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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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Prepared by the Geological Survey for the National Aeronautics and Space Administration

INTERAGENCY REPORT: ASTROGEOLOGY 20

GEOLOGIC TRANSCRIPT FROM APOLLO 11 MISSION

David Schleicher, Editor

December 1969

Prepared under NASA Contract T-65253G

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ILLUSTRATION

LIST OF ACRONYMS

CC	Capsule Communicator (Capcom)
CDR	Commander
CMP	Command Module Pilot
CSM	Command Service Module
DPS	Descent Propulsion System
EVA	Extravehicular Activity
GET	Ground Elapsed Time
GMT	Greenwich Mean Time
LAM	Lunar Landing Area Map
LEC	Lunar Equipment Conveyor
LGE	Lunar Geology Experiment
LM	Lunar Module
LMP	Lunar Module Pilot (LM pilot)
LOS	Loss of Signal
LR^3	Laser Ranging Retro-Reflector
MCC-H	Mission Control Center--Houston
MESA	Modularized Equipment Stowage Assembly
MSC	Manned Spacecraft Center
PAO	Public Affairs Office
PLSS	Portable Life Support System
PSEP	Passive Seismic Experiment Package
RCU	Remote Control Unit
SC	Sequence Camera
SEQ	Scientific Equipment Bay
SRC	Sample Return Container
SWC	Solar Wind Composition

GEOLOGIC TRANSCRIPT FROM APOLLO 11 MISSION*

By

David Schleicher, Editor

INTRODUCTION

Because complex data that are presented orally and extemporaneously are far easier to study from a written record than from the oral description alone, the Lunar Geology Experiment (LGE) team prepared a transcript of all communication between the LM and the Capcom during descent and lunar stay until the end of EVA. This transcript was a basis for study of the geologic data presented during that time.

METHOD AND RESULTS

Quick-time Transcript

A quick-time transcript was prepared by two court reporters working together (fig. 1). The first reporter transcribed the discussion on a stenograph (shorthand) typewriter, and the second translated the stenograph notes and typed the transcript. The transcript was displayed on closed-circuit television in MCC-H, generally within a minute after the corresponding voice communication. Isolated short phrases commonly appeared within seconds. Xerox copies of the transcript were distributed within a few minutes after it was typed. The total quick-time transcript comprises almost 11,000 words and covers 11 hours and 22 minutes, from GET 04 04 17 to GET 04 15 39. The part from the 2.5-hour EVA comprises roughly 4,500 words, about half of which related to the Lunar Geology Experiment.

The reporters, particularly the typist, took occasional rest periods when they deliberately omitted nongeologic discussion. Occasional brief transmissions are thus excluded, but Astronauts Armstrong's and Aldrin's comments from descent, touchdown, and EVA are essentially complete.

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*Prepared under NASA contract no. T-65253G.

THE SURFACE IS FINE AND POWDERY. I CAN KICK IT UP LOOSELY WITH MY ~~MXX~~ TOE. IT DOES ADHERE IN FINE LAYERS LIKE POWDERED CHARCOAL TO THE SOLE ~~XM~~ AND INSIDE OF MY BOOTS. I ONLY GO IN A SMALL
FRACTION OF AN INCH. MAYBE AN EIGHTH OF AN INCH, BUT I CAN SEE THE FOOT PRINTS OF MY BOOTS AND THE TREADS IN THE FINE SANDY PARTICLES.
NEIL, THIS IS HOUSTON, WE ARE COPYING.
GET 109 25

THERE SEEMS TO BE NO DIFFICULTY IN MOVING AROUND AS WE SUSPECTED IT'S EVEN PERHAPS EASIER THAN THE SIMULATIONS AT ONE SIX G THAT WE PERFORMED IN VARIOUS SIMULATIONS ON THE GROUND.
PRACTICALLY NO TROUBLE TO WALK AROUND.
THE DESCENT ENGINE DID NOT LEAVE A CRATER OF ANY SIZE. IT HAS ABOUT ONE FOOT CLEARANCE ON THE GROUND. WE ARE ESSENTIALLY ON A VERY LEVEL PLACE HERE. I CAN SEE SOME EVIDENCE OF RAYS EMINATING FROM THE DESCENT ENGINE OF A VERY SIGNIFICANT AMOUNT.
OKAY, BUZZ, WE READY TO BRING DOWN THE CAMERA.
I AM ALL READY. I THINK ITS ALL SQUARED AWAY AND IN
GOOD SHAPE.
OKAY.

Figure 1.-- Sample reproduction of quick-time transcript distributed in MCC-H during EVA's.

