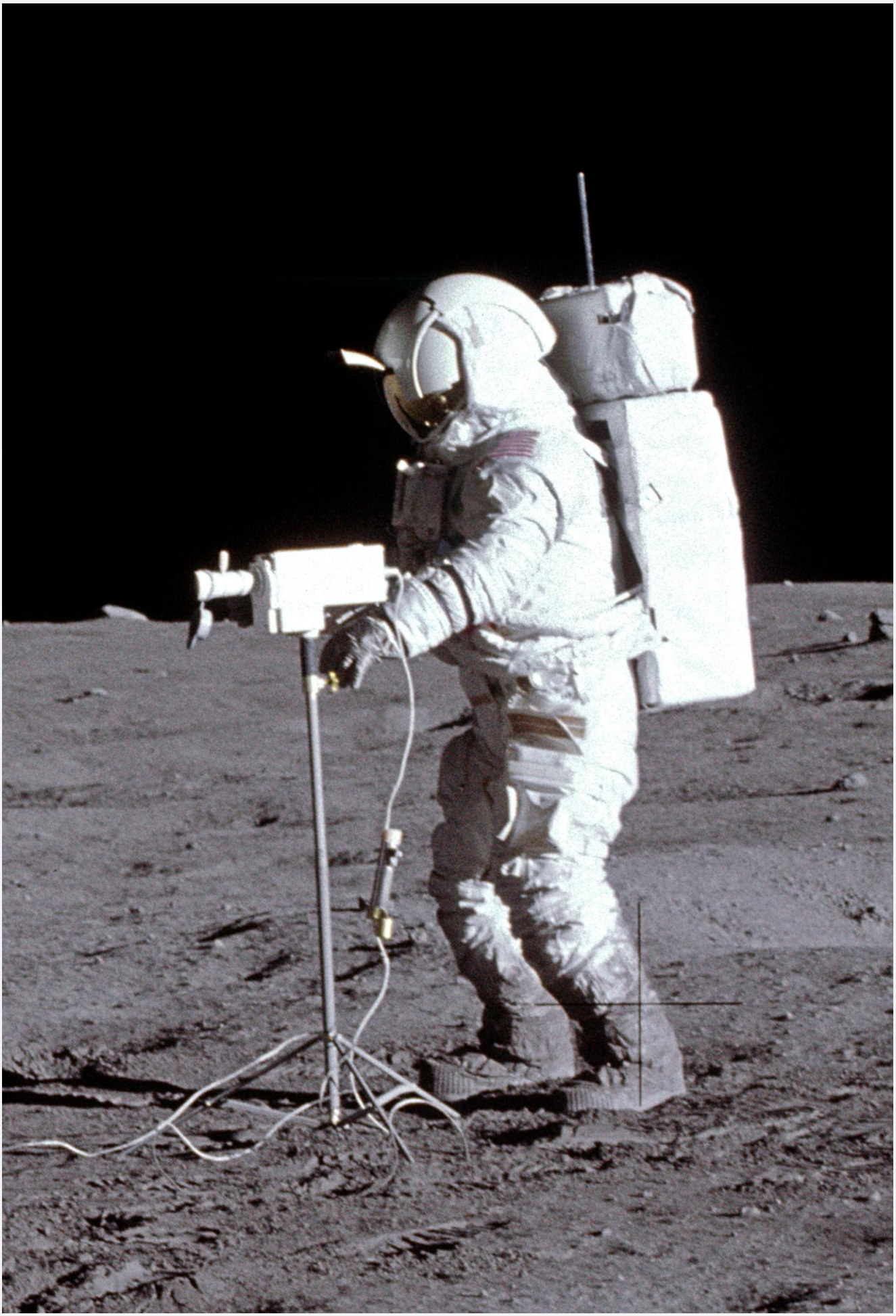
The Charged Particle Lunar Environment Experiment and the Dust Detector Experiment deployed on the surface. Annotations by Colin Mackellar. Image: NASA

Australian Physicist, Dr. Brian J. O'Brien

O'Brien was responsible for both experiments, writes,

"This is the only Apollo example of any scientist being inventor / Principal Investigator of two Apollo experiments on the Moon in two different scientific disciplines.

I like it because Apollo 14 proved my forecast in the early 1960s that electrons and protons causing auroras down around Earth's two magnetic poles should also travel along the vast magnetospheric tail and be measured on the Moon when the magnetospheric tail flapped across it during full Moon."



Ed Mitchell adjusts the television camera. Image: NASA (crop of image AS14-66-9240)

Two frames from the camera mounted to the Modular Equipment Transporter, as Mitchell (foreground above and background below) and Shepard (background above), deploy the individual ALSEP experiments. Images: NASA

the ALSEP site before they left the LM, so that Houston could watch the astronauts as they installed the ALSEP equipment – sometimes dropping out of sight as they crossed gullies in the lurain.

They began setting out the Apollo Lunar Scientific Experiments Package (ALSEP, the scientific station) at 116:04:00 GET (0307:02 AEST). It took a bit longer than anticipated, because they had trained on a flat surface and the rolling terrain forced Mitchell, who was carrying the ALSEP package, to take a couple of stops to get his breath. Also, the stiff spacesuits gave them more trouble than they expected.

By the time they were back at the LM at 118:27:01 GET (0530:03 AEST) they had been out for 4 hours 47 minutes 50 seconds. The first signal from the ALSEP was received by the tracking stations on Earth at 116:47:58 GET (0351:00 AEST).

Fullerton, *"We'll ring the alarm at 129 hours (GET), and I think that completes all the items we have for you. You are clear to go ahead with the last three steps before configuring for sleep. Over."*

Shepard, *"Very good. We'll press on with that now. Thank you so much."*

The astronauts left their suits on and took their gloves and helmets off. One helmet was stowed on the engine cover, and the other on the right hand corner on the floor. Mitchell's hammock was rigged first, across the cabin with the head to the right, and Shepard's into the aft area, above Mitchell's, with its head to the rear.

Before climbing into his hammock Shepard took his boots off on the engine cover. Mitchell explained, "I insisted that he take his boots off because I didn't want him raining dust down on me."

The last call of the day was from Fullerton with, *"Antares, Houston. Don't bother to acknowledge, but we're getting ready to do a station handover. You may hear a burst of noise. Over."*

REST PERIOD AND SECOND EVA

The rest period was similar to Apollo 12 – two hyped-up astronauts, aware of the desperately short time available to them, anxious to get as much as possible from the stay, trying to settle down and sleep. Shepard went to sleep quickly at 0900 AEST but woke up a few times as the 8° tilt of the LM made him feel the spacecraft was tipping over down the slope. Mitchell looked out the window to check the spacecraft was still stable, "Where I was lying I could turn over and pull the window cover down and take a look."

Another annoyance was the depressurised suits were uncomfortable, the neck rings interfering with finding a comfortable spot to rest their heads. Mitchell, "I don't think we got any deep sleep at all. I'm pretty sure it was fairly light sleep, little more than dozing."

Shepard began their new day in the spacecraft at 128:25:24 GET (1528:26 AEST) with a call to Houston, *"Houston, Antares."*

Fullerton, *"Antares, Houston, over."*

Shepard, *"Roger. Good morning, good morning. Reading you loud and clear."*

Shepard, *"Okay, we're up and running this morning. We're assuming we have a stay for EVA two and our crew status report is we've had no medication, and the shape of the crew is excellent."*

Fullerton, *"Roger, copy that."*

Mitchell, *"Good morning Gordon. How is it back in Houston this morning?"*

Fullerton, *"I'm not sure Ed. I haven't been outside in quite a while. But we're wondering if you'd give us an estimate of your sleep there."*

Mitchell, *"Well, not very much. I'd say four and a half to five hours at the most. Been kind of dozing the rest of the time."*

Shepard added, *"And about four hours for the Commander."*

Mitchell closed the TV circuit breaker at 130:31:38 GET (1734:40 AEST) before the second EVA began with the cabin depressurisation at 131:08:13 GET (1811:15 AEST), 27 minutes earlier than planned, as Shepard explained, "We decided that since we'd gotten a little bit behind on the timeline on the first EVA, we'd better start the second EVA early so we wouldn't get hung up on getting back in. We didn't want to be rushed for lift-off."

The two astronauts managed to get their space suits ready for depressurising the spacecraft in only 17 minutes, though 20 minutes was

scheduled. At 131:12 GET (1815:02 AEST) they were ready to go…..

Mitchell, *"Okay, time zero. Open the dump valve."*

Shepard, *"Coming open…."*

Mitchell, *"Okay, watch the hatch cover. Kick it closed with your knee… …I mean the handle cover."*

Shepard, *"Okay."*

Mitchell, *"Okay, you're going to have to lean towards me."*

Shepard, *"All right."*

Mitchell, *"You're hung up on the purse. There you go."*

Shepard, *"Coming over your way."*

Mitchell, *"Okay, now hold it while I get your hatch… …get your antenna. Okay. You're go… …go right on out… …back straight on out. Now you're in good shape."*

Shepard began to wriggle out of the hatch.

Shepard, *"Okay, Houston, Al is on the porch."*

Haise, *"Roger, Al. And we got a good picture here."*

Haise, *"And we just saw you hop off."*

Shepard, *"Okay."*

Shepard went to collect the MET and put it in roughly the same position it was at the end of the first EVA.

Haise, *"Roger, Ed, you're cleared to come out."*

Mitchell, *" Okay."*

Mitchell, *"And Houston, Ed's on the porch. Starting down the ladder."*

Mitchell was anxious to get to work, hating to see the time ticking away. He climbed down the ladder and as he jumped off the bottom rung announced, *"Well, it's nice to be out in the sunny day again."*

Shepard, *"Yeah, it's a beautiful day here in Fra Mauro Base."*

Haise, *"Sun ought to be a little higher today."*

By now, at the beginning of the EVA, the Sun was at an elevation of 22° above the horizon, having risen 9° from the 13° at the beginning of the first EVA.

Mitchell, *"Beautiful day for a game of golf."*

Mitchell was aware of Shepard's secret plot to swing a golf club on the lunar surface, and this was a reference to the upcoming event. They began to transfer equipment from the Equipment Transfer Bag (ETB) and the Modularised Equipment Stowage Assembly (MESA) to the MET.

Haise, *"And, Al and Ed, we've got about 10 minutes left now to complete the MET load."*

Mitchell, *"Okay, Freddo. It'll be completed easily in that time."*

Haise, *"Very good, we're going to need all the time we can get."*

Shepard, *"Okay. Let's run over the MET stowage. We have the BSLSS (Buddy Secondary Life Support System). Extension handles; and two pairs of tongs. Okay, we have two core-tube-cap assemblies. We have a (100-foot belaying) tether and a gnomon. We have a hammer, we have a small scoop, six core tubes. 35-bag dispenser, trenching tool, a 16-millimeter camera. Okay, a 16-millimeter camera and two and a half magazines; two SESCs (Special Environmental Sample Containers) and an MSSC (Magnetic Shield Sample Container), two 70-millimeter cameras; and one extra magazine, black and white, and we have a partial magazine of colour. Close-up camera is turned on. And we need some more weigh bags."*

Before departing, they wheeled the MET around to pick up the Lunar Portable Magnetometer.

Mitchell, *"I'll start out if you'll turn the TV camera around."*

Shepard, *"Yeah. I just wanted to get a good direction. Our line of sight to Station A is directly toward the centre of Cone Crater."*

Mitchell, *"Yeah, that's right over that way."*

Shepard, looking at the map squares and counting them, announced, *"And it's two…six. About 300 metres, a thousand feet."*

Mitchell, *"Okay. We'll start off that direction and take a look around."*

The television was fixed to a tripod and remained there during the EVA walk. The last action we saw on the screen was a diminishing Shepard running out to join Mitchell with the MET.

Shepard set off for Cone Crater at 131:46 GET (0249 spacecraft time, 1849:02 AEST).

Shepard, to Mitchell, *"Okay. Head on out, man."*

Mitchell, *"Yeah, let's go…I don't know exactly where we are."*

Shepard, *"Well, keep the map in your hand."*

As he studied the map, Mitchell mused, *"If I can locate a familiar crater…"*

Shepard grabbed the MET, leaving Mitchell the job of navigating, trying to figure out where they were, and where they were to go. Unlike the J missions that followed, either astronaut would pull the MET. In the J missions, only the Commander ever drove the Rover. Mitchell, "Al concentrated on the doing; I concentrated on getting us there, keeping us on procedure and on the timeline as much as possible."

Shepard, initially confident, announced,

"Okay, Houston. We're headed just about toward the centre of Cone Crater."

Cone Crater was 1,427 metres north east of the Lunar Module.

The two astronauts walked east into the rising Sun, heading towards Station A, Shepard dragging the MET behind him. Initially it was fairly easy going, loping along the undulating lurain, but as they began to ascend a slope scattered boulders and rocks made progress more difficult.

Looking around they immediately found identifying craters and the planned stations was almost impossible – they were surrounded by a sea of craters all looking similar, whitewashed by the brilliant Sun shining out of the jet-black sky. They found it hard to pick out and identify a crater from any distance.

Shepard, *"Houston, we're again proceeding directly towards the centre of the (Cone) crater Point A. We're passing north of North Triplet. The area over which we are passing again, of course, is pockmarked by craters. However, the land is generally flat right here. I was going to say 'mesa' but I really don't think it's a mesa. It's more of a ridge, which extends to the south east, almost normal to our path of travel. I think Point A is probably down in that valley."*

STATION A
Arrived: 131:53:34 GET 1856:36 AEST
Departed: 132:26:12 GET 1929:14 AEST
Duration: 32 minutes 38 seconds.

They reached actual Station A in 8 minutes, travelling at a fairly slow 1.5 kilometres per hour. The planned distance for Station A from the LM was 360 metres but ended up only about 200 metres. Cresting a ridge, they found a 5 metre deep trough crossing their path; the first of a series that ran parallel to Cone Ridge.

Mitchell, *"Okay. That large crater to your right, Al, just doesn't show up. Ah-ha! It does too. That's the one. Just beyond that is A."*

Shepard, *"That's what I thought – about 20 feet* (6 metres) *ahead of me. Right?"*

Mitchell, *"Yup…yup."*

Shepard described the surface,

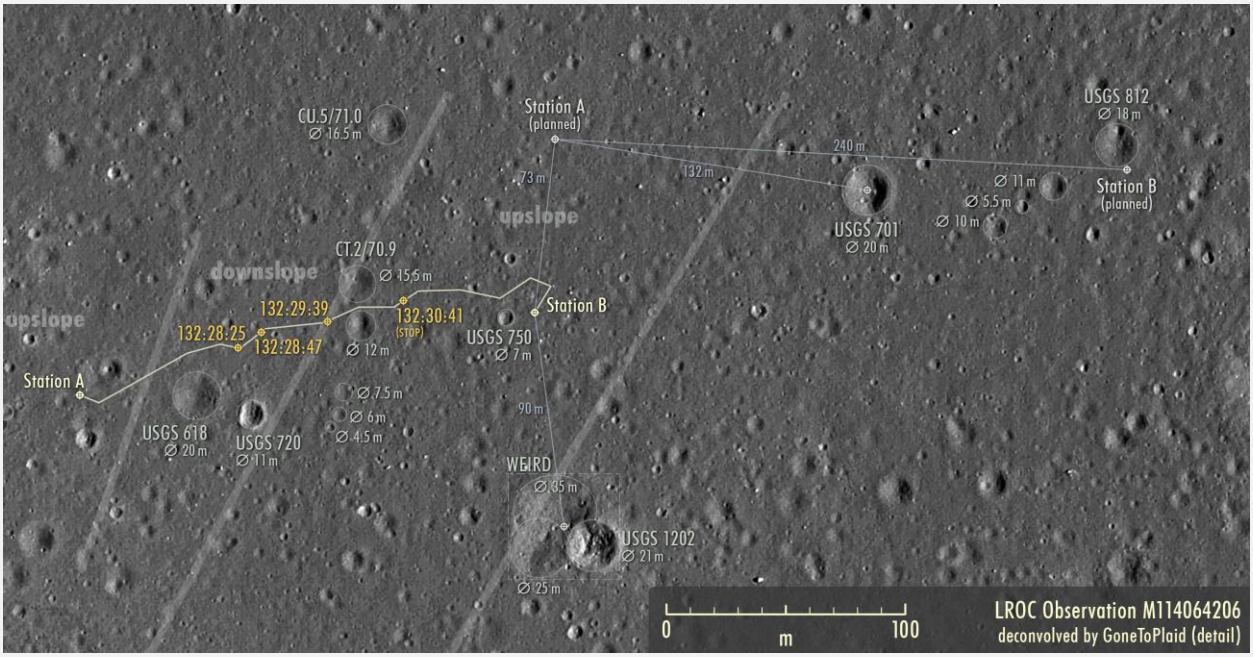
"Okay, babe. Fred, the surface, here - we spoke about that - is textured. It is, of course, a very fine-grain, dusty regolith, much the same as we have in the vicinity of the LM. But there seems to be small pebbles - more small pebbles - here on the surface than we had back around the LM area. And the population of larger rocks, perhaps small boulder size, is more prevalent here. Okay, this is probably pretty good."

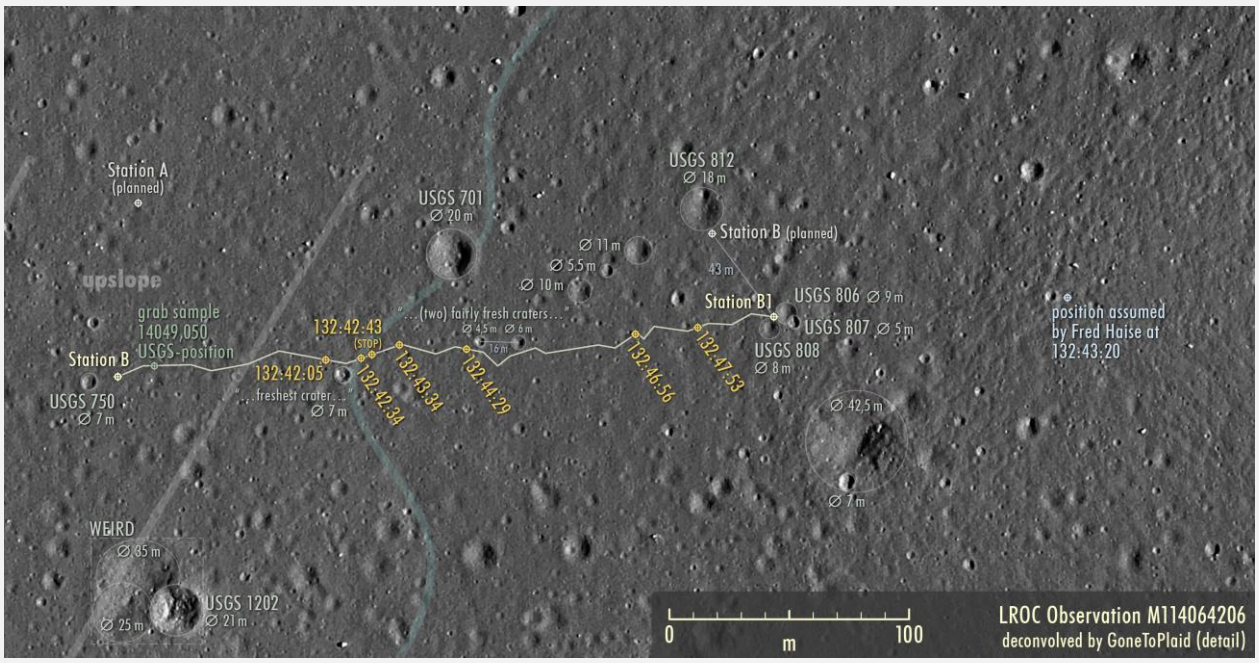
Mitchell, *"Yeah, this a good place for A and I might also comment, Freddo, that we have an appearance here, quite often like raindrops; like a very few raindrops have splattered the surface. It gives you that appearance. Obviously, they haven't; but it's that sort of texture in places."*