Revision and Paraphrasing

In response to questions from the Geology team and other experimeters, further geologic data were presented between the end of EVA and splashdown (GET: 04 18 33 to 04 18 47--questions answered right after EVA; 05 03 10 to 05 03 14--geologic summary; 05 17 17 liftoff; and 06 07 33 to 06 07 42--questions as to landing-site location, documented sampling, and depth of blocky-rimmed craters). These data comprise about 2,300 words and were transcribed in either the PAO "Mission Commentary" or the MSC "Apollo 11 Air-to-Ground Voice Transcript."

Except for the questions on PSEP and dust, these data and the original quick-time transcript have been revised and edited by members of the Lunar Geology Experiment team on the basis of repeatedly listening to the corresponding audio tapes. Particular attention has been paid to punctuation, in an attempt to convey in transcript the meanings suggested by vocal inflections, and to identify minor editing and show its reliability.

In the literal transcript, edited sections relating to the Lunar Geology Experiment are slightly indented and replace corresponding sections in the MSC transcript. The remainder of the MSC transcript has not been edited, and its time references have been preserved. Geologic descriptions made before and after EVA are excerpted from the MSC or PAO transcripts, and keyed to available time references. The paraphrased transcript attempts to convey the precise meanings suggested by vocal inflections on the audio tapes. This transcript eliminates some of the ambiguities present in the literal transcript, and it is considerably shorter. The paraphrased transcript is keyed to the literal transcript by GET, and activities are indicated, so descriptions can be tied to points on the traverse.

EVALUATION

The quick-time transcript is rough, primarily because of the speed with which it was typed. Punctuation is haphazard, and numerous misspellings and typographical errors are present. Several inadvertent omissions were made, especially during periods of bad communication, and at least one serious mistranscription (coordinates presented incorrectly at GET 04 14 37 28). The speakers are not identified, probably because the reporters were not completely familiar with their voices. But the transcript is surprisingly accurate and shows no obvious deterioration of accuracy during EVA. It is complete for all geologic aspects of the landing, LM-window description, and EVA, but it does not include voice transmissions after EVA. The reporters' courtroom experience and their experience in simulations enabled them to recognize complex terminology, to handle garbled transmissions, and to edit interruptions and intended corrections suggested by inflection.

The table on which the quick-time transcript was typed was relatively stable, thus minimizing image smear, and the TV camera was well adjusted, showing the line of transcript that had just been typed. Some of the Lunar Geology Experiment team members, however, were too far from the nearest TV monitor to read the transcript as it was displayed.

Generally, a written record is much easier to study than an oral description. Certainly the quick-time transcript proved useful for seeing whether major geologic objectives were being met and for recognizing new problems while the astronauts were still on the surface. In short, it was a valuable way to compare the data that had been gathered with those needed to solve the geologic problems. Gaps in geologic knowledge were thus readily apparent, and significant and specific questions could be posed to fill them during the mission. Moreover, the LGE transcript remains at this writing the most accurate record of voice communications for some parts of the mission, and has therefore proved invaluable for geologic study.

The paraphrased transcript condenses and clarifies the literal transcript. It is somewhat like a road map printed on an aerial photograph: the map shows where the roads are, even though it obscures the details of the photograph. Similarly, paraphrasing obscures the pauses and details of inflection, but shows what they meant. The ease of using a paraphrased transcript compensates for the possible loss of information.

RECOMMENDATIONS

Transcript Preparation and Revision

1. The Lunar Geology Experiment team should continue to use a quick-time transcript during lunar EVA's, improving techniques for production and distribution.
2. The court reporters should continue to participate in simulations, both to learn terminology and to gain more familiarity with the voices and vocal mannerisms of the crew.
3. The Lunar Geology Experiment team should be able to play back audio tapes as soon as they have been recorded; the capability of playing back short sections of tape immediately is needed to check and revise the transcript. This could be done by using two additional tape recorders in the Science Support Room.
4. Editing a transcript is time consuming. Consequently, there is a question as to how much time should be spent in devising and using elaborate punctuation to show precisely how the transcript was spoken. Probably a paraphrased transcript should be prepared from a fairly rough first revision of the original quick-time transcript, especially if the paraphrasing can be edited by the crew.
5. Because of the complexity of preparing an accurate transcript, the serivces of a highly competent secretary are needed during or immediately after the mission.

Communications Procedures

1. Some formality in oral presentation (of "Voice Communications Standards" in Lunar Geology Experiment Console Handbook Apollo 11*) would eliminate many of the anbiguities in the transcript: rigorous use of "one-one" for "eleven" for example. Some care should be taken to avoid words that are easily misconstrued, for example, "rocky" for "blocky."
2. If communication or presentation is marginal, it is helpful for the Capcom to paraphrase and repeat complex data of high scientific priority.

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* Manned Spacecraft Center, Experiments Systems Branch, 1969, Lunar Geology Experiment Console Handbook Apollo 11: Natl. Aeronautics and Space Adm., p. 4-5.

GEOLOGIC TRANSCRIPT FROM APOLLO 11 MISSION

EXPLANATION FOR TRANSCRIPT

Communication problems

_____	total loss of signal
__ __	signal broken, but recognizable as words or syllables
_ _ _	badly broken signal

Interpretation of missing words

		Examples	GET
(?)	almost-certain interpretation	virtually(?)	04 13 25 45
[__ __]	more speculative interpretation	[down there]	04 13 23 38
[ ]	editorial addition of words neglected in conversation, but understood	[That's what] it looks like down here.	04 15 34 36
{ }	alternative possibilities preferred choice on top	{insides / sides}	04 13 24 48

Punctuation

--	pause	It's--the strut isn't collapsed too far, but . . .	04 13 22 59
. . .	uncompleted sentence		
***	in the MSC transcript, three asterisks denote clipping of words or phrases.		

GMT = GET + 16 days 13 hr 32 min

Part A: Literal Transcript

Geologic Excerpts from Description during Descent

(approximate GET 04 06 46)

LMP — Forward, forward; 30 feet down; two and a half; picking up some dust.

Geologic Excerpts from LM-window Description

(approximate GET 04 06 53)

CDR — Houston, that may have seemed like a very long final phase. The auto targeting was taking us right into a football-field-sized crater, with large number of big boulders and rocks, for about one or two crater diameters around it; and it required us _ _ _ _ and flying manually over the rock field to find a reasonably good area.

LMP — We'll get to the details of what is around here, but it looks like a collection of just about every variety of shape, angularity, granularity--about every variety of rock you could find. The color is--well, it varies pretty much depending on how you're looking relative to the zero-phase point. There doesn't appear to be too much of a general color at all; however, it looks as though some of the rocks and boulders--of which there are quite a few in the near area--it looks as though they're going to have some interesting color to them. Over.

CC — Tranquility, Houston. We have you pitched up about four and a half degrees. Over.

CDR — That's confirmed by our local observation.

CDR — Houston, the guys that said that we wouldn't be able to tell precisely where we are are the winners today. We were a little busy worrying about program alarms and things like that in the part of the descent where we would normally be picking out our landing spot; and aside from a good look at several of the craters we came over in the final descent,

I haven't been able to pick out the things on the horizon as a reference as yet.

CDR The area out the left-hand window is a relatively level plain, cratered with a fairly large number of craters of the five- to fifty-foot variety, and some ridges twenty, thirty feet high, I would guess, and literally thousands of little one- and two-foot craters around the area. We see some angular blocks out several hundred feet in front of us, that are probably two feet in size and have angular edges. There is a hill in view just about on the ground track ahead of us; difficult to estimate, but might be a half mile or a mile.

CMP Sounds like it looks a lot better than it did yesterday at that very low sun angle. It looked rough as a cob then.

CDR It really was rough, Mike, over the targeted landing area. It was extremely rough--cratered and large numbers of rocks that were probably some--many larger than five or ten feet in size.

CMP When in doubt, land long.

CDR That's what we did.

CDR I'd say the color of the local surface is very comparable to that we observed from orbit at this sun angle--about 10 degrees sun angle--or that nature. It's pretty much without color. It's gray, and it's very white or chalky gray as you look into the zero-phase line, and it's considerably darker gray, more like ashen gray, as you look out 90 degrees to the sun. Some of the surface rocks in close here, that have been fractured or disturbed by the rocket-engine plume, are coated with this light gray on the outside, but where they have been broken they display a dark--very dark gray interior, and it looks like it could be country basalt.

EVA Transcript

GET		
04 13 19 16	CDR (TRANQ)	Okay. Houston, I'm on the porch.
04 13 19 20	CC	Roger, Neil.
04 13 19 36	LMP (TRANQ)	Okay. Stand by, Neil.
04 13 19 37	CC	Columbia, Columbia, this is Houston. One minute and 30 seconds to LOS. All systems GO. Over.
04 13 19 46	CMP (COLUMBIA)	Columbia. Thank you.
04 13 19 47	LMP (TRANQ)	Stay where you are a minute, Neil.
04 13 19 48	CDR (TRANQ)	Okay. Need a little slack?
04 13 20 38	CDR (TRANQ)	You need more slack, Buzz?
04 13 20 40	LMP (TRANQ)	No. Hold it just a minute.
04 13 20 41	CDR (TRANQ)	Okay.
04 13 20 56	LMP (TRANQ)	Okay. Everything's nice and straight in here.