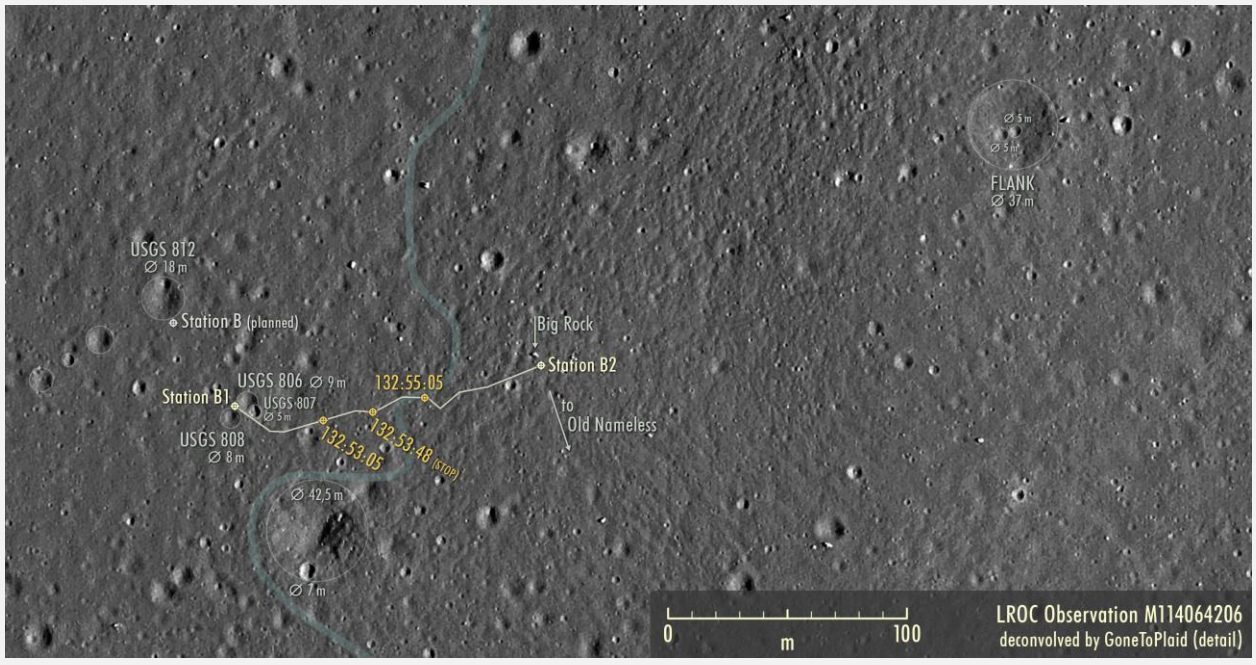
Mitchell, *"At Point A we do a double core and LPM. I'll start with the LPM and a pan."*

Shepard, *"The point where we're sampling is just about in the center of three craters of almost equal size. I would say, perhaps, 20 metres in diameter. The ones to the north and south are more fresh, more sharp; the one to the west is more subdued."*

In addition to picking up samples and drilling cores, they set out the magnetometer and took magnetic readings. Mitchell had the job of


CU.5/71.0
Ø 16.5 m
Station A
(planned)
USGS 812
Ø 18 m
240 m
73 m
132 m
Ø 11 m
Ø 5.5 m
Ø 10 m
Station B
(planned)
USGS 701
Ø 20 m
upslope
CT.2/70.9
Ø 15.5 m
downslope
upslope
132:29.39
132:30:41
(STOP)
Station B
132:28:25
132:28:47
Ø 12 m
USGS 750
Ø 7 m
Station A
Ø 7.5 m
Ø 6 m
Ø 4.5 m
90 m
USGS 618
Ø 20 m
USGS 720
Ø 11 m
WEIRD
Ø 35 m
USGS 1202
Ø 21 m
Ø 25 m
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)


Station A
(planned)
USGS 812
Ø 18 m
USGS 701
Ø 20 m
Station B (planned)
Ø 11 m
Ø 5.5 m
Ø 10 m
43 m
upslope
Station B1
USGS 806 Ø 9 m
USGS 807 Ø 5 m
USGS 808
Ø 8 m
grab sample
14049,050
USGS-position
132:42:43
(STOP)
(two) fairly fresh craters...
Ø 4.5 m
Ø 6 m
16 m
Station B
132:42:05
...freshest crater...
Ø 7 m
132:42:34
132:43:34
132:44:29
132:46:56
132:47:53
position assumed
by Fred Haise at
132:43:20
USGS 750
Ø 7 m
Ø 42.5 m
Ø 7 m
WEIRD
Ø 35 m
USGS 1202
Ø 21 m
Ø 25 m
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)


Ø 5 m
Ø 5 m
FLANK
Ø 37 m
USGS 812
Ø 18 m
Station B (planned)
Big Rock
Station B2
USGS 806 Ø 9 m
Station B1
USGS 807
Ø 5 m
132:55:05
to
Old Nameless
USGS 808
Ø 8 m
132:53:05
132:53:48 (STOP)
Ø 42.5 m
Ø 7 m
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)

measuring the magnetic field using the LPM (Lunar Portable Magnetometer). He set it up on a tripod 13 metres to the north west of the MET, with a connecting cable to the control panel mounted on the MET. He had to take three measurements – the magnetometer took four minutes to set up, ten minutes to conduct a reading, and five minutes to dismantle and stow.

Reeling the ribbon cable up after the readings, Mitchell had a bad time fighting the cable's resistance to going back onto the reel, "The tape was rolling up in bends, and looked like a giant bow, very fluffy, with lots of bends all balled up around the reel. It took two to three times as much time as expected to get the cable reeled in the first time. I was seriously considering just trailing that ribbon behind us and taking our chances."

Shepard tried a double core, the first section going down reasonably easily, but he had to tap the second section, finally belting it really hard to get it down, finishing with about 1¾ of the length of the two sections in the regolith – the deepest penetration of the mission.

Shepard explained to Houston, *"The first core went in fairly easily. Had some increasing difficulty with the last core."*

When they finished with Station A, Shepard announced, *"Okay, I'm going to head on up the hill to B."*

As Mitchell was still working he said, *"Yeah, I'll catch up. Go ahead."*

As he walked behind Shepard on the way to station B, Mitchell commented, *"And, Houston, I'm trailing along behind Al now. I'm starting to catch up with him. And - it hasn't been described for you before - the MET tracks make a very smooth pattern in the surface, reminiscent of driving a tractor through a ploughed field. It smooths it out and makes a very smooth, distinct pattern, and probably, oh, a quarter of an inch deep, no more."*

Haise, *"Roger, Ed."*

Mitchell, *"It leaves gaps every now and then as it bounces."*

At 132:30:41 GET (1933:43 AEST) the two astronauts stopped to look at the map together to see if they could work out where they were.

Mitchell, *"Can you see the boulders off to the side there on the map?"*

Shepard, *"Well they don't show very well."*

Mitchell, *"Ah! You should be able to spot that little chain of craters just to the south of us on the map – if that's where we think we are."*

Shepard, *"Boy. That little chain of craters right there…"*

Mitchell, *"Kind of small…"*

Shepard, *"That will make us right here – huh?"*

STATION B

Arrived:	132:34:22 GET	1937:24 AEST
Departed:	132:39:15 GET	1942:17 AEST
Duration:	4 minutes 53 seconds	

After another 8 minute 10 second walk from Station A, they arrived at Station B, as near as they could judge. Station B was planned to be on the southern rim of a 20 metre diameter crater in a boulder field north west of Weird Crater, 230 metres east of the planned Station A, but as they were overestimating their progress they actually stopped for B about half way between the original planned Station A and Weird Crater. They thought they were almost half way to Cone Crater but were actually only about one third.

Mitchell, *"Think you found B? Yeah, it's this big crater over here, isn't it?"*

Shepard, *"It's way up the hill."*

Mitchell, *"Oh, that's right. This is the crater we go by on the way to B. Gotcha…."*

Mitchell, "We were really having trouble with that terrain, figuring out where the heck we were. We knew we were within a hundred metres, but not the micro navigation that the geologists wanted us to do. It was frustrating. We wasted a lot of time.

I believe that our primary problem in navigation was the surprise brought about by the roughness and the undulation of the terrain. We couldn't see one set of landmarks, the prominent landmarks - our next set of landmarks - from our present positions. Large craters which we expected to be able to see standing out on a reasonably flat plane were not on a flat plane. They were hidden behind other craters, ridges, and old, worn-down mounds. You'd say 'Well, this next big crater

ought to be a couple of hundred metres away, or 100 or 150.' It just wasn't anywhere in sight. So, you'd press on to another ridge, and you still didn't see it. All you would see would be another ridge. Finally, you'd get over to it, and there it was. You could not get enough perspective from any one spot to pin down precisely where you were. The undulations over the neighbourhood were probably 3 to 5 metres high. Some of the big craters up to the north and to the south looked 15 to 30 metres below our level. It looked like we were in a large group of sand dunes. The wavelength of the sand dunes would be much greater here (on Earth), but that was the kind of the feeling I had. I never knew what to expect when I went over the ridge on the sand dune, or what I was going to see on the other side of it."

Shepard, at the technical debriefing said, *"I think we did come pretty close to Point A, and you and I are still arguing about where the hell Point B was."*

Mitchell responded, *"Yes, we were. And I still don't know. It is probably still there."*

Mitchell, *"That's Weird (Crater), that big one right over there, Al."*

Shepard, *"Yeah. That's what I say. I think B is that deep crater directly ahead of us, Ed."*

Shepard, *"Where do you think B is?"*

Mitchell, *"I think B's the one we just passed; back there where we were talking."*

Shepard, *"All right."*

Mitchell, *"And here's the little…ahha…it is! Here's the little double crater right beside it. Look here. See, there's that crater, see, there's the little double crater – it's right there in front of you."*

Shepard, *"Okay, let's go sample B."*

Haise, *"And Al and Ed – this is a grab sample at B, and we need the panorama. And while somebody's doing that, we can get a site description."*

Mitchell, *"Okay. And while Al takes the pan, I'll go ahead and give you a site description. The area here is in an area of considerably more boulders, a larger boulder field, more numerous boulders than we've seen in the past. We've just come into it as we approached B from A. Now there were boulders to the north of us; we previously talked of boulders to the north, and doggone it, they may turn out to be a ray pattern. It looks suspiciously like one. However, where we are now, we're about on the edge of a general boulder population lining the flank of Cone Crater. Now they're not too numerous at this point. They're somewhat patchy. There's a lot of them buried, half buried, a few of the smaller ones sitting on the surface. These boulders are filleted, and we'll have to sample that filleting later. The surface texture – the fine – appears very much the same as what we've been walking on all along. And about the only difference we could see is probably a larger number of smaller craters. I say 'probably'; they're so numerous that unless you really make a population count, you can't tell. I'm guessing a larger number of craters - probably secondaries from Cone perhaps - and certainly a larger number of boulders lying around. Now, most of these boulders are rounded. There are a few angular ones. There are a few rocks with angularities; but, by and large, you can see edges that have been chipped off indicating the beginning of a smoothing process. And some of them are far beyond the beginning of smoothing; they're worn down pretty well. And most of the rough edges are where they have fractured and perhaps turned over. Most of them appear to be along fractures of where other rocks are sitting near them that might have once been a part of that boulder."*

After picking up a sample they decided they had finished with Station B.

Mitchell said, *"Okay, I've got the MET."*

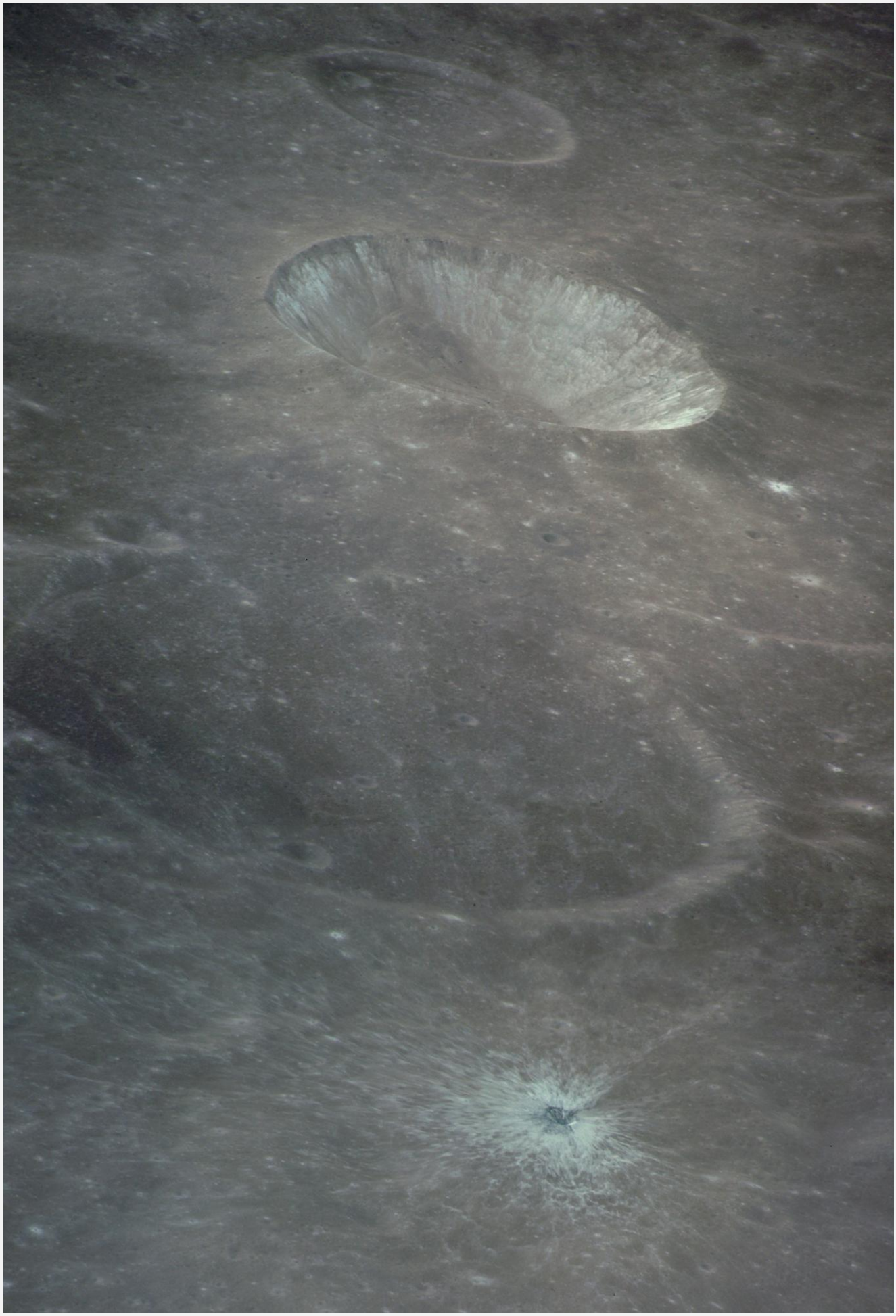
Shepard, *"Okay. You want to go first and I'll follow."*

Mitchell, *"Okay - to the top of Cone Crater."*

Shepard, *"We'll have to go almost to the east here, and then on up by Flank."*

Flank Crater was about 675 metres ENE of Station B and may not have been visible to the astronauts due to an intervening ridge.

Mitchell, *"Houston, as we go across here, this ground is very undulating. I would suspect that there is not 10 yards (9.1 metres) at the most between what were once old craters. They are most of them worn down, but the surface is*



Craters Hume Z (top), Hume (centre), and one unnamed with bright rays (below). Image: NASA (taken by Stuart Roosa)

continuously undulating. There's hardly a level spot anywhere. As we come up towards Cone we're getting to see lots more buried rocks - bigger rocks."

Mitchell was pulling the MET at this point, and he felt if it shook it too much, he was going to shake everything out.

Mitchell, *"Freddo, I'm trying to find something distinctive to say about some of these craters we're going by, and it's very hard to do so. They're all smooth-walled except the very freshest ones; and we're coming by a very fresh one now, which is rubbly on the inside... Hey! It may even...that has some pretty good chunks of rubble on the inside. This is about the freshest crater this size we've seen, Al."*

Shepard, *"That's correct. This is a very fresh crater. It's about opposite to the crater at Stop E. It's a crater about 20 metres in diameter and about 2 metres deep and I'll get a quick rock from the side."*

At 132:42:42 GET (1945:44 AEST), just before they began climbing a steepening slope, Shepard spotted an interesting rock and bent down to collect it but had difficulty getting back up. The spacesuits in Apollo 14 weren't as supple in the waist as the J missions. Mitchell turned back to help.

Mitchell, *"Al just dropped down on a knee to pick up a rock, and he went in 3 or 4 inches. Need some help, Al?"*

Shepard, *"Yeah, I think so. I can't get any…."*

Mitchell, *"Okay, come on, give me your hand."*

Shepard, *"Wait a minute – I got it now."*

Mitchell, *"Okay – come on up."*

Shepard grunted, *"Thank you."*

Mitchell, *"You're on your feet."*

Mitchell, *"And we're starting uphill. Climb's fairly gentle at this point, but it's definitely uphill."*

A minute later the MET almost turned over. They found it was pretty unstable in one-sixth g. They were also trying to move faster than they trained on Earth when they found the MET trailed nicely behind them in 1 g, but due to its light weight on the Moon it tended to bounce uncontrollably all over the place.

Shepard, *"Okay, baby. Okay – I got it."*

Mitchell, *"Almost turned, didn't it?"*

By now they were beginning to breathe quite heavily as they were climbing a height of 80 metres over a distance of 700 metres, or a 10% slope, with a soft surface and trying to make up for lost time. They pulled up for a spell at 132:48:09 GET (1951:11 AEST), Mitchell saying,

"Why don't we pull up beside this big crater?"

Shepard, *"Okay."*

Mitchell, *"Take a break, get the map, and see if we can find out exactly where we are. Press on from there."*

Haise, *"And Al and Ed, while you're stopped there, we could use a photo pan*(orama)*."*

Mitchell, *"Yeah, going to suggest that…if you'll take the pan, Al, I'll grab the map and put it over here and see if we can find…."*

Shepard, *"Let me pull it up on a little more level ground."*

Mitchell, *"Okay, give you a push."*

Shepard, *"Okay – there we are…level."*

Mitchell, *"That looks good…that old LM kooks like it's got a flat over there, the way it's leaning."*

STATION B1

Arrived:	132:48:38 GET	1951:40 AEST
Departed:	132:51:42 GET	1954:44 AEST
Duration:	3 minutes 4 seconds	

It took them 9 minutes to cover the 300 metres from Station B. By now they were about 700 metres from the LM. Over this segment Mitchell was 13 metres per minute faster than Shepard earlier.

Beginning at 132:50:52 GET (2053:54 AEST) there was a handover from Goldstone to Honeysuckle Creek tracking stations which introduced some communications problems on the uplink for just over four minutes.

Shepard, *"Okay, Houston – we're going by Flank on the way up. We're passing to the north side of it."*

Mitchell, *"Let me pull awhile, Al – you're having all the fun!"*

Five minutes later, puffing with exertion, Mitchell described the lurain, *"And the soil here is a bit firmer, I think, than we've been on before. Except around the mounds in between craters where it's been thrown out. But, by and large, it seems to have a little firmer footing. We're not sinking in as deep."*

Haise, *"That should help you with the climb there."*

Mitchell, *"Yeah. It helps a little bit. Al's picked up the… …Al's got the back of the MET now, and we're carrying it up. I think it seems easier."*

The astronauts agreed sometimes it was easier to carry the MET, they could move at a fairly rapid clip, though it was not as free a pace.

Shepard, *"Left, right, left, right."*

Haise, *"There are two guys here* (astronauts Cernan and Engle in Mission Control) *that kind of figured you'd carry it up."*

The back-up crew had made a bet the MET wouldn't make it up to Cone Crater, but it was really designed to bring back a load full of rocks.

Mitchell, *"Well, it'll roll along here, except we just move faster carrying it."*

Shepard, *"Okay, you want to rest here by this rock?"*

Mitchell, *"Okay."*

STATION B2
Arrived: 132:56:35 GET 1959:37 AEST
Departed: 132:58:31 GET 2001:33 AEST
Duration: 1 minute 56 seconds

It took them 4 minutes 53 seconds to cover the 140 metres from Station B1 to B2, but they probably travelled up to 170 metres with a detour to inspect a crater.