04 13 20 58	CDR (TRANQ)	Okay. Can you pull the door open a little more?
04 13 21 00	LMP (TRANQ)	All right.
04 12 21 03	CDR (TRANQ)	Okay.
04 13 21 07	LMP (TRANQ)	Did you get the MESA out?
04 13 21 09	CDR (TRANQ)	I'm going to pull it now.
04 13 21 18	CDR (TRANQ)	Houston, the MESA came down all right.
04 13 21 22	CC	This is Houston. Roger. We copy. And we're standing by for your TV.
04 13 21 39	CDR (TRANQ)	Houston, this is Neil. Radio check.
04 13 21 42	CC	Neil, this is Houston. Loud and clear. Break. Break. Buzz, this is Houston. Radio check, and verify TV circuit breaker in.
04 13 21 54	LMP (TRANQ)	Roger, TV circuit breaker's in, and read you five-square.
04 13 22 00	CC	Roger. We're getting a picture on the TV.
04 13 22 09	LMP (TRANQ)	You got a good picture, huh?
04 13 22 11	CC	There's a great deal of contrast in it, and currently it's upside-down on our monitor, but we can make out a fair amount of detail.
04 13 22 28	LMP (TRANQ)	Okay. Will you verify the position - the opening I ought to have on the camera?
04 13 22 34	CC	Stand by.
04 13 22 48	CC	Okay, Neil, we can see you coming down the ladder now.
04 13 22 59	CDR (TRANQ)	Okay. I just checked getting back up that first step, Buzz. It's--the strut isn't collapsed too far, but. . . It's adequate to get back up.

04 13 23 10	CC	Roger. We copy.
04 13 23 11	CDR (TRANQ)	It takes a pretty good little jump.
04 13 23 25	CC	Buzz, this is Houston. F two, one one-sixtieth second for shadow photography on the sequence camera.
04 13 23 35	LMP (TRANQ)	Okay
04 13 23 38	CDR (TRANQ)	I'm at the foot of the ladder. The LM footpads are only depressed in the surface about 1 or 2 inches, although the surface appears to be very, very fine grained as you get close to it. It's almost like a powder-- down there. It's very fine.
04 13 23 13	CDR	I'm going to step off the LM now.
04 13 24 48	CDR	THAT'S ONE SMALL STEP FOR MAN, ONE GIANT LEAP FOR MANKIND.
04 13 24 48	CDR	Yes, the surface is fine and powdery. I can kick it up loosely with my toe. It does adhere in fine layers like powdered charcoal to the sole and {insides / sides} of my boots. I only go in a small fraction of an inch--maybe an eighth of an inch, but I can see the footprints of my boots and the treads in the fine sandy particles.
04 13 25 30	CC	Neil, this is Houston. We're copying.
04 13 25 45	CDR	There seems to be no difficulty in moving around, as we suspected; it's even perhaps easier than the simulations at one-sixth G that we performed in various simulations on the ground. Virtually(?) no trouble to walk around. The descent engine did not leave a crater of any size. It has about one foot clearance on the ground. We're essentially on a very level place here. I can see some evidence of rays emanating from the descent engine, but a very insignificant amount.
04 13 26 54	CDR	Okay, Buzz, we ready to bring down the camera?
04 13 26 59	LMP	I'm all ready. I think it's been all squared away and in good shape.
04 13 27 03	CDR	Okay.

04 13 27 05	LMP	Okay. You'll have to pay out all the LEC. It looks like it's coming out nice and evenly.
04 13 27 13	CDR	Okay. It's quite dark here in the shadow and a little hard for me to see that I have good footing. I'll work my way over into the sunlight here without looking directly into the sun.
04 13 27 28	LMP	Okay. It's taut now.
04 13 27 51	LMP	Okay. I think you're pulling the wrong one.
04 13 27 55	CDR	I'm just--Okay. I'm ready to pull it down now. There was still a little bit left in the--
04 13 28 01	LMP	Okay. Don't hold it quite so tight.
04 13 28 02	CDR	Okay.
04 13 28 17	CDR	Looking up at the LM--I'm standing directly in the shadow now looking up at Buzz in the windows--and I can see everything quite clearly. The light is sufficiently bright--backlighted into the front of the LM--that everything is very clearly visible.
04 13 28 55	LMP	Okay, I'm going to be changing the film magazine(?).
04 13 28 58	CDR	Okay.
04 13 30 23	CDR	The camera is installed on the RCU bracket, and I'm storing the LEC on the secondary strut.
04 13 30 53	CDR	I'll step out and take some of my first pictures here.
04 13 31 05	CC	Roger. Neil, we're reading you loud and clear. We see you getting some pictures and the contingency sample.
04 13 32 19	CC	Neil, this is Houston. Did you copy about the contingency sample? Over.
04 13 32 26	CDR	Roger. I'm going to get to that just as soon as I finish these picture series.
04 13 33 25	LMP	Okay. Going to get the contingency sample there, Neil?

04 13 33 27	CDR	Right.
04 13 33 30	LMP	Okay, that's good.
04 13 33 58	LMP	Okay, the contingency sample is down and it's up--sample(?). Looks like(?) it's a little difficult to dig through the--[surficial crust there].
04 13 34 12	CDR	[This surface is] very interesting; it's a very soft surface, but here and there where I plug with the contingency sample collector, I run into very hard surface, but it appears to be very cohesive material of the same sort. I'll try to get a rock in here--just a couple.
04 13 34 54	LMP	That looks beautiful from here, Neil.
04 13 34 56	CDR	It has a stark beauty all its own. It's like much of the high desert of the United States. It's different, but it's very pretty out here. Be advised that a lot of the rock samples out here--the hard rock samples--have what appear to be vesicles in the surface. Also I'm looking at one now that appears to have some sort of phenocrysts.
04 13 35 30	CC	Houston. Roger. Out.
04 13 35 43	LMP	Okay, the handle is off the [contingency sampler]. It pushes in about--oh--six, eight inches into the surface. [Looks] like it's pretty easy to ___ ___.
04 13 35 56	CDR	Yes, it is. I'm sure I could push it in farther, but it's hard for me to bend down farther than
04 13 36 07	LMP	Now, you can throw so far.
04 13 36 08	CDR	You can really throw things a long way up here.
04 13 36 32	CDR	That pocket open Buzz?
04 13 36 35	LMP	Yes, it is. It's not up against your suit though. Hit it back once more. More toward the inside. Okay. That's good.
04 13 36 57	CDR	That in the pocket?
04 13 36 52	LMP	Yes. Push down.

04 13 36 55	CDR	Got it?
04 13 36 57	LMP	No. It's not all the way in. Push it. There you go.
04 13 37 08	CDR	Contingency sample is in the pocket. My oxygen is 81 percent. I have no flags, and I'm in minimum flow.
04 13 37 22	CC	This is Houston. Roger, Neil.
04 13 37 40	LMP	Okay, I got the cameras on at one frame a second.
04 13 37 44	CDR	Okay.
04 13 37 52	LMP	And I've got the 80 percent, no flags.
04 13 38 00	CDR	Are you getting a TV picture now, Houston?
04 13 38 05	CC	Neil, yes we are getting a TV picture.
04 13 38 22	CC	Neil, this is Houston. We're getting a picture. You're not in it at the present time. We can see the bag on the LEC being moved by Buzz, though. Here you come into our field of view.
04 13 38 33	CDR	...
04 13 38 35	LMP	Roger.
04 13 38 36	CDR	Hold it a second. First let me move that over the edge for you.
04 13 38 41	LMP	Okay. Are you ready for me to come out?
04 13 38 42	CDR	Yes. Just stand by a second. I'll move this over the handrail.
04 13 39 06	CDR	Okay.
04 13 39 07	LMP	All right. That's got it. Are you ready?
04 13 39 11	CDR	All set. Okay. You saw what difficulties I was having. I'll try to watch your PLSS from underneath here.

04 13 39 43	LMP	All right. The backup camera's positioned.
04 13 39 57	CDR	Okay. Your PLSS is - Looks like it is clearing okay. Your toes are about to come over the sill. Okay. Now drop your PLSS down. There you go; you're clear. And laterally you're good. You've got an inch clearance on top of your PLSS.
04 13 40 18	LMP	Okay. You need a little bit of arching of the back to come down. ... How are are my feet from the edge?
04 13 40 27	CDR	Okay. You're right at the edge of the porch.
04 13 40 30	LMP	Okay. Back in *** little of foot movement *** porch. Little arching of the back. Helmet comes up and clears the bulkhead without any trouble at all.
04 13 40 48	CDR	Looks good.
04 13 41 08	CC	Neil, this is Houston. Based on your camera transfer with the LEC, do you foresee any difficulties in SRC transfer? Over.
04 13 41 18	CDR	Negative.
04 13 41 28	LMP	Okay. Now I want to back up and partially close the hatch.
04 13 41 47	LMP	Making sure not to lock it on my way out.
04 13 41 53	CDR	(Laughter) A pretty good thought.
04 13 41 56	LMP	That's our home for the next couple of hours and we want to take good care of it. Okay. I'm on the top step and I can look down over the RCU, landing gear pads. It's a very simple matter to hop down from one step to the next.
04 13 42 18	CDR	Yes. I found I could be very comfortable, and walking is also very comfortable.
04 13 42 28	CDR	You've got three more steps and then a long one.