Shepard, *"This is the first big boulder we've seen, Houston. I think it's worthwhile taking a picture of it with the close-up. Go ahead and keep going."*

Mitchell, *"I'll pull on up. We probably ought to take a pan to locate everything here, while you're taking a close-up."*

Haise, *"Okay, understand, Al – you're shooting a close-up shot of a big boulder. What's the size of this one, Al?"*

Shepard, *"The shot's been taken on the close-up counter number 317. Sun angle was 8 o'clock. This particular one is only about 12-feet (3.66 metres) long by about 4-feet (1.2 metres) wide. It's about one-third buried. It's old, very weathered. There are some evidences of some crystal shining through some of the fractures."*

By the time Mitchell finished taking his panorama, Shepard was already on the way to the next station, dragging the MET behind him.

Shepard, *"We're starting up the last flank of the crater* (he means the Cone Crater Ridge) *now, Houston. The slope is probably about, oh, 18 percent. The surface texture is still pretty much the same as far as the raindrop pattern is concerned. But we seem to find an increasing population of smaller rocks."*

Mitchell, *"There's small rocks and smaller, fresher craters, as well. Well, wait a minute; maybe I'm being deceived. With this slope, the Sun angle is entirely different than it is on the flat land. The craters look sharper in these shadows."*

At this stage they are 150 metres south from Cone Crater and further west than they thought they were.

Haise, *"Okay Al and Ed. They'd like you to take another stop here."*

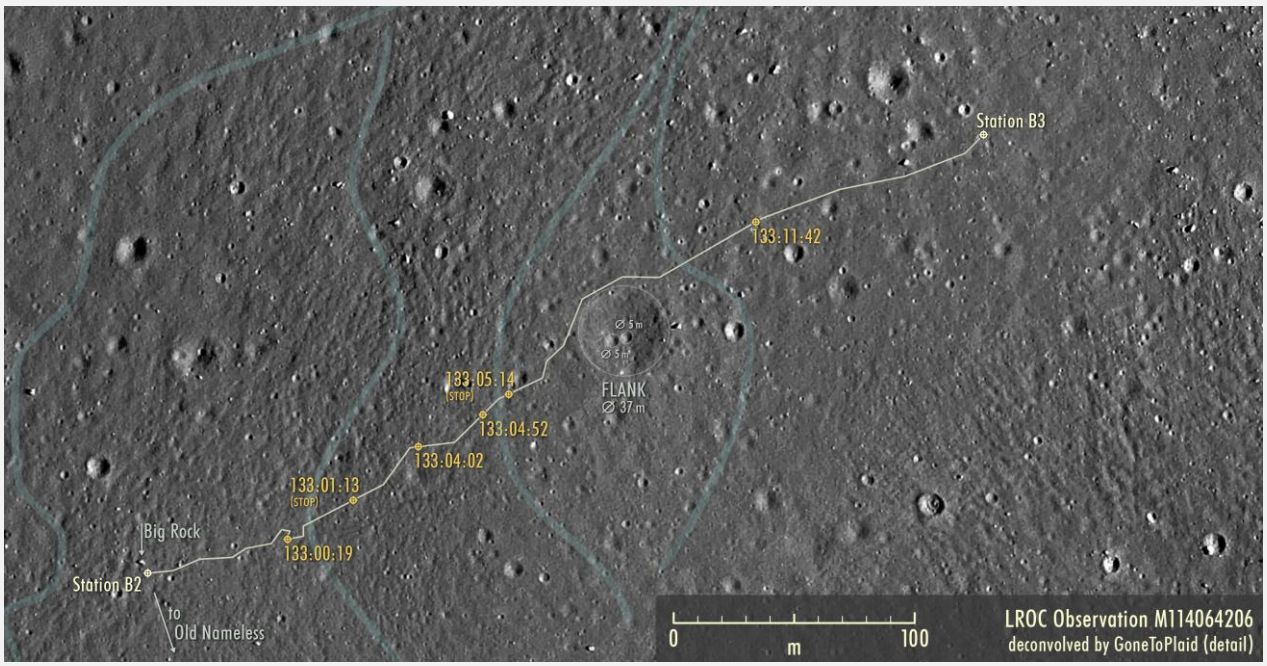
Mitchell, *"Okay. We're really going up a steep slope here."*

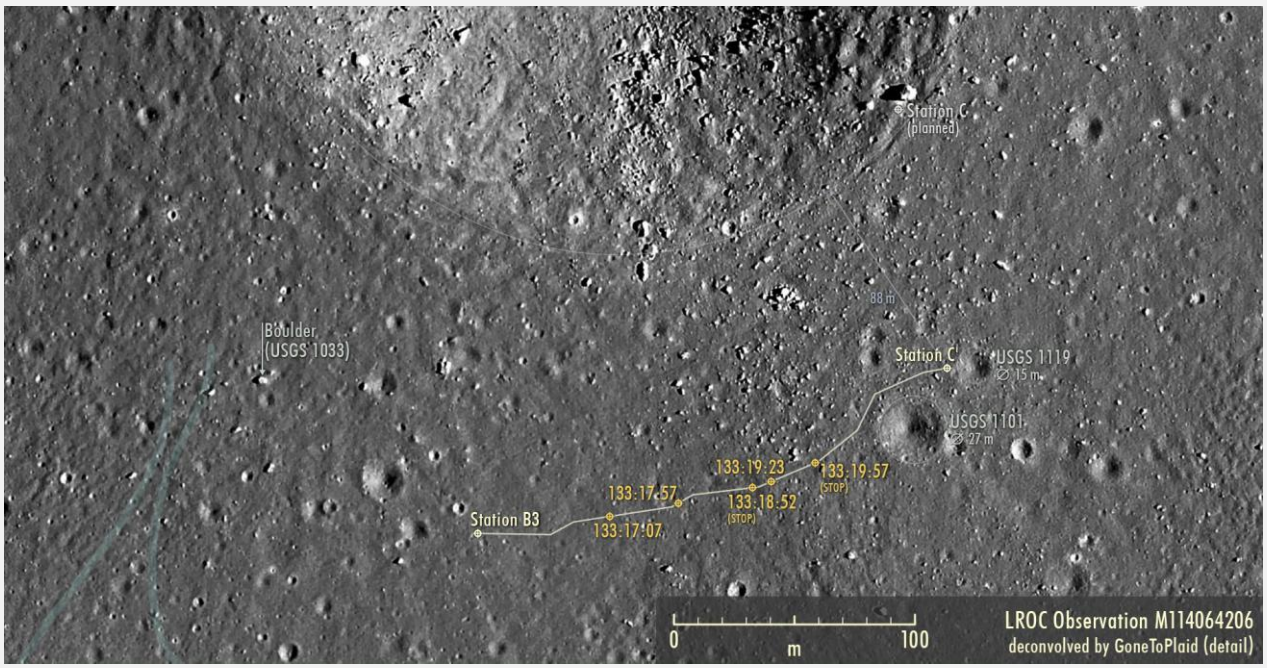
Haise, *"Yeah. We kind of figured that from listening to you." They had covered another 85 metres since the last rest stop."*

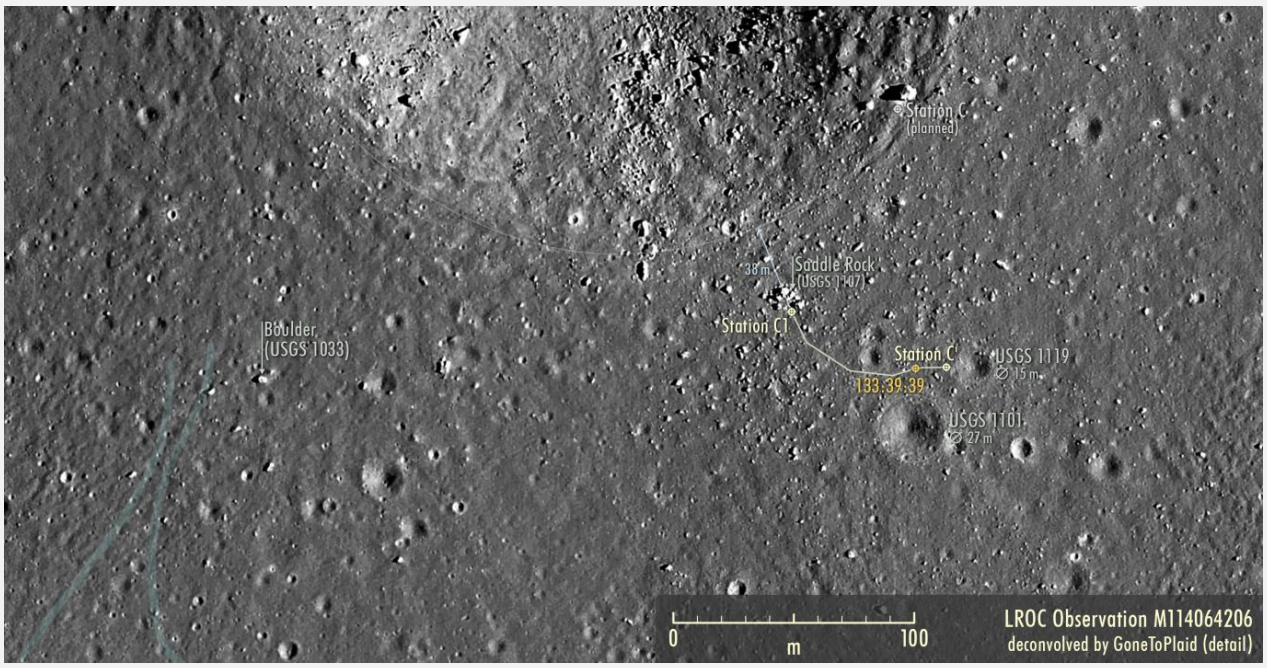
Haise, *"Al and Ed, in view of your assay of where your location is, and how long it's going to take to get to Cone, the word from the backroom is they'd like you to consider where you are is the edge of Cone Crater."*

This inferred they were at the end of their outward journey. A dismayed Mitchell responded with, *"I think you're finks!"*

Haise, *"That decision, I guess, was based on Al's estimate of another, at least, 30 minutes and, of course, we cannot see that from here. It's kind of your judgment on that."*


Station B3
133:11:42
∅ 5 m
∅ 5 m
133:05:14
(STOP)
FLANK
∅ 37 m
133:04:52
133:04:02
133:01:13
(STOP)
Big Rock
133:00:19
Station B2
to
Old Nameless
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)


Station C
(planned)
88 m
Boulder
(USGS 1033)
Station C
USGS 1119
∅ 15 m
USGS 1101
∅ 27 m
133:19:23
133:19:57
(STOP)
133:17:57
133:18:52
(STOP)
Station B3
133:17:07
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)


Station C
(planned)
38 m
Saddle Rock
(USGS 1107)
Station C1
Boulder
(USGS 1033)
Station C
USGS 1119
∅ 15 m
133:39:39
USGS 1101
∅ 27 m
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)

Mitchell, *"Well, we're three quarters there…why don't we lose our bet, Al, and leave the MET and get on up there? We could make it a lot faster without it."*

Shepard *"Well, I think what we're looking at right here in this boulder field, Ed, is the stuff that's ejected from Cone."*

Mitchell, *"But not the lower most part, which is what we're interested in."*

Shepard, *"Okay, we'll press on a little farther, Houston – and keep your eye on the time."*

Haise, *"Okay. And, as of now we have a thirty minute extension."*

Haise, *"And Al and Ed – Deke says he will cover the bet if you'll drop the MET."*

Mitchell, *"Well, it's not that hard with the MET. We need those tools."*

Shepard, *"No, the MET's not slowing us down, Houston. It's just a question of time. We'll get there."*

STATION B3
Arrived: 133:14:25 GET 2017:27 AEST
Departed: 133:15:49 GET 2018:51 AEST
Duration: 1 minute 24 seconds

They were now 1.28 kilometres from the LM and 440 metres from Station B2. It took them 15 minutes 54 seconds with two rest stops enroute.

The two astronauts stopped for a rest at 133:18:15 GET, (2021:17 AEST), Shepard saying to Houston *"We're right in the middle of the boulder field on the west rim. We haven't quite reached the rim yet. Okay – want to rest here a minute?"*

Mitchell, breathing heavily, agreed, *"Yeah. Let's take a look at the map. I think we're closer than that."*

Shepard, *"We're resting now."*

Mitchell, *"Look, let me show you something. Here's that crater. We're down here. We got to go there."*

Shepard, *"What crater?"*

Mitchell, *"That crater right there is that one right there."*

As they were approaching Station C, Shepard observed *"We're at about maximum elevation now, Houston. It's levelled out a little bit. And it looks like we'll be approaching the rim here shortly."*

Shepard thought they were further north than they really were. But they had reached the farthest point from the LM, Station C prime, about 90 metres south east of the rim of Cone Crater.

STATION C (Prime)
Arrived: 133:21:57 GET 2024:59 AEST
Departed: 133:39:39 GET 2042:41 AEST
Duration: 17 minutes 42 seconds

The two explorers had travelled the 225 metres from Station B3 in 6 minutes 8 seconds. It had taken them 1 hour 35 minutes 57 seconds to reach Station C from the LM. At a distance of 1,463 metres this was the farthest point of their excursion from the LM, about 90 metres south east of Cone Crater's rim.

Haise, *"Al and Ed, do you have the rim in sight yet?"*

Shepard, *"That's negative. We haven't found that yet."*

Haise, "*And, Ed and Al, we've already eaten into our 30 minute extension and we're past that now. I think we'd better proceed with the sampling and continue with the EVA."*

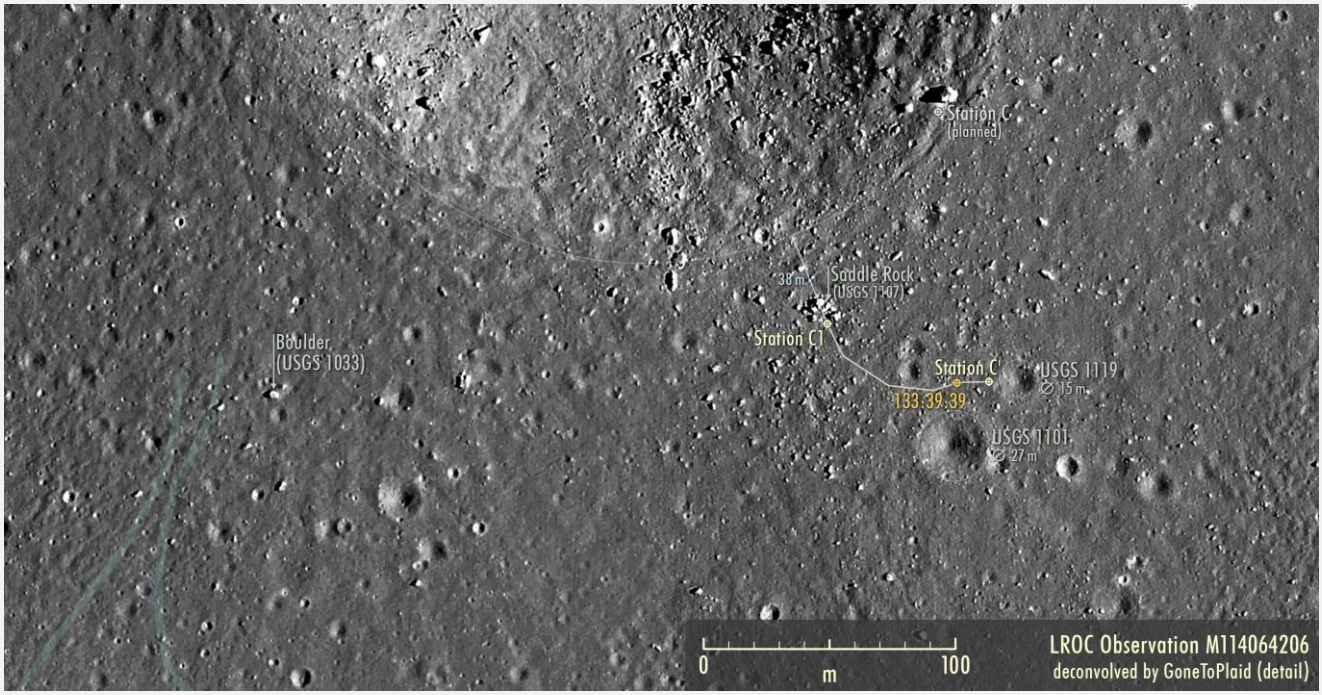
Mitchell, *"Okay, Freddo."*

Shepard, *"Okay. We'll start with a pan from here. I'll take that."*

Mitchell, *"All right. I'll start sampling."*

Even with a half hour's extension they still could not be sure of their position in relation to Cone Crater. It was important to get rocks from the crater's rim as they were expected to be from the deepest part of the crater when it was created. They arrived at many a crest thinking they had found their elusive Crater, but they never did find it, and eventually time ran out.

They thought that as they came up over the ridge they were going up they had reached the rim of Cone Crater. When they still couldn't see the crater, they realised they didn't know where they were, though they suspected they were close – and now they had to turn back. Mitchell said it was one of the most frustrating times of his life. He didn't feel they were lost as they could see the LM down in the valley. "It's not reaching and



The traverse from Station C (Prime) to Station C1 which was only 17 metres from the rim of Cone Crater.
Image: Lunar Reconnaissance Orbiter Camera/NASA

looking down into that bloody crater. Another 20 feet (6 metres) and it would have been obvious."

Shepard described the scene to Houston *"Okay, Houston. We are in the middle of a fairly large boulder field. It covers perhaps as much as a square mile. And, as the pan will show, I don't believe we have quite reached the rim yet. However, we can't be too far away, and I think certainly we'll find that these samples come from pretty far down in Cone Crater."*

Addressing Mitchell, *"Okay – you about to start taking documented samples?"* and back to Houston, *"All righty. Let me say, Houston, that most of these boulders are the same brownish grey that we've found. But we see one (Saddle Rock) that is definitely almost white in colour. A very definite difference in colour, which we'll document. We noticed that beneath this dark brown regolith, there is a very light-brown layer. And I think we'll get a core tube right here to show that. As a matter of fact, I think I'll do that right now."*

Shepard said he felt sure they had some new and strange rocks. They looked decidedly different from some of the rocks they had seen on the way up the slope to the crater. *"Let me suggest that we take one of these football-sized rocks from here, too, Freddo."*

Mitchell, *"Yeah."*

Haise, *"Roger, Al. Very good."*

Mitchell, *"This area we're in now is a pretty darn rugged, boulder-strewn area."*

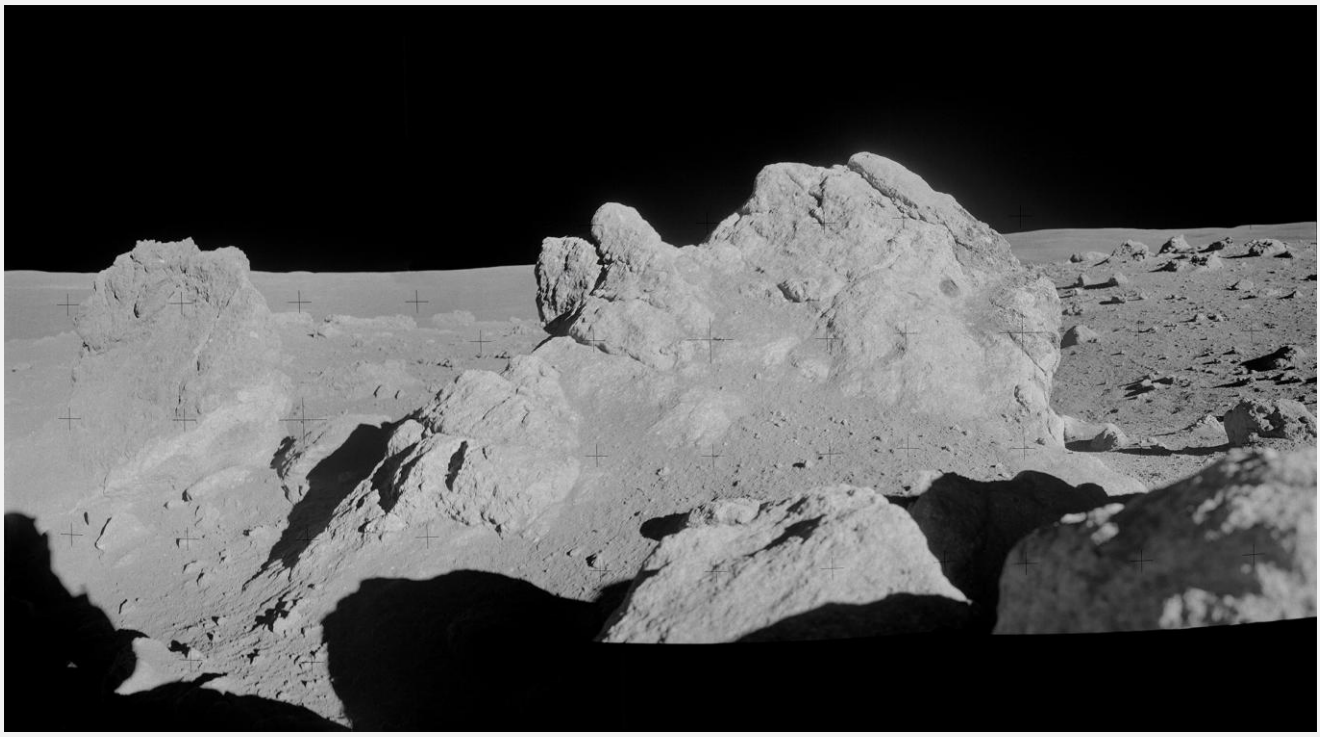
Mitchell announced, *"LPM deploy."* He had dragged out the magnetometer to take some readings, while Shepard was busy with a core sample that included a white layer beneath the usual brown. Unfortunately, it drained out of the tube and was lost. Shepard bagged some soil samples of the layers instead, plus some more rocks.

Shepard explained to Houston,

"The core tube sample turned out to be only about three-quarters of a tube. The area is apparently very rocky, but I did get down into the second layer - the underlying layer of the regolith - which was white as opposed to being dark brown…on second thoughts forget that core tube. It's too granular and most of the material came out of the tube. I'll just scoop a couple of samples and bag it, of the two top layers."

Mitchell, *"Hey, Freddo, I'm having a hard time levelling the LPM…okay, there it is."*

He read out the magnetometer readings and Houston told him to throw the instrument away - its job was finished.



The "boulder field" at Station C1. Note part of the astronaut's shadow visible lower left.
Image: NASA (three photos combined to create this panorama)

Haise, *"Did you mention either seeing a white boulder, or a brownish-grey boulder, earlier?"*

Mitchell, *"I mentioned there's a boulder definitely whitish in colour, Fred. We'll be over there in a minute. Not in our immediate vicinity, but it definitely looks worthwhile sampling."*

Haise, *"That's affirm. They concur here and would like a sample from the white boulder."*

Mitchell, *"Where is it you're headed for, Al?"*

Shepard, *"Well…."*

Mitchell, *"I'll get the bag."*

Shepard, "The first thing that we ought to do if we want to drag the MET with us – see that white boulder down there?"

Mitchell, *"Yeah. I saw it. Let's grab a…."*

Shepard, *"We can sample both types of boulders right down in that area, so let's go on down there."*

Mitchell, *"Right."*

The white boulder, now called Saddle Rock, was at the next station, C1. Station C1 was lower than C prime, which was on a ridge. Because Station C1, on the south side of Cone Crater, was about 40-metres higher than the north side, the two explorers still couldn't see the crater, let alone into its bottom.

Shepard asked, *"And can you give us a feel, Houston, about when you'd like us to leave the area?"*

Haise, *"Okay…estimated time of departure is in about 8 minutes…7½ minutes from now."*

Shepard, *"I guess we just run down this way, huh?"*

Mitchell, *"Yeah. One of these boulders, Freddo, is broken open. They're really brown boulders on the outside, and the inner face that's broken is white, and then another one that most of it is white. They are right in the same area."*

Haise, *"Ed, I assume you're going to sample some of those?"*

Mitchell, *"That's where we're headed right now. It's about 50 yards* (45.7 metres) *away."*

Shepard, *"Why don't you go on down and start, and let me bring the MET down?"*

Mitchell, *"All right. Yeah. It's further than it looked."*

Shepard, *"That's the order of the day."*

STATION C1
Arrived: 133:40:24 GET 2043:26 AEST
Departed: 133:46:13 GET 2049:15 AEST
Duration: 5 minutes 49 seconds

As they walked the 60 metres down to C1, they came within 17 metres of the rim of Cone Crater – the closest they came to their prime target.

Mitchell, *"Freddo, I'm right in the midst of a whole pile of very large boulders here. Let's see what I can do to grab a meaningful sample. They are all so darn big that there's hardly anything I can find that's small enough to put in a sample bag. Let's see if I can chip one."*

Haise, *"To get us back on the old timeline here, when you depart C here, we'd like to proceed directly to Station F, Weird Crater, and we'll pick up from that point. Enroute you can make grab samples as you see fit."*

Shepard, *"Okay."*

Mitchell, *"I've chipped off one of the white rocks. There don't seem to be any samples of the white rocks lying around that are small enough for me to sample and be sure they're what I'm looking for."*

Shepard, *"And Al is just going around picking up hand-sized samples from the immediate vicinity of where Ed is operating. There's a football-sized rock, Houston, coming out of this area, which will not be bagged. It appears to be the prevalent rock of the boulders of the area. Got it?"*

Mitchell, *"Got it."*

Haise, *"Roger, Al, we copy."*

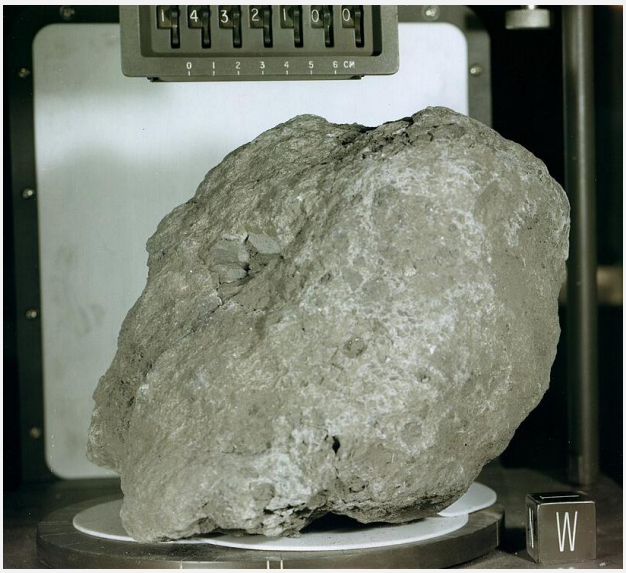
This 9 kilogram rock, to become known as Big Bertha, was too large to be picked up with the tongs, so Shepard had to bend down low enough to pick it up with his hand, helped by Mitchell. It was the largest rock collected in Apollo 14, and one of the larger samples in the whole Apollo program.

Haise, *"Okay, Al and Ed, We have about one more minute here at C1."*

Shepard, *"Okay, we're moving down the hill now," to Mitchell, "Can you see Weird (Crater) from here?"*

Mitchell, *"No."*

Shepard, *"Kind of hard to find."*



Weighing 8.998kg, Lunar Sample 14321, better known as "Big Bertha". Image: NASA

Mitchell, *"I can't even see Triplet from here."*

Shepard, *"Why don't you take the map, and I'll just head down to the general area of the LM, and you'll probably get enough elevation view from down there so we can see Weird?"*

Shepard, *"We're leaving C1 now, Houston."*

Haise, *"Roger, Al. And to rephrase the question earlier, on the way back down, you might integrate any distinction in the lithology on the way back with a better Sun angle, and you're free to take grab samples enroute to Weird."*

Going downhill and down Sun was much easier, though the MET slowed them up a bit – it tended to bounce around, and they had to navigate around obstacles. Mitchell found that his skipping gait was easy to do on the Moon as he could take longer steps.

As they neared the top of Flank Ridge Shepard suggested, *"Why don't we stop here to see if we're really going to Weird?"*

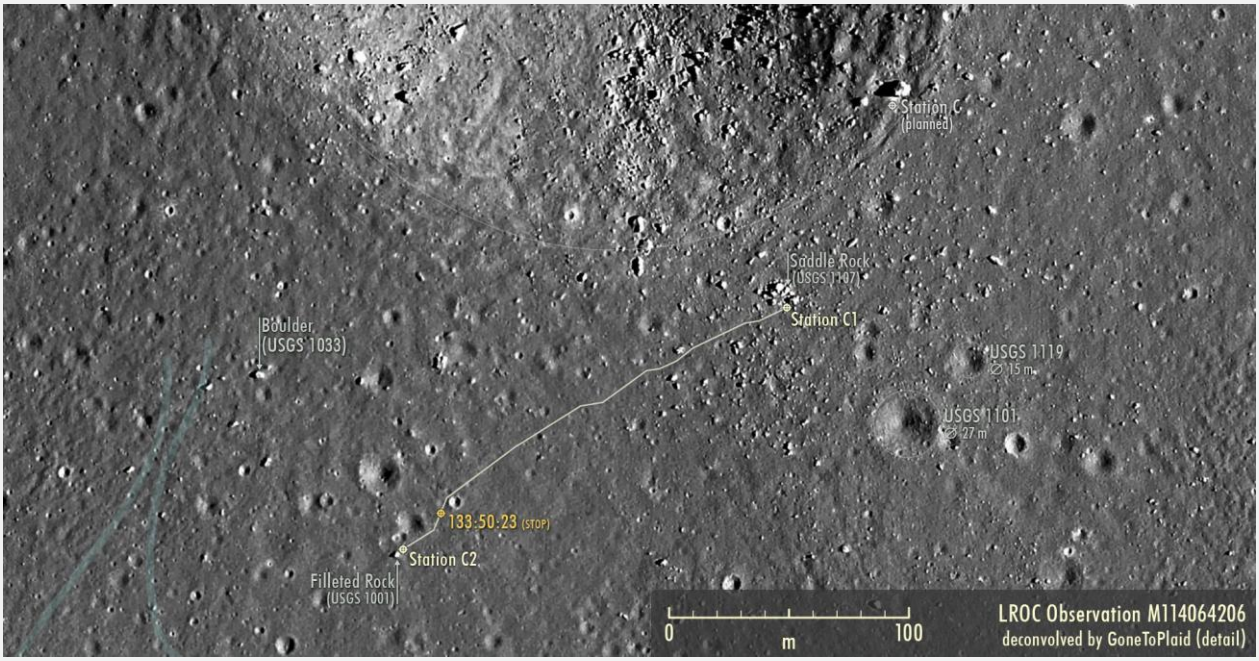
Mitchell, *"Yup…man, the LM doesn't seem like it's getting much closer."*

Shepard, *"Is that Weird right down there, do you think?"*

Mitchell, *"Huh? No, Weird is…let's see. Weird is almost due east of the LM."*

A few moments later Mitchell said, *"And there is Weird, Al. You can see the triple crater in it."*

Weird Crater actually represented three over-lapping craters. At the debriefing after the


Station C
(planned)
Saddle Rock
(USGS 1107)
Station C1
Boulder
(USGS 1033)
USGS 1119
∅ 15 m
USGS 1101
∅ 27 m
133:50:23 (STOP)
Station C2
Filleted Rock
(USGS 1001)
0
m
100
LROC Observation M114064206
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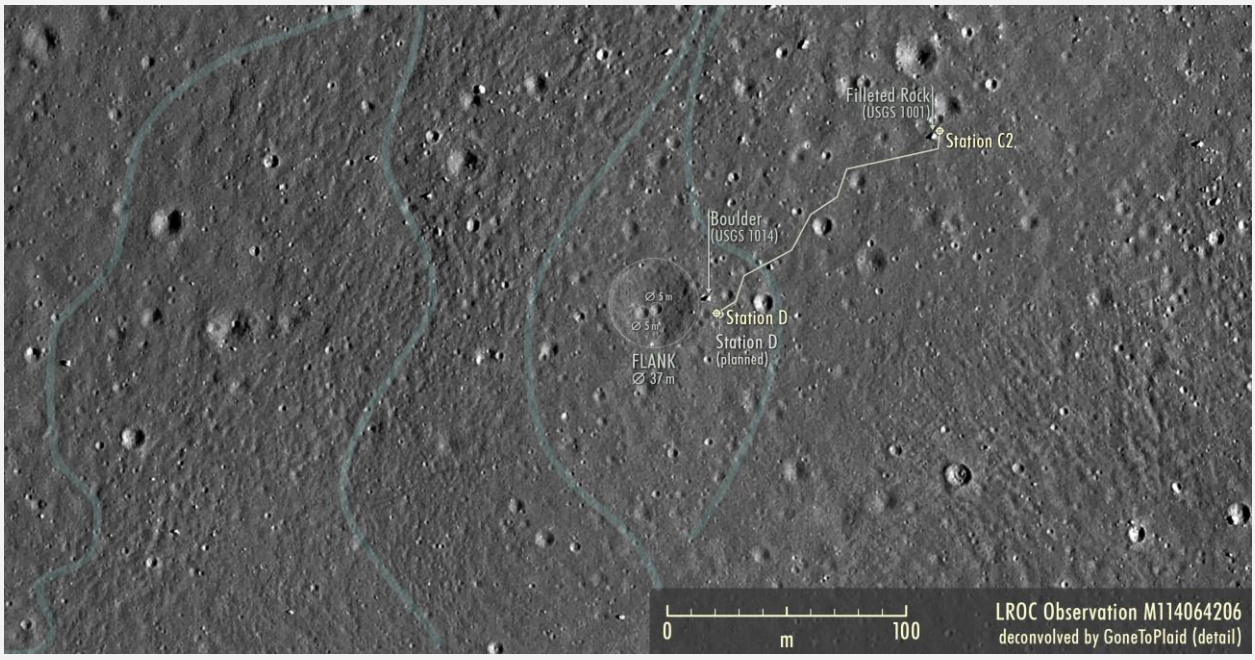
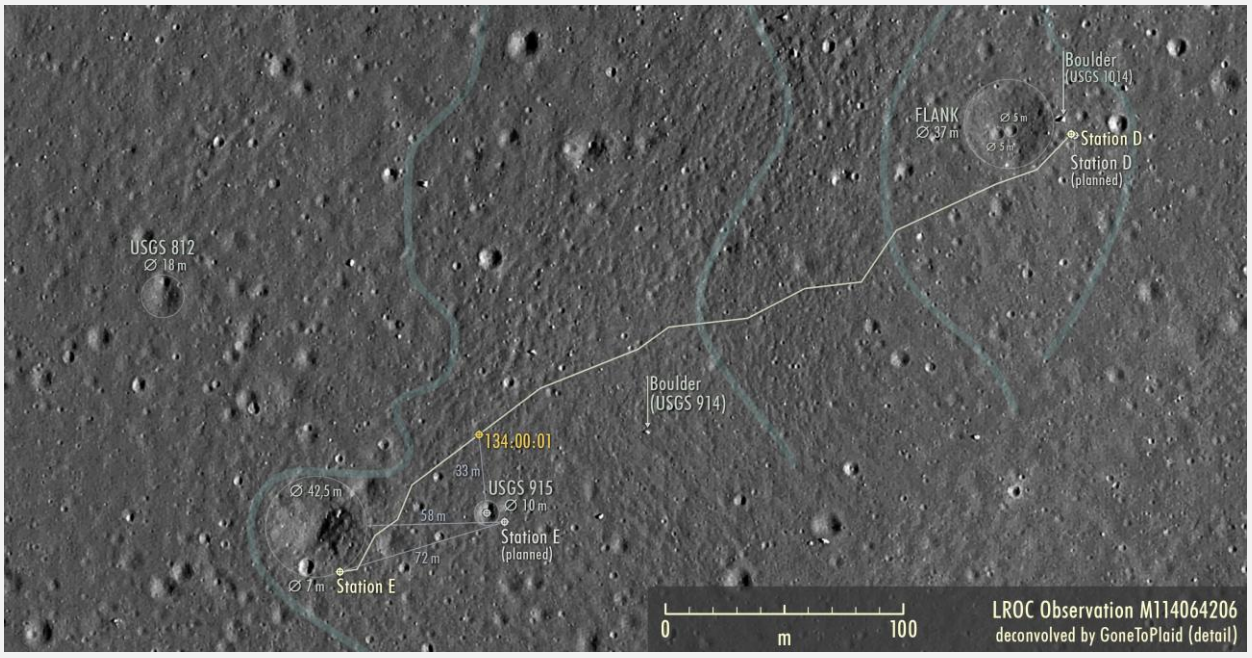

Filleted Rock
(USGS 1001)
Station C2
Boulder
(USGS 1014)
∅ 5 m
∅ 3 m
Station D
Station D
(planned)
FLANK
∅ 37 m
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)


Boulder
(USGS 1014)
FLANK
∅ 37 m
∅ 5 m
∅ 3 m
Station D
Station D
(planned)
USGS 812
∅ 18 m
Boulder
(USGS 914)
134:00:01
33 m
∅ 42,5 m
USGS 915
∅ 10 m
58 m
Station E
(planned)
72 m
∅ 7 m
Station E
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)

mission, Shepard said, "From the elevation where we stopped, the view down the valley was just fantastic. But outside of that, we could see exactly where we were going at this time. We said we were going back to Weird and we could see Weird. There was no question about it."

Shepard, *"We're now out of the boulder field, Houston, and proceeding down the flank."*

The lurain was fairly flat here.

STATION C2
Arrived: 133:51:57 GET 2054:59 AEST
Departed: 133:53:47 GET 2056:49 AEST
Duration: 1 minute 50 seconds

They were skirting along the top of the south east side of Flank ridge, walking parallel to the ridge crest. They stopped for a few moments at Station C2 to pick up a 250 gram rock.

Shepard, *"We're just going to get a quick grab here of a rock, and I'll photograph it because it's got some tremendous fillets on it,"* to Mitchell, *"Don't hit the fillets until I photograph it – let me get a quick shot here…..yeah, we ought to get a piece of that baby."*

Mitchell, *"Oh, man. That's hard, hard, hard. Look at that impact melt in it."*

A minute later, as they headed towards Flank Crater, Mitchell offered, *"Do you want me to pull awhile?"*

Shepard, *"No, just watch everything. We don't want anything to drop off."*

Mitchell, *"Well, it's holding in very well – if it doesn't turn over."*

Haise, *"And, position-wise, you're past Flank now. Is that correct? Or at least abeam position of Flank?"*

Shepard, *"No we're not, Freddo. No, we're not at Flank yet. I'd say we're probably 15 minutes away from Weird."*

Two minutes later Shepard said, *"We're moving along pretty well, Fred, at this point. And I'd say we're still probably ten minutes away from Weird."*

Haise, *"Very good, Al. Looks like you're making a little better time going down than up."*

Mitchell, *"Yeah, the slopes a different way, Freddo…in this case the MET helps."*

Mitchell, *"I think we've already passed Flank."*

Haise, *"Okay. It maybe looks down here, Ed, that may be what you're looking at there, if you've got another Flank sized crater, is the one by Station E."*

Mitchell, *"No, this a big crater. It's 40 to 50 metres across. It has a fairly sharp crater in the south edge of it, which is 6 to 9 metres across. Yeah, I think that's it, Freddo. Oh – it's at least 15 or 18 metres deep."*

Haise, *"Okay, that looks like it may be the one by E."*

STATION E
Arrived: 134:01:03 GET 2104:05 AEST
Departed: 134:02:12 GET 2105:14 AEST
Duration: 1 minute 9 seconds

It took them 7 minutes 16 seconds (including a 30 second stop) to cover the 400 metres from Station C2 to Station E. The crater they were talking about is one the two were confused with Flank on their way out. The nearest rim of this crater was about 60 metres west of the planned Station E.