04 13 42 42	LMP	Okay. I'm going to leave that one foot up there and both hands down to about the fourth rung up.
04 13 42 50	CDR	There you go.
04 13 42 53	LMP	Okay. Now I think I'll do the same ***
04 13 43 01	CDR	A little more. About another inch.
04 13 43 05	CDR	THERE YOU GOT IT.
04 13 43 08	CDR	That's a good step. About a 3-footer.
04 13 43 16	LMP	Beautiful view!
04 13 43 18	CDR	Isn't that something! Magnificent sight out here.
04 13 43 24	LMP	Magnificent desolation.
04 13 43 47	LMP	Looks like the secondary strut *** little thermal effects on it right here, Neil.
04 13 43 54	CDR	Yes. I noticed that. That seems to be the worst, although similar effects are on - all around.
04 13 44 07	LMP	Very, very fine powder, isn't it.
04 13 44 09	CDR	Isn't it fine?
04 13 44 11	LMP	Right in this area I don't think there's much of any[thing but] fine powder; some [of it] clods together, and it's hard to tell whether it's a clod or a rock.
04 13 44 23	CDR	Notice how you can kick(?) it up.
04 13 44 28	LMP	Yeah, and it bounces and then. . .
04 13 44 55	LMP	Reaching down fairly easy. Get my suit dirty at this stage.

04 13 45 11	LMP	The mass of the backpack does have some effect in inertia.
04 13 45 30	LMP	There's a slight tendency, I can see now, to _____ backwards, _ _ _ due to the soft--very soft texture.
04 13 45 45	CDR	You're standing on a rock--big rock there now.
04 13 46 01	LMP	This pad sure didn't _ _ _.
04 13 46 05	CDR	No, it didn't.
04 13 46 08	LMP	There's absolutely no crater there at all from the engine.
04 13 46 10	CDR	No.
04 13 46 12	LMP	I wonder if that right under the engine is where the probe might have hit, _____ [side like that.]
04 13 46 25	CDR	Yes, that's--I think that's a good representation of our sideward velocity at touchdown, there. It folded(?) the probe.
04 13 46 30	LMP	See that probe over on the -Y strut? Broken off and bent back up.
04 13 46 40	CDR	Yes, it did, didn't it? The other two both bent over.
04 13 47 04	LMP	Can't say too much for the visibility right here without the visor up.
		Pretty dark. It looks like here's the surface of a rounded rock. Incidentally these rocks have a very powdery surface, __ __ __ __.
04 13 47 40	CC	Say again, please, Buzz; you're cutting out.
04 13 47 45	LMP	I say that the rocks are rather slippery.
04 13 47 50	CC	Roger.
04 13 47 52	LMP	A powdery surface when it's on there, fill up all the very little fine porouses [sic]. you tend to slide over it rather easily.
04 13 48 25	LMP	Traction seems quite good _ _ [area].

04 13 48 30	LMP	*** About to lose my balance in one direction and recovery is a quite natural and very easy *** And, moving your arms around, Jack, doesn't *** off the surface *** not quite that light-footed.
04 13 49 06	CDR	And, I have the insulation off the MESA now and MESA seems to be in good shape.
04 13 49 13	LMP	Got to be careful that you are leaning in the direction you want to go, otherwise you *** slightly inebriated. In other words, you have to cross your foot over to stay underneath where your center-of-mass is.
04 13 49 37	LMP	Neil, didn't I say we might see some purple rock?
04 13 49 42	CDR	Find a purple rock?
04 13 49 44	LMP	Yep; very small sparkly fragments are ___ [the rock] [especially strong] in places. I would make a first guess of some biotite. I will leave that to the further analysis.
04 13 50 28	LMP	Soil compacts underneath _____. You don't sink down more than a quarter of an inch.
04 13 50 59	CDR	Okay, Houston. I'm going to change lenses on you.
04 13 51 05	CC	Roger, Neil.
04 13 51 30	CDR	Okay, Houston, tell me if [you] get a new picture.
04 13 51 35	CC	Neil, this is Houston. That's affirmative: we are getting a new picture. You can tell it's a longer focal length lens. And for your information, all LM systems are go. Over.
04 13 51 46	LMP	We appreciate that. Thank you.
04 13 52 19	LMP	Neil is now unveiling the plaque *** gear.
04 13 52 27	CC	Roger, we've got you bore sighted but [back and to one side.]