Shepard decided to just pick up samples at this station, *"Why don't we just grab a couple from right here. Yup."*

Shepard, *"That baby came apart – very soft."*

Mitchell, *"Yeah, it's falling apart as you pick it up – very crumbly, isn't it?"*

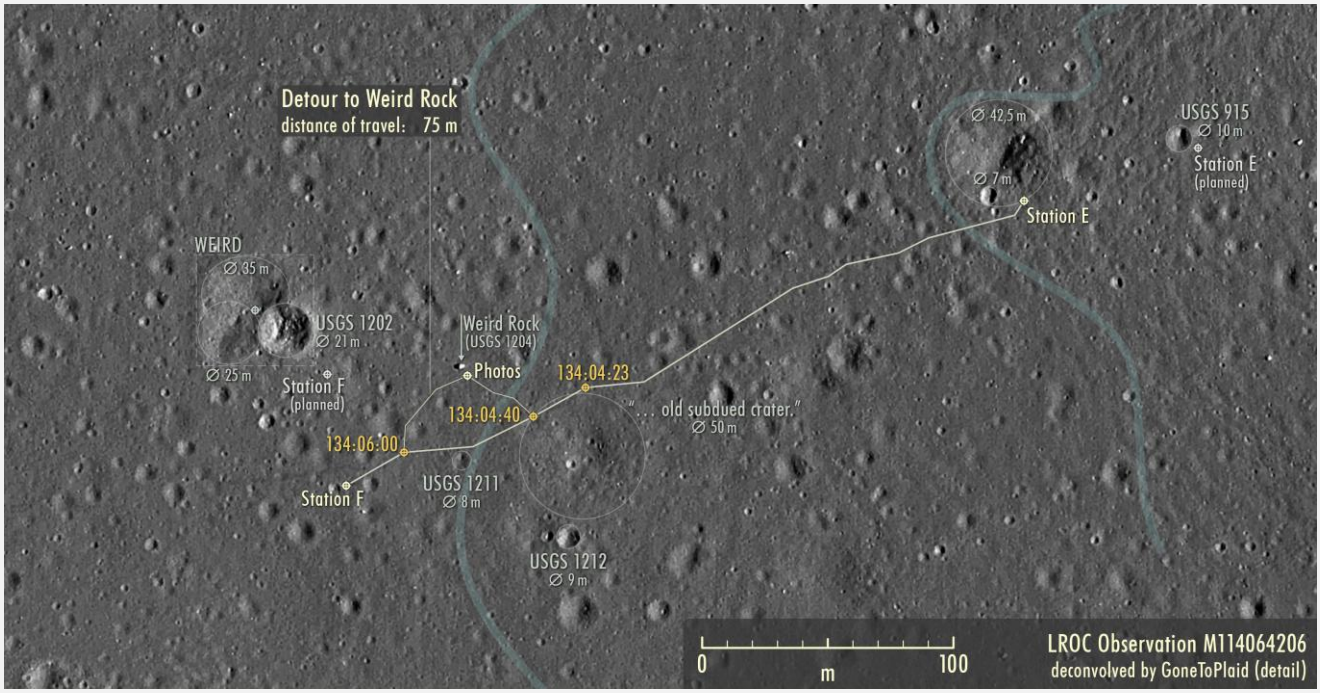
After leaving Station E on their way to Station F, Shepard made a detour to Weird Rock.

Mitchell, *"Yeah, we're going right for Weird. Head right for the big boulder. Then Weird's right beyond it."*

Shepard, "Okay, Fred, we're still moving, and the MET's about 3 minutes away from Weird."

Two minutes after leaving Station E, Mitchell commented, *"The crater we're going by now – we're just north of it, Freddo – is an old, subdued crater."*

Shepard ran across to the boulder called Weird Rock as Mitchell said, *"I'll pull the MET. You go ahead."*



Looking at Weird Rock, Shepard said, *"Sure is a big old boulder. I'll take a picture of it anyway."*

Haise, *"And this big boulder, Al, is…You're just about at Weird now. Is that right?"*

Shepard, *"Oh, probably a couple of hundred metres short of Weird."*

Mitchell, *"This country is so rolling and undulating, Fred, with rises and dips everywhere, that you can be going by a fairly good-sized crater and not even recognise it."*

Shepard returned to join Mitchell, *"Okay, I'm back with you."*

Mitchell, *"Okay, I think this is Weird to our right here. Forward, Al. See that fresh one there? I think that's the fresh one of the Weird pattern."*

STATION F
Arrived: 134:06:39 GET 2109:41 AEST
Departed: 134:09:15 GET 2112:17 AEST
Duration: 2 minutes 36 seconds

They had covered about 200 metres since leaving Station E in a time of 4 minutes 27 seconds at an average pace of 5.1 kilometres per hour. Planned Station F was to be beside Weird Crater but ended up further south.

As they arrived at Station F Houston suggested,

"Okay, Al and Ed. On the Weird task, we'd like a pan and grab samples at Weird. And we'll pick up most of our tasks that we by-passed at E when we get to Triplet."

Shepard took a panoramic set of pictures and announced, *"Okay, pan's complete."*

Haise, *"Roger, Al."*

Shepard, *"Did you grab a sample, Ed?"*

Mitchell, *"I'll grab some right up here, Al."*

Shepard, *"We've got a pan and a grab sample. What else do you want from here, Houston?"*

Haise, *"Okay – that's it, Al. We would like to proceed on to North Triplet, and I'll give you the tasks when we get there."*

Shepard, *"Okay, we'll try and get to North Triplet."*

Haise, *"Al and Ed, for your stop at G, we'd like that….take an estimated one crater diameter short of the crater – North triple Crater."*

Mitchell, *"You want us to stop one crater diameter short?"*

Haise, *"That's affirm, because some of the items coming up are the triple core and the trench."*

Mitchell, *"I think we're seeing the rim of the Triplet series right ahead of us, aren't we, Al?"*

Shepard, *"I would say so – yes. We can say that's the rim of the North right there."*

Mitchell, *"Yes, it's got boulders on it, and that's the only thing big enough to have boulders. We're probably about one diameter out right now."*

Shepard, *"I'd say we are – right here."*

STATION G
Arrived: 134:11:02 GET 2114:04 AEST
Departed: 134:46:31 GET 2149:33 AEST
Duration: 2 minutes 36 seconds

It was only a 1 minute 47 second walk to Station G to arrive at what Shepard estimated as one crater diameter to the north east of the Triplet Craters, though actually it was more like half a diameter.

Shepard advised Houston, *"Okay, Houston, we're about one diameter to the east of North Triplets."*

Haise, *"Okay, copied, and the number one item is the triple core."*

After sorting out the clean tubes, Mitchell began trying to push a triple core into the regolith by hand, but…

"Freddo, I've tried to push in the triple core tube. I get maybe, oh, 3 to 4 inches (7.6 to 10 centimetres) *pushing in by hand. And it's just surface stuff; a very soft...it will not support the weight of the core tubes…. Now, I've got it balanced, and I can take a picture of it, perhaps. We'll try to drive it."*

Haise, *"And do I understand correctly, Ed, you're taking care of the triple core on your own there?"*

Mitchell, *"That's affirm. Al's digging, busy with his trench."*

Haise, *"Okay, very good."*

Mitchell, *"I'll try driving a bit more, but I think I'm on solid rock, and I'm only about one core tube down."*

Haise, *"Okay, the recommendation, Ed, is to pull it up and move over a bit and try again."*

Mitchell, *"The way this one feels, it'll be the same thing."*

Haise asked Shepard, *"How's the trench going, Al? Are you getting down there?"*

Shepard replied, *"I've got a trench here. It's going fairly easily, but I need the extension handle (which Mitchell was using at that moment) to get it deeper so, we'll wait 'til Ed's through with that. I'm cutting into the rim of a crater which is approximately, oh, say 6 meters in diameter, has a depth of about three-quarters of a meter. And we're back in about one diameter away from the north member Triplet. The trench is going through at least three layers that I can see. The fine-grain surface, dark browns; then, a layer of what appears to be quite a bit of glass; and then, a third layer of some very light material. And we should be able to sample all three of these.*

You know what's happening in this trench? The surface fines are so loose that they're just falling down covering the layer that we want to get… …I tell you we're not going to get a classic vertical wall here, Houston, on this trench… damn!"

At the mission debriefing Shepard said, "It looked as if Ed and I should have changed positions, because it was not soft enough for him, and it was too soft for me. We did the best we could without getting a vertical wall. We were running out of time again, and it was either do the best we could with that particular trench, or not do it at all."

It is interesting to note that none of the other Apollo missions suffered this problem; they all had cohesive, vertical walls.

A frustrated Shepard explained,

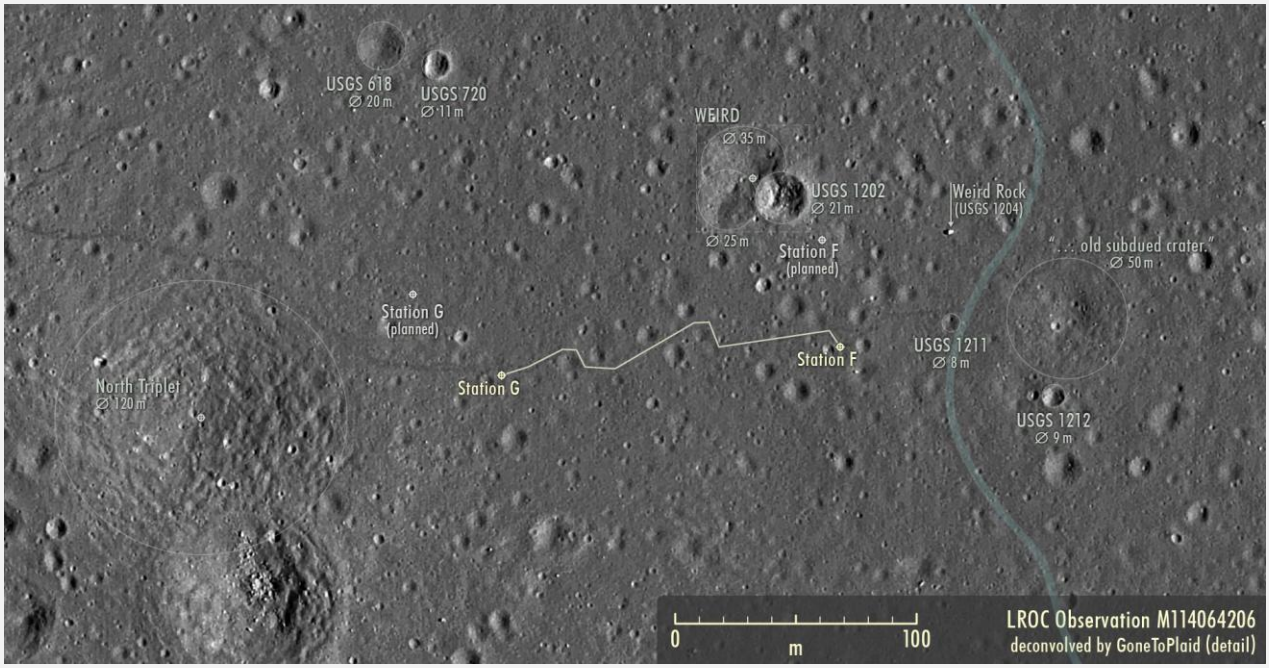
"I am unable to take from the walls of the trench the type of material – the glassy type of material that I could see when I was digging – so, I'll just get a shovel full of that, and it will mix the surface with the second layer."

Haise, *"Roger, Al. How deep did you finally end up getting down?"*

Shepard, *"Well, the trench is about a foot and a half* (45.7 centimetres) *deep. I gave up actually, not because it was hard digging, but because the walls kept falling in on it and it was covering all the evidence of stratigraphy."*

Mitchell, trying a second attempt at driving a core, interrupted, *"And, Houston, I'm over 50 feet* (15.2 metres, actually it was about 7.6 metres) *from where Al is, and on the east side of these craters. I have the triple core in about a tube and a quarter and it's tightening up again. I don't think it's going to go in the rest of the way."*

Haise, *"Okay, Ed. We'll just take your judgment on that. When you don't think you can get in any further, you can stop there."*


USGS 618
∅ 20 m
USGS 720
∅ 11 m
WEIRD
∅ 35 m
USGS 1202
∅ 21 m
Weird Rock
(USGS 1204)
∅ 25 m
Station F
(planned)
"...: old subdued crater."
∅ 50 m
Station G
(planned)
Station F
USGS 1211
∅ 8 m
North Triplet
∅ 120 m
Station G
USGS 1212
∅ 9 m
0
m
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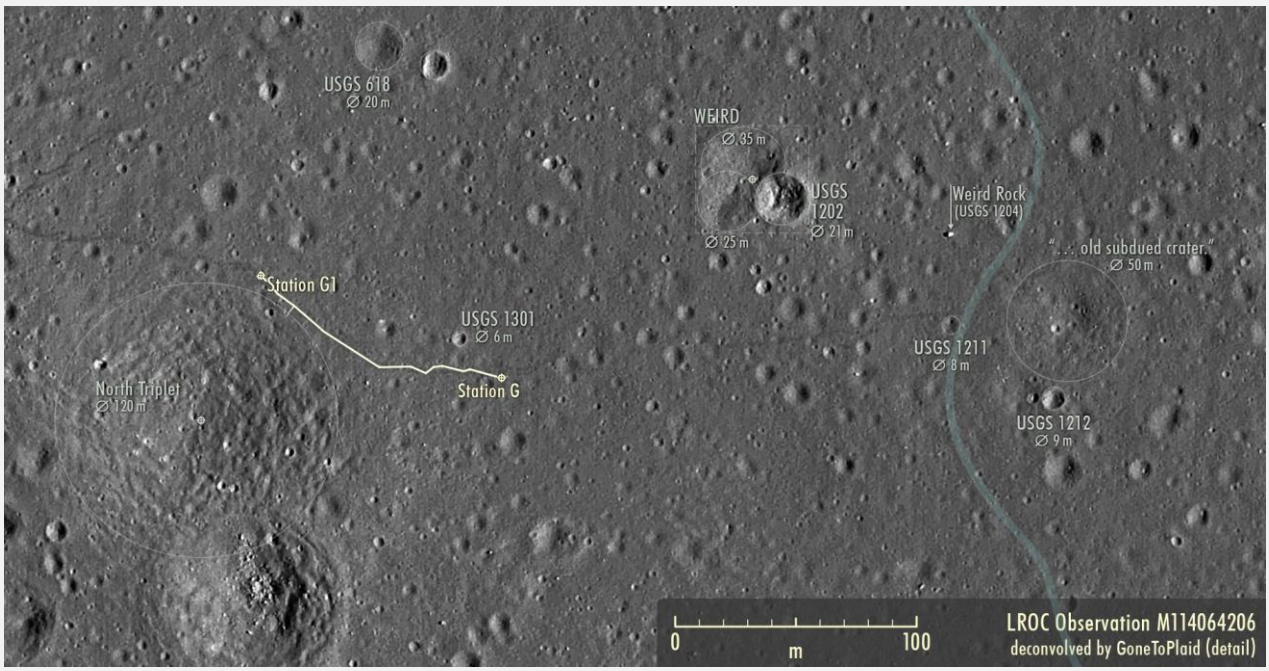
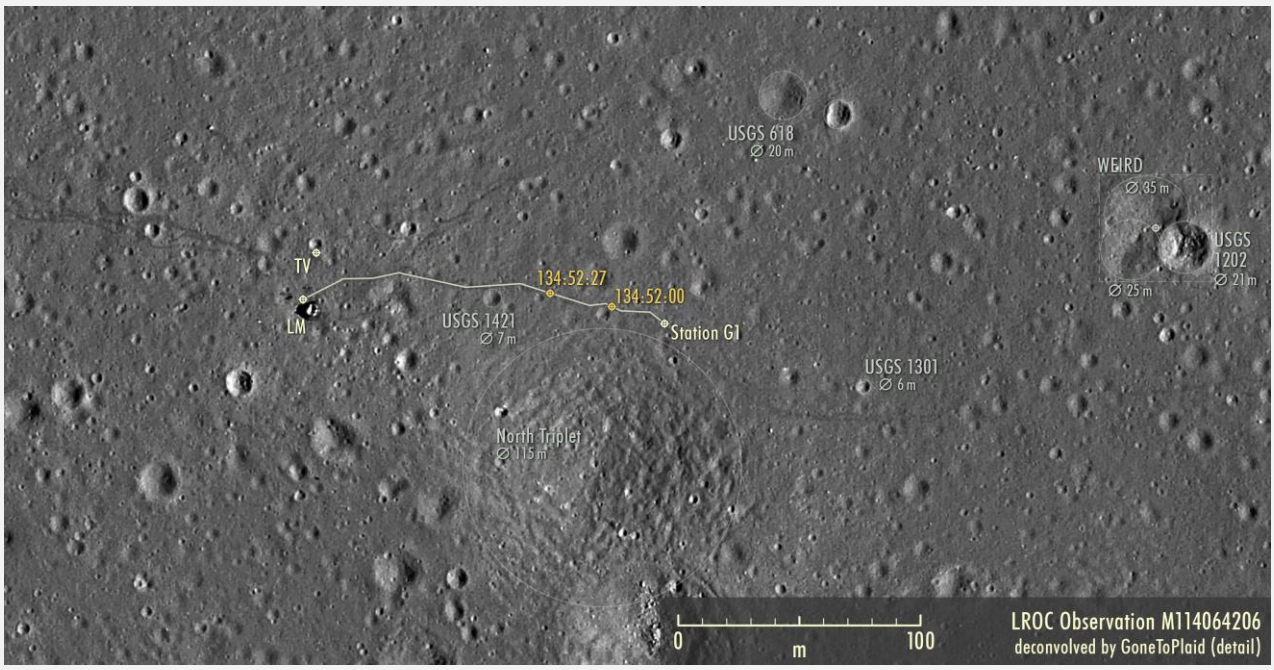
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)


USGS 618
∅ 20 m
WEIRD
∅ 35 m
USGS
1202
∅ 21 m
Weird Rock
(USGS 1204)
∅ 25 m
"...: old subdued crater."
∅ 50 m
Station G1
USGS 1301
∅ 6 m
USGS 1211
∅ 8 m
North Triplet
∅ 120 m
Station G
USGS 1212
∅ 9 m
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)


USGS 618
∅ 20 m
WEIRD
∅ 35 m
USGS
1202
∅ 21 m
∅ 25 m
TV
134:52.27
134:52.00
LM
USGS 1421
∅ 7 m
Station G1
USGS 1301
∅ 6 m
North Triplet
∅ 115 m
0
m
100
LROC Observation M114064206
deconvolved by GoneToPlaid (detail)

Mitchell, *"I think I could probably beat it for the next ten minutes, Fred, and not get another inch out of it."*

Mitchell found he was driving into increasingly denser material, not a rock this time, making the core get tighter and tighter*, "I was hitting hard – I mean I used a lot of energy with that hammer, and it just wasn't going anywhere."*

Haise, *"Well, I don't think you need the exercise – you may as well extract it now."*

Haise, *"And, Al and Ed, we have about 8 minutes left here at Triplet."*

Shepard, *"Roger. You're still counting on a quick trip out to the ALSEP antenna?"*

Haise, *"That's affirm, Al. That's included in this time. And when you start out, we'd like you to make some grab samples as you pass by North Triplet."*

Mitchell, *"And Freddo, the triple core tube, the second core didn't have anything in it. As soon as I opened it up, a little bit fell out, and the second core tube is empty. Even though it drove in about three inches* (7.6 centimetres)*, it didn't get anything."*

Haise, *"Okay, Ed."*

Shepard, *"We're going to have to mush, Ed, right down the middle, and get a documented sample there."*

Haise, *"Okay."*

STATION G1

Arrived: 134:49:23 GET 2152:25 AEST
Depart for LM: 134:51:36 GET 2154:38 AEST
Duration: 2 minutes 13 seconds

The two astronauts skirted around the north rim of North Triplet Crater, stopping on the rim of Station G1.

Haise, *"Okay, Al and Ed, as soon as you wrap this one up, you're going to have to press on back to the LM, or we're going to be really tight on the closeout."* Mitchell, *"Okay, let's mush for the LM."*

Haise, *"Okay, Al and Ed. I guess we can skip the rim of North Crater and proceed right back to the LM area."*

Mitchell, *"That's where we are… …We're at … …we are right at the rim of North Crater."*

Haise was unaware the astronauts had moved to the North Crater rim, *"Okay."*

Mitchell, *"We're on the west..."*

Haise, *"I think you misunderstood the message. We can proceed right by the rim. We have the buried rock samples now, and head on back to the LM – that's to Antares."*

Mitchell, *"That's right – that's where we're headed."*

Shepard, *"Okay, that's where we're headed."*

Mitchell, *"Hold it – I'll get it – keep going. We lost a core tube."* It had fallen off the MET.

Shepard, *"Okay… ...got it?"*

Mitchell, *"I'll have it in a minute… …I got it."*

Shepard, *"Everything still hanging on?"*

Mitchell, *"Yeah, everything's still there."*

Shepard, *"We're approaching the LM now. Coming in at Fra Mauro Base."*

RETURN TO THE LUNAR MODULE

Arrived: 134:54:14 GET 2157:16 AEST

It was only a 2 minute 38 second trek to leave North Triplet and return back to Antares, and Houston immediately began organising the duo,

"Roger Al. And I guess from here we can split up; Ed can take the MET and proceed to the cluster of boulders he had reported earlier to the north west of the LM, and you can proceed out to the ALSEP."

Both astronauts acknowledged, *"Okay."*

Shepard, *"Al's on the way out to the ALSEP."*

Mitchell, on his way to Station H, a boulder field lying 65 metres to the north west of the LM, made an on-the-spot decision,

"As a matter of fact, Freddo, I'm just going to take a weigh bag and no sample bags; that way I can get more… ...the size of these rocks! The sample bags are too small anyhow."

Arriving among the boulders, Mitchell announced, *"Okay, Freddo, my plan... I'm out in the area of the boulder field. I'm going to photograph many of the boulders, the rocks, the broken ones, the big ones, what have you; and*

then, grab as many of the different fragments as I can around these piles of broken boulders."

Haise, *"Okay, Ed. That sounds great."*

Meanwhile Shepard re-aligned the ALSEP antenna and waited while Houston verified an improvement in signal strength, *"Okay, are the ALSEP signals satisfactory?"*

Haise verified the tracking stations had an improvement in the ALSEP signal level, and told Shepard, *"That's affirmative."*

Shepard, *"Okay, heading back to the LM."*

Back at the LM Shepard set up the television camera to look at the ladder area of the LM so Houston could watch the preparations to leave the Moon.

Mitchell had finished with the boulder field,

"Okay, Freddo. I'm heading back from the boulder field. I've sampled two of the larger boulders, rocks broken from them, and lying on them; and I've taken a pan."

The last minute jobs were unexpectedly interrupted by…

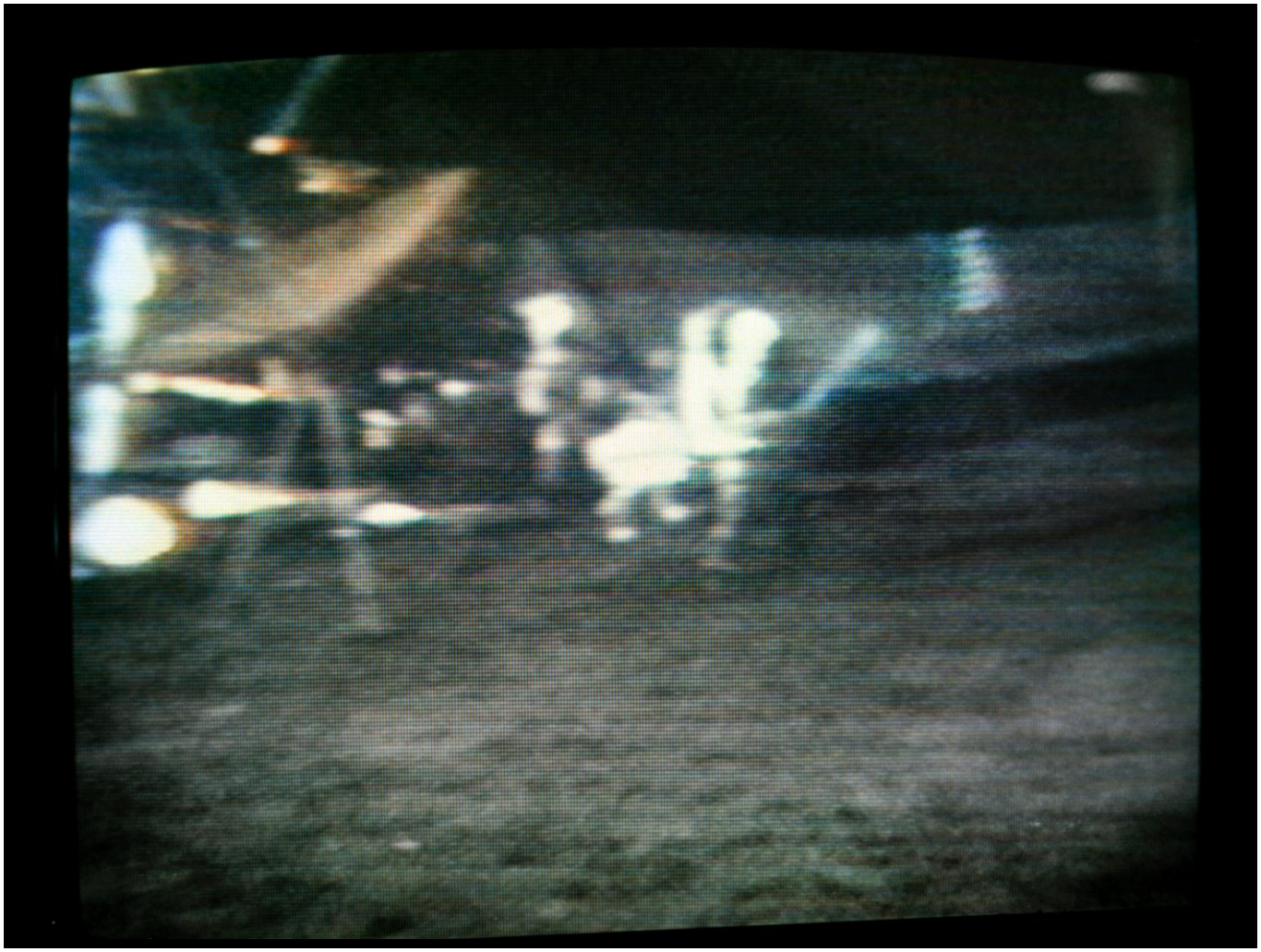
The First Lunar Golf Tee Drive

Shepard had planned a little surprise for their last moments on the Moon.

At 135:08:17 (2211:19 AEST) he stood in front of the television camera and announced,

"Houston, you might recognize what I have in my hand as the handle for the contingency sample return; it just so happens to have a genuine six iron on the bottom of it. In my left hand, I have a little white pellet that's familiar to millions of Americans. I'll drop it down. Unfortunately, the suit is so stiff, I can't do this with two hands, but I'm going to try a little sand-trap shot here."

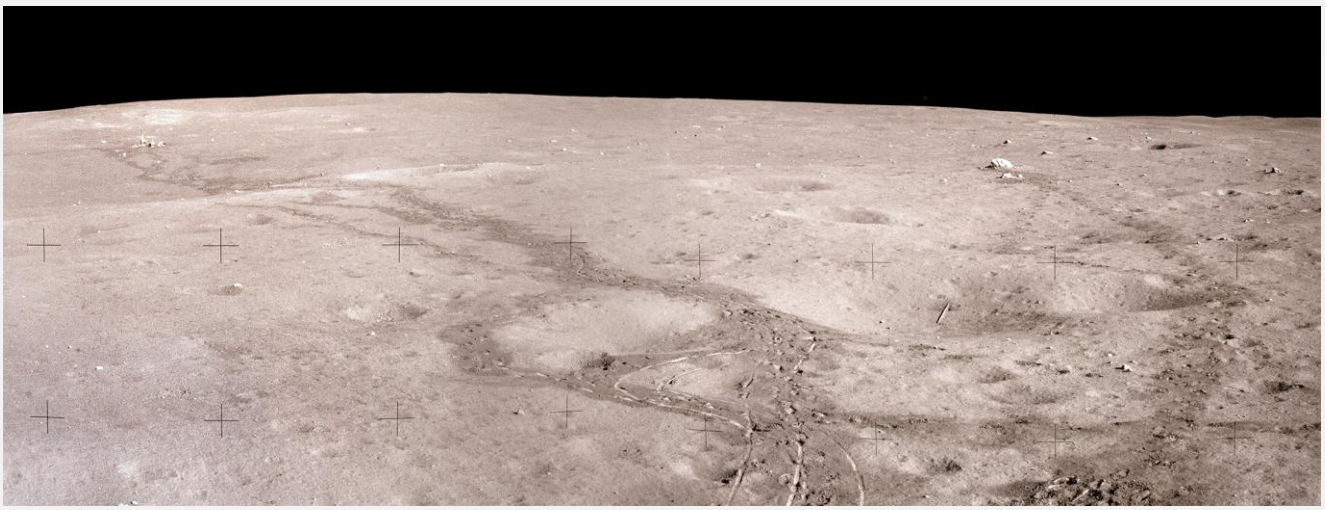
Shepard had the head of a six-iron golf club machined to fit onto the end of his aluminium rock collector by Houston's Technical Services Division and bootlegged through the workshops to avoid detection by management. He then managed to smuggle it into the spacecraft in one of his suit pockets. On the Moon he pulled out the six iron tip from the pocket, fitted it to the end of the rock collector, then dropped a golf ball onto the lunar soil and took a swing.



The Back Swing

Striking the Ball

The Follow Through



"Miles and miles and miles!"
The lunar golf course. Tracks lead out towards the position of the ALSEP (upper left).
In the right mid-ground is 'Javelin Crater', where Mitchell's javelin throw and Shepard's first ball landed (see below).
Image: NASA (three images combined for this panorama)

The first attempt topped the ball, driving it into the lurain.

Mitchell observed, *"You got more dirt than ball that time."*

Shepard dropped a second ball onto the lurain, *"Got more dirt than ball! Here we go again."*

The second swing edged the ball to dribble about a metre.

Haise, *"That looked like a slice to me, Al."*

Shepard, *"Here we go – straight as a die. One more."* He steadied himself and tried a third swing. It connected to drive the ball out of view of the camera lens.

Shepard grinned, *"Miles and miles and miles!"*

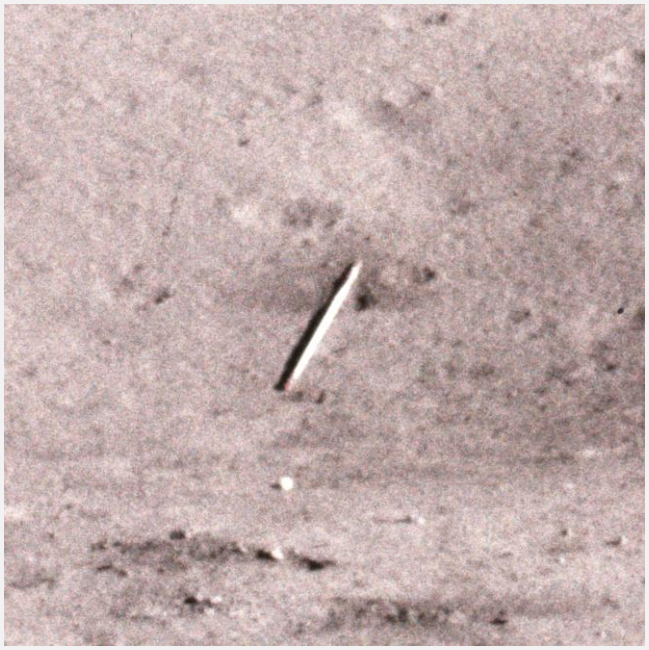
Haise, *"Very good Al."*

Everyone was afraid of the reaction of the Director of the Manned Spacecraft Center to this flippant break from mission procedures, but Chris Kraft, also a keen golfer, said, "Hell, if I'd known, I would have gone along with the gag."

Thirteen minutes later Mitchell decided to throw the Solar Wind Collector (SWC) staff away like a javelin, and Shepard commentated,

"Now, let's see – what have we got left… …there's the greatest javelin throw of the century."

Mitchell lined the staff up, *"We'll see if it is."*, and heaved with all his might.



Detail from above: the javelin and golf ball.

Shepard, *"Old Lefty himself… Outstanding! Right in the middle of the crater."*

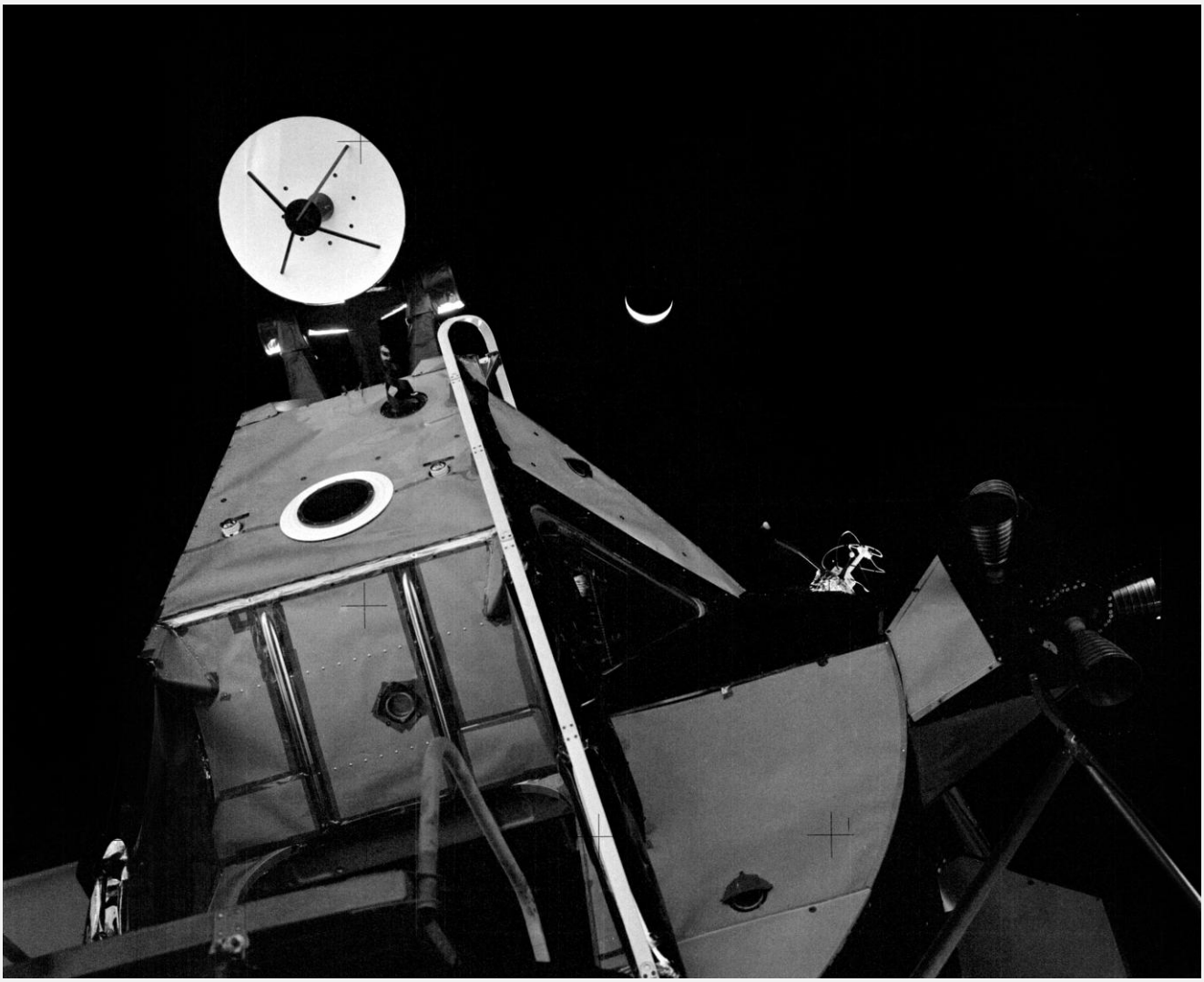
Mitchell, *"Stayed up!"*

Shepard, *"Stabilised spin!"*

Mitchell, *"Wasn't bad at all."*

With the fun over, the two astronauts cleared the area, unloaded the MET, and packed everything away. Before he stepped onto the LM's ladder, Mitchell queried, *"I saw you over there…. did you get a picture of Earth?"*

Shepard, *"I did… of the LM in the foreground. Yep, several."*



Looking up at the crescent Earth above the Lunar Module. Image: NASA

Mitchell, *"Are you ready to go up?"*

Shepard, *"Sure."*

Mitchell, *"All right, Freddo, I'm starting up the ladder."*

They climbed back into the LM and repressurised the cabin at 135:42:54 GET (2245:56 AEST) thus ending the last EVA for the mission. The second EVA lasted 4 hours 34 minutes 41 seconds; the distance travelled was 2.987 kilometres and 22.3 kilograms of samples were collected.

The total time spent outside the LM during the two EVAs was 9 hours 22 minutes 31 seconds; the total distance walked was 3.99 kilometres and the total weight of samples came to 42.28 kilograms. The greatest distance walked from the LM was 1.45 kilometres.

Shepard decided to check on their CSM pilot orbiting the Moon above them,

"And how's our friendly Command Pilot doing? Is he going to be ready to pick us up with a nominal launch time?"

Ron Evans, the CSM Capcom answered, *"You bet, Al. I've been talking with him all morning here, and he's really whipping around, getting a lot of pictures, and doing a lot of landmark tracking. He said he's picked you up on two passes now, and he also saw the reflections from the ALSEP on his last pass up through there."*

Mitchell, *"Yeah, Ron, the ALSEP from the top of Cone crater is so bright it stands out like a little jewel. I'm not surprised at all that Stu could see it."*

A new development demanded their attention. They had been troubled by the LM's high gain antenna jittering intermittently ever since coming around the Moon before landing. Mitchell,

"Hey, Ron. Tell them that this high gain antenna is setting here, kind of wobbling, and making all

sorts of racket, when it should be sitting very still, and was until just a minute or so ago. Now it seems to be starting to go unstable, or at least neutrally stable. It's not driving wildly, but it's making a hell of a racket. It's just kind of wobbling, around a neutral point."

Evans, *"Okay, INCO* (Communications Officer) *copies that, and we'll let you know on it."*

Fred Haise returned to his Capcom's console, *"Antares, Houston."*

Mitchell, *"Go ahead."*

Haise, *"Okay, they've made some configuration change on the ground station hookup down here to you; and for some reason, they think that that may have helped your antenna chatter, or whatever. The thing seems to be steadier now?"*

Mitchell, *"It steadied out for a minute or two, and now it's picking up again."*

Haise, *"Okay."*

Mitchell, *"Why don't they accept the fact that the damn thing is about to quit on us."*

Haise, *"Okay, Antares, Houston here. They'd like you to go back and select the lunar stay – the erectable* (antenna)*."*

SUNDAY, 7 FEBRUARY 1971 - AEST
DAY – 7 LUNAR STAY – DAY 2

In Mission Control Bruce McCandless replaced Fred Haise as Capcom for the upcoming launch.

On the Moon the crew were running about an hour and a half ahead of schedule and had settled down to eating a meal.

Lunar liftoff

As the time to leave approached, Shepard called down, *"And Antares is counting down to 2 minutes…..3……2…..1…… mark! Two minutes and counting."*

McCandless, *"We concur."*

McCandless, *"Kitty Hawk, Houston. Antares has got ascent engine armed."*

Roosa, in the CSM, *"Okay. How do you read, Antares."*

Shepard, *"There's our boy. Reading you loud and clear. We are 45 seconds and counting. Be up to see you shortly"*

Just outside the Honeysuckle Creek Operations Room, "the Fickle Finger of Fate" told the troops the current status of the mission.
Photo: Hamish Lindsay. Scan: Colin Mackellar

Roosa, *"Roger, I'm waiting."*

Mitchell, to Roosa, *"Have a nice cool one set up!"*

Shepard, *" 3…. 2… 1…. We have ignition."*

Mitchell, *"What a lift-off!"*

Shepard repeated, *"….and lift-off."*

Lunar liftoff was at 141:45:40 GET 6 February UT (0448:42 AEST, 7 February) with a 7 minute 11.1 second firing of the ascent engine, with Madrid the prime tracking station. The spacecraft had been on the lunar surface for 33 hours 30 minutes and 29 seconds. At lift-off the CSM Kitty Hawk was about 124 kilometres to the east. Antares entered an initial orbit of 95.7 by 15.7 kilometres. After some adjustment burns of 12.1 seconds to change the orbit to 94.8 by 15.56 kilometres, and a 3.6 second terminal phase initiate burn, 2 small midcourse corrections and a 26.7 second manoeuvre brought the LM into a final orbit of 113.9 by 85.2 kilometres ready for rendezvous. This was the first time a docking had been

Antares ascent stage lifts off the lunar surface, the powerful LM engine causes a brief ‘force of wind’ which scatters gold-coloured foil, covering the LM, and disturbs the U.S. flag.
This frame is from the 16mm data acquisition camera - which was mounted inside the LM. Image: NASA

completed in one orbit, reducing the transit time by about 2 hours.

As the two spacecraft came together Houston was watching on television from the CSM,

"Thank you Stu, and we've got a real good TV picture."