04 13 52 40	CDR	For those who haven't read the plaque, we'll read the plaque that's on the front landing gear of this LM. First there's two hemispheres, one showing each of the two hemispheres of the Earth. Underneath it says "Here Man from the planet Earth first set foot upon the Moon, July 1969 A.D. We came in peace for all mankind." It has the crew members' signature and the signature of the President of the United States.
04 13 53 35	CDR	Ready for the camera? I'll get it.
04 13 53 38	LMP	[No, you take the TV; I'll get it].
04 13 53 45	CDR	Watch the LEC, there.
04 13 53 53	LMP	I'm afraid these soft materials are going to get _____ dusty.
04 13 43 07	LMP	The surface material [is] powdery. I don't know how good your lens is, but if you can _____ smudges on my gloves. Very much like a very finely powdered carbon, but pretty sooty(?) looking.
04 13 54 40	CDR	Would you pull out some of my cable for me, Buzz?
04 13 54 58	LMP	Houston. How close are you able to get things in focus?
04 13 55 02	CC	This is Houston. We can see Buzz's right hand. It is somewhat out of focus. I'd say we were focusing down to probably - oh, about 8 inches to a foot behind the position of his hand when he was pulling out the cable.
04 13 55 21	LMP	Okay. How's the temperature on there?
04 13 55 25	CDR	Temperature of the camera is showing zero.
04 13 55 32	LMP	I'm a little cool. I think I'll trade ***
04 13 55 43	LMP	I'm on intermediate now, Houston, and I show 3.78. No flags, 70 ***
04 13 55 50	CC	Houston. Roger. Out.
04 13 55 57	LMP	And, we'll probably need a little *** distance *** back location *** television camera.

04 13 56 14	LMP	Neil, look at the -Y strut, the direction of travel there, traveling from right to left.
04 13 56 24	CDR	Right.
04 13 56 25	LMP	So this one over here underneath the ascent engine where the probe first hit-- [the minus Y probe — —].
04 13 56 35	CDR	I got plenty of cable?
04 13 56 38	LMP	You got plenty--plenty more.
04 13 56 48	LMP	Okay, I think I got the end of it.
04 13 56 51	CDR	Something interesting in the bottom of this little crater here. It may be . . .
04 13 57 01	LMP	Now keep going. We've got a lot more.
04 13 57 03	CDR	Okay.
04 13 57 04	LMP	Getting a little harder to pull out, here.
04 13 57 30	CDR	How far would you say I am, Buzz?
04 13 57 33	LMP	Forty, 50 feet. Why don't you turn around and let them get a view from there and see what the field of view looks like?
04 13 57 42	CDR	Okay.
04 13 57 45	LMP	You're backing into the cable.
04 13 57 46	CDR	Okay.
04 13 57 50	LMP	Turn around to your right, would be better.
04 13 57 53	CDR	I don't want to go into the Sun if I can avoid it.
04 13 57 55	LMP	That's right. Yes.
04 13 57 59	CDR	I'll just leave it--
04 13 58 01	LMP	- -All right.
04 12 58 02	CDR	- -sit like that and walk around it.

04 13 58 06	LMP	Houston. How's that field of view going to pick up the MESA? ***far away?
04 13 58 15	CC	Roger.
04 13 58 20	CC	Neil, this is Houston. The field of view is okay. We'd like you to aim it a little bit more to the right. Over.
04 13 58 28	CDR	Okay.
04 13 58 32	LMP	Okay. That's all the cable we have. ***not going out. I'll start working on the solar wind - -
04 13 58 40	CC	A little bit too much to the right. Can you bring it back left about 4 or 5 degrees?
04 13 58 50	CC	Okay. That looks good Neil.
04 13 58 55	CDR	Okay, now. Do you think I ought to be farther away, or closer?
04 13 59 01	LMP	Can't get too much further away.
04 13 59 05	CDR	Let's try it like that for a while. I'll get a couple of panoramas with it, here.
04 13 59 13	CC	Roger. You look okay as far as distance goes, Neil. And we'll line you up again when you finish the panorama. Now you're going too fast on the panorama sweep. You're going to have to stop, or -
04 13 59 28	CDR	I haven't stopped--I haven't set it down yet. That's the first picture in the panorama right there.
04 13 59 35	CC	Roger.
04 13 59 40	CDR	That's taken just about north northeast.
04 13 59 52	CDR	Tell me if you get a picture, Houston.
04 13 59 54	CC	We've got a beautiful picture, Neil.
04 13 59 58	CDR	Okay, I'm going to move it.