Antares, *"I shall do a loop, leader."*

Roosa, *"Okay – make it smooth… …and around we go."*

Antares, *"Show us a little style… …oh, you look good. Kitty Hawk is doing an extremely smooth loop. We're sitting at 70 feet (21.3 metres) watching him go around. He looks very clean. You look nice and clean, Stu. Want to come a little closer? I'll save you some gas."*

Docking

Taking 1 hour 47 minutes 10 seconds from lift-off, the two spacecraft docked at 143:32:50 GET (0635:52 AEST) at an altitude of 108.5 kilometres above the lunar surface, having been apart for 39 hours 45 minutes 9 seconds.

McCandless, *"You're GO for the docking."*

Antares, *"Roger – we got you. How about that?"*

Antares, *"Okay, we capture."*

McCandless, *"Beautiful. Normal docking."*

Antares, *"And we have a hard dock."*

McCandless, *"Beautiful. There's a big sigh of relief being breathed around here."*

Roosa, *"All over the world there is."*

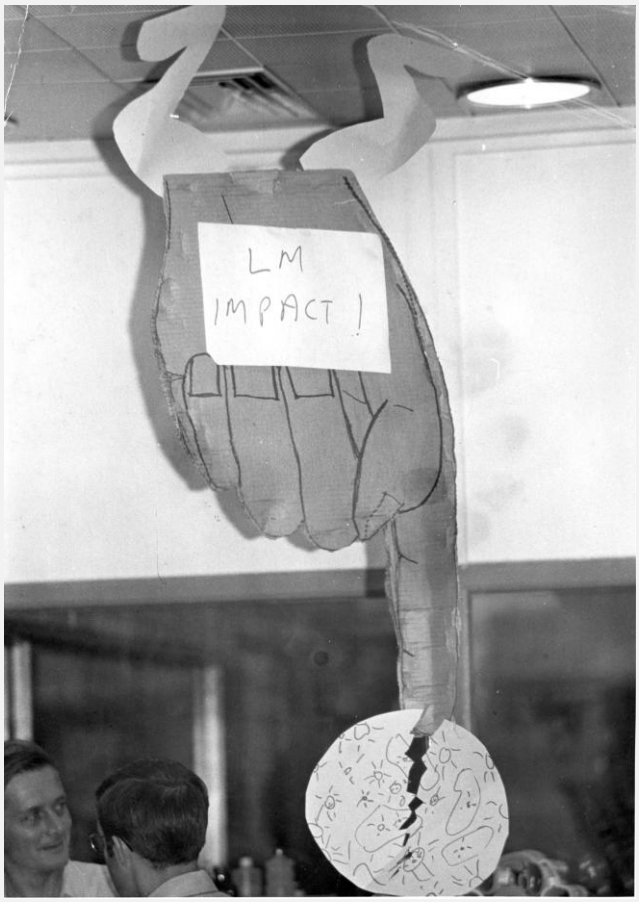
Antares, *"You want to try it from up here!"*

LM jettison

After transferring the crew and samples from the LM to the CSM, at 145:44:58 GET (0848:00 AEST) the LM was jettisoned, and a 15.8 second burn set the two spacecraft well apart. Then the LM ascent stage was manoeuvred by remote control to smash into the lunar surface at coordinates 3° 25' 12"S x 19° 40' 12"W, some 66.7 kilometres west of the Apollo 14 landing site at 147:42:24 GET (1045:26 AEST).

Trans Earth Injection (TEI)

Following 34 lunar orbits lasting 66 hours 35 minutes and 40 seconds, Kitty Hawk entered TEI



"The Fickle Finger of Fate" is updated with the latest LM status. At lower left, Don Loughhead (facing camera) chats with Bryan Sullivan.
Photo: Hamish Lindsay. Scan: Colin Mackellar.

(Trans Earth Injection) with a 2 minute 29.23 second burn at 148:36:02.3 GET (1139:04 AEST).

Shepard, *"Okay, Gordo. We had a good burn – we're on our way home."*

Fullerton, *"Roger Al, that's good news."*

Shepard, *"You bet. We're like tourists with the cameras right now."*

At 150:44:00 GET (1344:07 AEST) the Director of Flight Crew Operations, Deke Slayton, came on line:

"We thought you'd all gone to sleep on us up there."

Roosa, *"Yeah. We were working on that, but we didn't have any place to sleep, we're inundated, so we've been scurrying around trying to get things in some sort of order."*

Slayton, *"Well we want to power down your tired bodies as soon as you can arrange it. We have nothing at all programmed for about the next twelve hours. You guys have done an*

The Fickle Finger of Fate indicating LM IMPACT during the Apollo 14 mission. In the picture is Bryan Sullivan (standing) with John McLeod seated at the computer control console. Photo and scan: Ed von Renouard.

Bryan Sullivan adds: "After the discarded lunar module ascent stage had impacted the moon's surface, the giant finger was hung from the Computer Room ceiling above another giant circle of cardboard representing the moon with the finger jammed into a huge crack effectively splitting the cardboard moon in half.

The finger was also used to indicate other events in the Apollo mission flight plan. For instance, if it pointed straight upwards we had achieved lift-off, if it was pointing downwards we were close to a landing or splash down, if it was pointing at a yellow balloon hanging from the ceiling we were on the way to the moon and if it was upside down pointing away from the balloon we were on the way back to Earth. It was always a thing of great anticipation arriving on shift to see where, whom or at what the dreaded fickle finger of fate pointed.

During mission simulations the finger was attached to a tall adjustable microphone stand on wheels. Whenever a person made or caused an operational blunder or 'stuffed-up' so to speak, then this huge finger would be wheeled up and pointed at the offender with much ceremony, hilarity and embarrassment. The finger was the idea of Peter Cohn, and it was made by Mike Linney. It was first seen on a popular 1960s TV show called "Laugh In" where the giant fickle finger would be 'pointed at' a US politician or a celebrity as an award for some act of stupidity."

outstanding job in the last couple of days and we appreciate it."

Roosa, *"Okay, Deke, I'll pass that on. I'm the only one on the loop right now."*

With the excessive lunar dust problem experienced in the previous missions, this mission tried special dust control procedures, which turned out to be effective in lowering the overall lunar dust entering the Command Module cabin.

Slayton wondered if the procedures had been successful,

"Hey, Stu. Is your clean happy home still clean? We haven't heard much comment about any micro lunar samples floating around."

Roosa, *"Yeah, it's amazingly clean, Deke. Almost no dust at all. The suits were a little dirty but vacuumed off, and we got almost zero in the Command Module."*

Slayton, *"Outstanding!"*

After a meal, the three astronauts turned in for a sleep around 152:41:00 GET (1544:02 AEST) as they coasted away from the Moon at 5,033 kilometres per hour, already 17,551 kilometres behind them.

MONDAY, 8 FEBRUARY 1971 - AEST
DAY – 8 Trans Earth Coast (TEC)

Mitchell was the first up in their morning at 163:04:00 GET (0207:02 AEST) to hear Capcom McCandless stirring them with,

"Apollo Fourteen this is Houston. Reveille! Reveille! Ease out and trace up. Sweepers, man your brooms – clean sweep down fore and aft."

Mitchell complained, *"The other sweepers are still asleep around here."*

On the way back, Mitchell was relaxed and looking out of the window at their environment, "Because we were rotating every two minutes, the Earth, the Moon and the Sun would come in and out of view." This experience made him realise that all the molecules in him and the spacecraft were created from ancient generations of stars. This realisation that they were manufactured from those stars made this a personal experience. He found this feeling spellbinding, an overwhelming feeling of joy. He found it was a feeling of connectedness, of bliss and joy, every time he looked out the window during the three days coming back to Earth. The feeling was so powerful, he couldn't let go of it.

Midcourse correction

At 165:34:56.69 GET (0437:58 AEST) a 3-second midcourse correction burn was performed for the re-entry corridor, changing the angle of re-entry from minus 6.97° to a more accurately required minus 6.5°, putting the spacecraft nicely in the centre of the re-entry corridor. As well, an oxygen flow rate test for future Apollo mission EVAs on the return journey was conducted. A dump valve was opened to increase the oxygen flow rate from 45 grams to 2.7 kilograms per hour.

Due to coming down about 6 kilometres west of the International Date Line after the burn, the crew were advised they were now landing on Wednesday instead of Tuesday.

The spacecraft retorted, *"We haven't considered the fact, but I guess we'll make it up between the splashdown and Houston, right?"*

In the end they did land on Tuesday.

Science Demonstration television show

At 171:30:00 GET(1033:02 AEST) the crew put on a scientific TV show and tell.

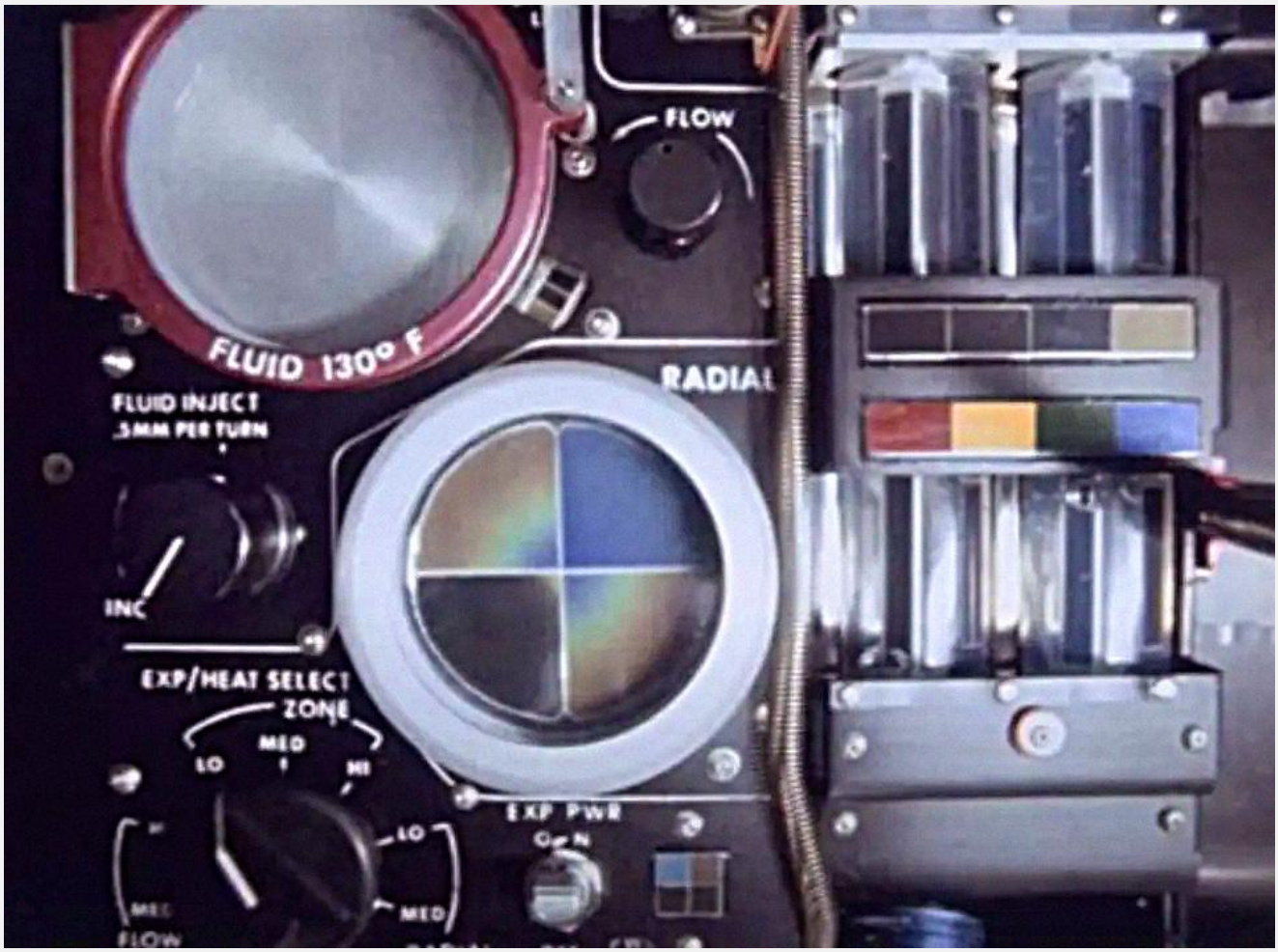
Capcom Fullerton, *"The Gold Team's at your service and standing by for your show."*

Spacecraft, *"Okay. We'd like to welcome you to an afternoon with Apollo 14. A Sunday afternoon with Apollo 14. And we're going to present some experiments for you. Our narrator for this afternoon will be Stu Roosa, and I guess he's about ready to go. Stu?"*

Roosa, *"Okay, Houston. What we'll try to do this afternoon is show you four of the experiments that we're carrying on board, and even though we'd like to think that they're a major breakthrough, essentially what these are, are experiments to checkout not only the steering involved in the zero-g environment, but also the technical problems that we may face in designing bigger and better experiments for Skylab. Three of these experiments deal primarily with convection, or in our case, lack of convection, we hope, during zero-g."*

The zero gravity in-flight demonstrations involved several pieces of equipment, time-lapse photography, and other techniques, for investigation of how weightlessness affects various types of fluids and gases. Among the demonstrations were electrophoretic separation, heat flow and convection, liquid transfer and composite casting. Only a small portion of the total time involved in these demonstrations was shown in the television show, because many of the investigations would take an hour or more to complete.

The first experiment was a heat flow and convection demonstration, aimed at showing how various types of fluids and gases would flow in a weightless environment when heated. This particular demonstration used heat sensitive



The heat flow experiment. Image: NASA

crystals that changed colour. It was photographed at one frame a second with the motion picture camera in a time-lapse technique. It was photographed for a total of one hour and twenty-eight minutes.

The second experiment was the composite casting demonstration, using a metal alloy with a very low melting point. It was to understand how materials, not only metals, but composites with chopped fibres, or wire stiffening, inside the composite casting to increase its strength, would behave from a manufacturing stand point. In a one-g situation on Earth the fibres would tend to settle to the bottom – in zero-g conditions they would remain suspended in the composite material. 18 sealed canisters, each containing a different metal, were placed in a heater and allowed to cool. They cooled in one-g conditions with internal convection currents. In theory in zero-g they should have even cooling with no convection currents and greater strength.

The third experiment was the electrophoretic separation demonstration. It could lead ultimately to a method for processing and manufacturing new vaccines and other biological preparations on manned space stations. This was how the astronauts explained it,

"It's a one shot operation. But on the left side here we've got three channels going across this beauty and over on the left, in a chamber, we have three different compounds containing organic molecules. And what we're going to do is apply a voltage to each one of these chambers and then open up the partition between the chamber where the organic molecules are and our channel going across. And the theory here being that as you charge the molecules they will move out across this channel. Now some molecules will take a better charge than the other ones, and they will move faster. Well, under a gravity field, here again you have a convection current, and it tends to mix up the molecules - the heavier molecules settle to the bottom of the channel - they don't make it all the way across and so forth.

All the problems involved with the convection again, so here hopefully, the only variable will be the different type of molecule. And we hope the molecules will then separate themselves in bunches based on the assumption that all molecules of the same kind you know are all been doing their physical conditioning and will run at the same rate. So, anyway, the molecules will move across and hopefully will separate into bands.

Now we've got three different types of molecules here, and one the simplest one – it's just a red and blue dye and this phenomena will take place under a gravity field just as happens on the Earth. And we work in numbers up to quite heavy molecules and these are the ones that we cannot do on Earth, and we're trying to see if it's possible to do them here under the zero-g and there are quite a few ramifications to this if it really comes off, and one of the most obvious is in the field of medicine in making pure vaccines and so forth. Now we don't expect this experiment to solve the problems. We're trying to get a hack see if the theory is correct and also to work out some of the engineering details such as when you apply this voltage you form a few gas bubbles around it, and so we have to have a little pump that circulates the fluid in a very low rate and we want to see if this works, and if it disrupts the travel of the molecules. So, this we hope, is the first step for bigger and better experiments, and eventually a true manufacturing process."

The last experiment, a liquid transfer demonstration, looked into the effects and benefits of having baffles inside tanks. In zero-g fluids tend to cling to the sides of tanks and it is thought with adequate baffling, or slosh plates, inside tanks, this particular phenomenon could be reduced. The experiment clearly showed that baffles in the tank made it much more efficient transferring liquids from one tank to another, as Fullerton commented,

"We can see that without baffles it's a pretty hopeless situation."

Shepard concluded the show with,

"I just wanted to say a couple of words before we signed off tonight. What we've been talking about among the three of us when we were setting up these experiments, is the contribution this can make immediately and directly into American lives and the lives of people around the world. For example, if specifically, these manufactures and processes of metal turned out to be better in the space environment, or the vaccines which are proposed to be developed in weightless condition can be used effectively and immediately and certainly this type of an operation in Skylab of the future can become immediately beneficial to the peoples of the United States and the peoples of the world.

As a matter of fact, one of the things we're talking about, and in connection with tremendous achievements of the space program so far that have contributed particularly in the field of communication. For example, right now, I'm sure this broadcast is going directly overseas to millions of people who are seeing it in their homes through satellite. And I think many people have said that this improvement in communication through the space satellites will certainly go a long way in solving the problems of the world. Problems of understanding between peoples of different nations and different countries.

Three frames showing the formation of bubbles inside the liquid transfer experiment. Image: NASA

We are reminded however, as we look at that shimmering crescent tonight, which is the Earth, on our way back, that there still is fighting going on, the three of us all have acquaintances, friends, and even relatives in Vietnam, we are reminded that some of the people, some of the men who have gone to Vietnam have not returned, that are still being held there, listed as missing in action, or as prisoners of war and it is our wish tonight that we can in some way, contribute through our efforts in the space program to promote a better understanding of peace throughout the world, and help to rectify these situations which still exists, and with that thought, for Ed, and Stu, and myself, I will say good night to you from Apollo Fourteen."

Fullerton, *"Roger, Apollo Fourteen. Thank you very much for the interesting and - thank you very much for the whole show, we enjoyed every minute of it. Goodnight."*

The 50-minute television program ended at 172:20:00 GET (1123:02 AEST), and the astronauts went back to routine flight activities.

At 177:22:00 GET (1625:02 AEST) their last sleep period began, 286,050 kilometres from Earth.

Down in Mission Control at 178:12:00 GET (1715:02 AEST) it was quiet as Pete Frank's Orange Team, with Capcom Fred Haise, spread among the consoles to take over the shift. With splashdown round the corner, the flight controllers were beginning to show interest in the recovery forces' preparedness.

The half way point in time was reached at 183:10:00 GET (2213:02 AEST), 253,785 kilometres from Earth.

TUESDAY, 9 FEBRUARY 1971 - AEST
DAY - 9

Fred Haise called the crew at 186:03:00 GET (0106:02 AEST) with,

"It's pretty chilly down here. How's it up there?"

Shepard, *"Oh, very comfortable. 71 degrees* (21.6°C) *in the cabin. What do you mean by chilly? Is it freezing?"*

Haise, *"Al, let's see this little report I've got here. It says it's supposed to go down to 28 degrees* (-2.2°C)*."*

Shepard, *"Man, have you moved Houston to the North Pole already?"*

Haise, *"Yeah. There's also a pretty good breeze blowing which doesn't help."*

The crew began stowing gear away ready for their return until the next television transmission at 194:29:00 GET (0932:02 AEST) for a Press Conference with 14 questions submitted by journalists covering the mission.

The conference coincided with a Houston shift changeover to Gerry Griffin's team with Gordon Fullerton as Capcom.

INFLIGHT PRESS CONFERENCE

Fullerton opened the conference with,

"The questions that you'll be asked at this news conference have been submitted here at the Manned Spacecraft Center by newsmen who have been covering the flight. Some of the questions they raised have been answered in your communications with Mission Control but the public, at large, has not necessarily heard them in order to specify by them. First of all, for Al and Ed. Cone Crater was your major objective on your second Moon walk. You almost made the rim. How close do you think you got, and do you believe you collected enough rocks and samples to accomplish the purpose of your mission?"

Shepard, "I think so. Let me take the first part of it with respect to how close we got. I think we were within perhaps 100 yards, or less, off the rim, and certainly in a boulder field that was right there associated with the boulders on the rim."

Mitchell, "I agree with Al. I think we were in 100 - 150 yards and I think the majority of the type rocks that you find at the rim were in the boulder field that we were working and although it was a disappointment. Just as it's been a challenge not to get up there, I think we accomplished the scientific objectives that we looked for."

Fullerton, "It is hard for us to get a feel for what it was like in a large boulder field. Was it a forest of

Roosa, Shepard, and Mitchell answer questions during the inflight press conference. Image: NASA/JSC

big rocks higher than you? Could you see any distance?"

Shepard, "The rocks that we were in – ranging them different sizes. They ranged up to 10 or 12 feet (3 – 3.6 metres) in height above us, so at times we were behind rocks that were taller than we were. As far as stability concerned, Ed, do you want comment on that?"

Mitchell, "Ah yes. We just had a great deal of trouble moving around the rocks. We didn't even have trouble moving the MET around the rocks, except we did have to dodge them – of course we had to be a bit more careful with the MET than walking without it. Our major problem, however, was the undulating terrain where you simply couldn't see more than 100 to 150 yards (91 – 137 metres) away from you and see landmarks. Consequently, we were never quite sure what landmark would appear when you topped the next ridge, and we were very surprised when we topped the ridge - approach the ridge which we thought to be the rim of Cone Crater, to find there was another one beyond it, and that was the beginning of the real problem."

Fullerton, "The next question is tell us about your problems of fatigue, orientation and visibility, and apply them if you will to the longer 7 hour moon walks planned for Apollo 15."

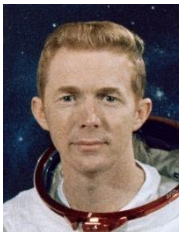
Shepard, "Well, I guess we didn't realize that we had problems of fatigue and visibility. As far as we were concerned our only problem was the amount of time allotted for the excursion. I don't exactly know what our heart rates were. Obviously they were higher than the normal sitting rate, but we still were not operating at maximum capacity of our backpacks for cooling nor were we operating for extended periods of time at high heart rates. To us it was just a matter of working against the

clock. I think that we had the capability to go longer from the standpoint of fatigue – I don't believe that we were disoriented or lost at any time at all, either."

Mitchell, "I agree with Al. If my previous venture misled you, it was only a matter of context because giving a few minutes to look around, we figured out where we were but trying to do it rapidly made it difficult, and as A1 says, time was our major factor. Given another 30 or 40 minutes I think we could have reached the top of Cone Crater, covered all of our objectives and got back in good fashion."

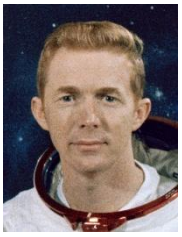
Shepard, "Well let me add one thing here. I think if we had wanted to reach the top of the crater and did nothing else that we could have done that within the time period allotted, but I think that this method in which we reverted to that of collecting rocks from a point not quite near the top of the crater provided a lot more geologically, and gave us a better cross section of the rocks in the area, and therefore a better chance of getting rocks ejected from Imbrium than had we gone to the crater and back, and not collected as many rocks."

Fullerton, "The next question is for Stu Roosa. Stu. What did you see of the Lunar Module from orbit?"



Roosa, "The first pass that I made on the landmark tracking, I picked the LM up with no problem. It just showed up as a white spot, obviously something foreign to the lunar surface reflecting light, but the ringer was the long shadow put out. The first day I tracked it, while the sun angle was still pretty low, and you could see the shadow coming out and the shadow and the reflection cinched it as the LM. Now you couldn't see a shape of the LM as such but - with no doubt, the LM was there. And on the next day as I was doing landmark tracking, it was not on the schedule to track the LM again, however, I had a landmark just prior to the Fra Mauro region, and one after it, and I was in the right attitude for landmark tracking, so I looked for the LM again - apparently this time without any trouble. The shadow had diminished to almost nothing to landmark just prior to the Fra Mauro region and one after it, and I was in the right attitude for landmark tracking, so I looked for the LM again and found it this time without any trouble. The shadow had diminished to almost nothing, or it was very small, but here again, then I could see the glint coming off the ALSEP. At this time the ALSEP had been deployed, so I could see the glint coming off it, and I checked with Ron Evans later and told him what I thought it was and he agreed that that was the ALSEP location."

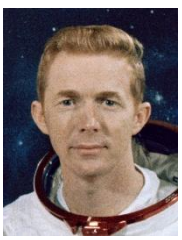
Fullerton, "The next question is also for you, Stu. A top priority for you is taking detailed pictures of the Descartes Crater as a possible landing site for a later mission. Since your big camera was broken, do you think you got enough high resolution photos?"



Roosa, "Well, I guess I'd say yes. We made 3 passes with the 500 millimetre, using what we call the COAS manoeuvre, or you PITCH and keep the camera on the Descartes landing site, and this way you get a real good stereo. And I guess we will have to develop the pictures and see how they are, but I'd say the answer to that is probably yes, but I really can't answer it completely at this time."

Fullerton, "Was there a docking problem, and battery problem, abort switch problem and a problem with the landing radar? How concerned were you about not making a successful landing or a safe return?"

Mitchell, "This is Ed. I never doubted it for a minute we were going to make it."



Roosa, "Well, I guess we're always concerned about the operation of the equipment. That's what we're up here to assure that it operates to the best of our ability, as well as it's designed to function all the time. We're always concerned

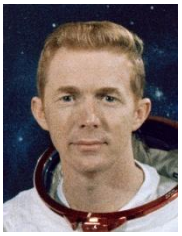
about that, and we still are - I still have a little bit of this voice left to go, and we're still concerned about a safe return. I think that anyone that's involved in this kind of a business of a research line, has to be concerned until the flight's totally over."

Mitchell, "I'd like to make one other comment about the question about the news pictures of Descartes. The photographic technique which we used is essentially the same as Apollo 12 used, which took the pictures of the area in which it landed. We feel that was successful."

Fullerton, "The next question – other crews had trouble with dust. How did that affect you on landing; on the surface; and on the way back?"

Shepard, "Well, let me take the landing part, and I'll give Ed the surface part and I'll let Stu handle the way back part. As far as the landing was concerned, there was less dust than I figured, and I think that was generally borne out as we progressed through our EVA, but the dust started forming, I think, approximately 100 feet (30 metres) above the surface, maybe 150 (45 metres). It was a thin layer, as we've seen before, but was less dense than I expected. And it did not interfere with my vision or capability to land at all. Now, do you want to talk about how it was on the surface, Ed?"

Mitchell, "I think it was substantially as previous crews have reported it, as far as working on the surface is concerned. It's a nuisance. The material is soft. It clings very readily to equipment, to suits, and it's a nuisance, but surprisingly, we didn't find that we had too much of it in the LM with us in the evening, starting on the first night, nor did we feel we carried too much of it back in with us after the second EVA. Except for the fact that it had impregnated the top of the suits and was on most other pieces of cloth. However, it came off of the metal very readily and that didn't cause any problems. I think it was more of a nuisance than anything else."



Roosa, "Okay, as far as – after the docking and on the way back, the dust problem's really been non-existent. They – of course Al and Ed took their suits off in the LM and then we have a vacuum cleaner in the command module, which I passed over, and they vacuumed the suits. And I passed over several bags in which they put all of the equipment that they brought from the lunar surface, into these bags. They have zippers on them and so forth to keep the fine dust in. So, I took each one of their suits and put it in a special suit bag that we have in here and another bag that they came back across and by holding a little positive pressure in the command module, we've had very little dust, and absolutely no problem at all."

Shepard, "I might just add, too, that we certainly have benefited from the lessons of earlier flights in this respect. I think the problem, particularly on Apollo 12, showed us how to handle the dust problem and I think that we have most of the answers now solved."

Fullerton, "Now we'd like you tell us about the rocks you're bringing back. How big are they? What is their texture, colour and did they crumble? And compare them with the rocks on Apollo 11 and 12."

Shepard, "Well, I tell you. We've been so busy we really haven't looked at the rocks. Stu's going to see if he can find one for us now. But while he is digging, to comment on that particular question, of course we don't have the equipment here to analyse these rocks from the standpoint of mineral content and how they compare with the various mineral percentages with those brought back. We didn't have a dust problem until just now. With respect to size, I think the largest one we have brought back is about a foot (0.3 metre) in diameter. And the large rocks we've brought back were not crumbly. Some of the rock specimens, the smaller hand samples that we collected, were in fact crumbly, but the large rocks we brought back I think we have four or five

relatively large rocks. And these are not of the crumbling type. I think we're faced with a different sort of problem that has just now been created. I think we'll have to hold on showing you a rock until we get back."

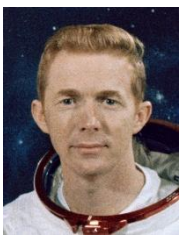
Fullerton, "Okay."

Roosa, "I don't want to get a rock out."

Fullerton, "The next question is for Al Shepard. Was the terrain in the landing area different from what you expected and describe your reaction to landing on a slope."

Shepard, "No. With respect to the general terrain, it was exactly as we had expected. As a matter of fact, as soon as the vehicle pitched over in the final stages of the landing approach, and we were able to recognize where we were and could control the spacecraft accordingly, we were essentially right on target, and we landed essentially right on target. I had originally planned to land a little bit to the south of the designated spot within a couple hundred yards because I thought it was smoother there. It turned out that there really was no smooth place in the general area of the landing site. As far as slope was concerned, there was something like 7 degrees slope, and it didn't give us any problem at all. The LM landed very softly, gently. No tendency for it to topple over, and it stayed there steady as a rock for the duration of the stay."

Fullerton, "This next question is for each of you. As Space Pilots, what is your dominant professional impression of the flight?"



Roosa, "Well, I guess any comment like that – the answer that I'd give would be that to me it's gone - it's been very gratifying and I think it's been a challenge. I think each one of us has certainly had the chance to use his abilities as a research pilot and a scientist, and I think it's gone real well up to this point. And before we elaborate too much on a post mission conference, I'd rather wait till after re-entry."

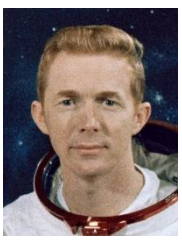
Mitchell, "I think Stu's put it very well. The small things we've had to encounter that were unexpected have been handled very well by the entire team. I think everyone on the team functioned very well, certainly from our point of view. And all the major objectives that we went after were accomplished, at least well backed up… In my opinion, the mission was, to this point, quite a success. And I expect the re-entry to be quite a success."

Shepard, "I would only add to these comments that we're basically sensible people. That we're involved in a program of developing and promoting technology. Apollo 14 is only one step in the space technology. I feel that Apollo 14, has been a resounding success and I don't really think that we've been able to assess at this stage what the contributions will be, but I can intuitively tell from what we've done, what we've seen on the surface, that we're bringing back a lot of information photographically and geologically, that we've left stations and other stations on the moon sending back information for scientific purposes, and I think that generally speaking that it is a smashing success."

Fullerton, "Again, for each of you. What event in the flight touched you most emotionally?"

Shepard, "Well, I think the big emotion for me is yet to come, and that's getting both feet on the carrier!"

Roosa, "Okay, I'd say up to – there's been a lot of rather tremendous sights on the mission so far and re-entry will be another one, but I guess the first look at the moon after you burn LOI and in the darkness and you come around, pitch to an attitude where you can see the Moon and it's there below you at about 60 miles (111 kilometres) and it looks like about 200 feet (61 metres). And your first impression of its body is a rather tremendous thing."



Mitchell, “I think Stu’s sight is my number 2, and my number 1 impact is when we pitched over and there was Cone Crater right out the window. It was very impressive.”

Fullerton, “You have not talked to your wives and families since you left Cape Kennedy, is there anything that you would like to say to them now? We’ll make sure they hear about it.”

Shepard, “Well, thank you. I’m sure you all have done a wonderful job of keeping them posted particularly with the communications and everything and I guess perhaps they’re probably as well informed of the flight as we are ourselves. We’re all very well, very happy, and say hello and we’ll look forward to seeing them in a few days.”

Fullerton, “The next question is for Al. Would you give us your personal feelings about the differences between the rides on Freedom 7 a decade ago and Apollo 14.”

Shepard, “One big step. It’s very difficult to – of course as the question implies – discuss the technical differences between the two flights. And standpoint of personal differences, I think that for those days, that the Mercury Redstone flight was just as much of an individual challenge as has been Apollo 14. I think, of course, the machinery is different, but the men with whom we worked, the individuals that helped us along, are pretty much the same and therefore the emotions are pretty much the same. They were both a great thrill for me, there’s no question about that.”

Fullerton, “The final question is also for Al. You became the first Lunar Golfer with your little 6-iron. How many golf balls did you hit, how far did they go, and did you make the green?”

Shepard, “Well, you saw the whole action on television. I missed the first one. The second one went perhaps a couple of hundred yards (183 metres) and the third one perhaps about 400 yards (366 metres), which was not bad for a 6 iron.”

Mitchell, “Let me add – there weren’t any greens in sight.”

Shepard, “There were no green rocks.”

Fullerton, “Thank you very much. We’ve certainly enjoyed every minute of your commentary. And this concludes the list of questions that we have for you. Thanks again.”

Shepard, “Thank you, and we’ll look forward to seeing you shortly.”

The press conference, lasting 23 minutes, finished at 194:52:00 GET (0955:02 AEDST)

WEDNESDAY, 10 FEBRUARY 1971 - AEST DAY - 10

Approaching Earth and the end of the mission, the Service Module was jettisoned at 215:32:42 GET (0635:44 AEST) and the spacecraft manoeuvred to face the heat shield forward.

Re-entry

Apollo 14 came booming home, slamming into the atmosphere at 39,688 kilometres per hour with Entry Interface at 215:47:45 GET (0650:47 AEDST), and the drogues billowing in the slipstream by 215:56:08 GET (0659:10 AEST) to drop the Command Module into the Pacific Ocean at location 27° 1’ 12"S x 172° 40’ 12" W.

SPLASHDOWN

End of Mission

So, after an uneventful return journey lasting 67 hours 9 minutes 14 seconds Kitty Hawk splashed into the Pacific Ocean at 216:01:58.1 GET 9 February UT (0705:00 AEST on 10 February), 7 kilometres from the recovery aircraft carrier USS New Orleans.

Recovery called, *“Stand by for splash on third mark.”*

Roosa, *“Okay….I got 100 feet (30.5 metres) ….I show 100 feet.”*

Shepard, *“One hundred….”*

Recovery, *“Mark. Mark…..MARK.”*

Kitty Hawk descends under parachutes towards a splashdown in the South Pacific Ocean. Image: NASA

With the Command Module Kitty Hawk safely on the ocean a sense of relief swept through the crew:

Roosa, *"We did it, Ed."*

Shepard, *"You got it."*

Roosa, *"Hey, I think we made it."*

Shepard, *"Hey, we did it."*

Roosa, *"We made it… good show."*

Shepard, *"Okay. Ha, ha!"*

Recovery carrier, *"Apollo 14. This is New Orleans. Welcome home."*

Shepard, *"We're stable one. Everybody's in good shape."*

'Stable one' meant the spacecraft was right way up, ready for the swimmers.

The spacecraft hatch was opened at 216:37:00 GET (0740:02 AEST) and the crew were welcomed aboard the carrier at 216:50:00 GET (0753:02 AEST).

The total distance travelled by the spacecraft over 9 days, 1 minute and 58 seconds was estimated to be 1,000,279 nm, or 1,852,517 kilometres.

The Apollo 14 crew spent 15 days quarantined in the Lunar Receiving Laboratory, the last time it was used, as no signs of any lunar microbes were ever found.

It wasn't until after the mission that Shepard was reading the morning paper over his breakfast in the Laboratory that he found out Edgar Mitchell had secretly conducted the first ESP experiment in space during his mission. Mitchell said, "*It was really intended to be a very personal and private experiment."* Instead of taking a set of Zener ESP cards, Mitchell used the 5 card symbols, and by prearrangement with three parapsychologists on Earth, tried to transmit the symbols before going to sleep during the flight. So, instead of using the cards, he generated four tables of 25 random numbers using numbers from 1 to 5. He then assigned a Zener symbol to each number. He then checked the particular table of random numbers and thought about the corresponding symbol for about 15 seconds. Each transmission took about 6 minutes. He tried four times during the flight to and from the Moon, but never on the lunar surface. Although they tried to coordinate times

with the participants on Earth, they found it didn't make any difference experimenting during the Houston evenings.

Shepard's reaction was predictable – Mitchell's tale of the mission would have probably been very different if Shepard had found out before the mission! Though there were some supporters at the time, NASA's reaction was to keep their distance. In his book Psychic Exploration – A Challenge to Science, (1974) Mitchell wrote, "The results were statistically significant, not because any of the receivers got a large number of direct hits, but because the number of hits was amazingly low. The statistical probability of scoring so few hits was about 3000:1" With the disappointing results the experiments faded into obscurity.

Shepard summarised his mission, "I look back now on the flights carrying Pete's crew and my crew as the real pioneering explorations of the Moon. Neil, Buzz and Mike in Apollo 11 proved that man could get to the Moon and do useful scientific work. Our two flights – Apollos 12 and 14 – proved that man could get there with precision and carry out objectives with relative ease and a very high degree of success. We were all able to make minor corrections or major changes at times when they were needed, sometimes for better efficiency, and sometimes to save the mission."

Shepard and Mitchell found difficulty in meeting the geologists' requirements, and failed to document all the samples properly, giving the scientists extra work identifying them.

In this photo taken on 19 February 1971, Apollo 14 astronauts show off some of the largest of the lunar rocks they brought back from the moon during a through-the-glass meeting with news men in the Crew Reception Area of the Lunar Receiving Laboratory (LRL) at the Manned Spacecraft Center (MSC). Ed Mitchell points out a large basketball-size rock, as Stuart Roosa (centre) and Alan Shepard (right) look on. Four of the 14 men quarantined with the Apollo 14 crew look on in the background. Image: NASA S71-20373

Apollo 14 was the last time the Lunar Receiving Lab was used, and the last time the astronauts had to walk their excursions.

The next mission began a new phase of the Apollo program using a small vehicle to transport the astronauts around the lunar surface, and science took on a bigger role.

Essay by Hamish Lindsay.
Images, illustrations and captions by Hamish Lindsay, Colin Mackellar, and Glen Nagle.
Unless specified, audio recorded by Bernard Scrivener, digitised by Mike Dinn, edited and encoded by Colin Mackellar.
PDF formatted by Glen Nagle.

ACRONYMS

AEST	Australian Eastern Standard Time
AGS	Abort Guidance System – *to abort landing and return to the CSM*
ALSEP	Apollo Lunar Scientific Package – *left behind for science*
BSLSS	Buddy Secondary Life Support System – *astronauts sharing life support systems*
CM	Command Module
CSM	Command and Service Module
ETB	Equipment Transfer Bag
EVA	Extra Vehicular Activities – *exiting the spacecraft such as space walks*
GET	Ground Elapsed Time – *the time in hours/minutes/seconds from lift-off*
INCO	Instrumentation & Communications Officer – *in Mission Control, Houston*
LM	Lunar Module
LPM	Lunar Portable Magnetometer
LRL	Lunar Receiving Laboratory – *Houston, isolating the astronauts after their return*
LUT	Launch Umbilical Tower – *or the Saturn V launch tower*
MESA	Modularised Equipment Stowage Assembly – *on the LM*
MET	Modular Equipment Transporter – *or astronaut's trolley*
MOCR	Mission Operations Control Room – *Houston*
PDI	Powered Descent Initiation – *initiating drop down to lunar surface from orbit*
PLSS	Portable Life Support System
RCS	Reaction Control System – *the Service Module's attitude control rockets*
SM	Service Module – *carrying the consumables and science equipment*
TEI	Trans Earth Injection – *burn to send the spacecraft to go back to Earth*
TEC	Trans Earth Coast – *travelling from the Moon back to Earth*
TLC	Trans Lunar Coast – *travelling from Earth to the Moon*

ACRONYMS

TLI	Trans Lunar Injection – *a burn to send the spacecraft off to the Moon*
USEST	United States Eastern Standard Time
UT/UTC	Universal Time / Universal Co-ordinated Time

TERMS

Lurain	Lunar Terrain

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by Gene Kranz

Flight
by Chris Kraft

To a Rocky Moon
by Don Wilhelms

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by Hamish Lindsay

NASA Mission Transcripts

NASA's Apollo Flight Journal

Apollo Lunar Surface Journal
edited by Eric Jones and Ken Glover
(excerpts used with permission)

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.