04 14 00 10	CC	Okay, there's another good one.
04 14 00 23	CC	Okay, we got that one.
04 14 00 29	CDR	Okay, now this one is right down sun, straight west, and I want to know if you can see an angular rock in the foreground, sticking up out of the soil.
04 14 00 41	CC	Roger, we have a large angular rock in the foreground, and it looks like a much smaller rock a couple inches to the left of it. Over.
04 14 00 52	CDR	Right. And then on beyond it about 10 feet is an even larger rock that's very rounded. That rock is about--the closest one to you--is about--sticking out of the sand about 1 foot. It's about a foot and a half long and it's about 6 inches thick, but it's standing on edge.
04 14 01 16	CC	Roger.
04 14 01 26	LMP	Okay, Neil, I have got the table out, got a bag deployed.
04 14 01 33	CC	We got this view, Neil.
04 14 01 42	CDR	This is straight south.
04 14 01 45	CC	Roger, and we see the shadow of the LM.
04 14 01 48	CDR	Roger. The little hills just beyond the shadow of the LM is a pair of elongate craters about--probably the pair together--is 40 feet long and 20 feet across, and they are probably 6 feet deep. We will probably get some more work in there later.
04 14 02 20	CC	Roger. We see Buzz going about his work.
04 14 02 22	CDR	How's that for a final?
04 14 02 26	CC	For final orientation we'd like you to come left about 5 degrees. Over.
04 14 02 36	CC	Now, back to the right about half as much.
04 14 02 42	CDR	Okay?
04 14 02 53		Okay. That looks good there, Neil.

04 14 03 00	CDR	Okay?
04 14 03 20	LMP	Okay, you can make a mark, Houston.
04 14 03 24	CC	Roger, solar wind.
04 14 03 36	LMP	And, incidently, you can use the shadow that the staff makes to *** getting it perpendicular ***.
04 14 03 50	CC	Roger.
04 14 04 05	LMP	Some of these small depressions [are pretty soft] and you tend to sink--oh, maybe 2 or 3 inches. I can see exactly what the Surveyor pictures showed when they pushed away a little bit, because(?) force is transmitted through the upper surface of the soil, and about 5 or 6 inches away, it breaks loose and moves as if it were caked on the surface when in fact it really isn't.
04 14 04 43	CDR	I noticed in the soft spots where we had footprints nearly an inch deep that the soil is very cohesive, and it will retain a slope of probably seventy degrees on the side of the footprint.
04 14 06 29	CDR	Okay?
04 14 06 30	LMP	Yes. I think that's excellent.
04 14 06 39	LMP	They didn't come off?
04 14 06 46	LMP	*** get the ***
04 14 07 01	CDR	*** that part? *** a rock here.
04 14 07 38	LMP	You'll have to extend that one.
04 14 07 58	CC	Columbia, Columbia, this is Houston. Over.
04 14 08 26	LMP	***
04 14 08 53	CMP (COLUMBIA)	Houston, Columbia on the high gain. Over.
04 14 08 55	CC	Columbia, this is Houston. Reading you loud and clear. Over.
04 14 09 03	CMP (COLUMBIA)	Yes. Reading you loud and clear. How's it going?

04 14 09 05	CC	Roger. The EVA is progressing beautifully. I believe they are setting up the flag now.
04 14 09 14	CMP (COLUMBIA)	Great.
04 14 09 18	CC	I guess you're about the only person around that doesn't have TV coverage of the scene.
04 14 09 25	CMP (COLUMBIA)	That's all right. I don't mind a bit.
04 14 09 33	CMP (COLUMBIA)	How is the quality of the TV?
04 14 09 35	CC	Oh, it's beautiful, Mike. It really is.
04 14 09 39	CMP (COLUMBIA)	Oh, gee, that's great! Is the lighting half-way decent?
04 14 09 43	CC	Yes, indeed. They've got the flag up now and you can see the stars and stripes on the lunar surface.
04 14 09 50	CMP (COLUMBIA)	Beautiful. Just beautiful.
04 14 10 16	LMP	That's good. See if you can pull that end off a little bit. Take that end up a little.
04 14 10 33	CDR	It won't pull out.
04 14 10 39	CDR	Okay.
04 14 12 21	CC	Neil, this is Houston. Radio check. Over.
04 14 12 27	CDR	Roger, Houston. Loud and clear.
04 14 12 29	CC	Roger. Out.
04 14 12 30	LMP	Loud and clear, Houston.
04 14 12 32	CC	Roger, Buzz.
04 14 13 15	LMP	I'd like to evaluate the various paces that a person can *** traveling on the lunar surface. I believe I'm out of your field of view. Is that right, now, Houston?

04 14 13 30	CC	That's affirmative, Buzz.
04 14 13 37	CC	You are in our field of view now.
04 14 13 42	LMP	Okay. You do have to be rather careful to keep track of where your center of mass is. Sometimes, it takes about two or three paces to make sure you've got your feet underneath you.
04 14 14 05	LMP	About two to three or maybe four easy paces can bring you to a nearly smooth stop. *** change directions, like a football player, you just have to to *** foot out to the side and cut a little bit.
04 14 14 38	LMP	So-called kangeroo hop does work, but it seems that your forward mobility is not quite as good as - it is in the conventional - more conventional one foot after another.
04 14 15 06	LMP	It's hard saying what a sane pace might be. I think it's the one that I'm using now - would get rather tiring after several hundred *** but this may be a function of this suit, as well as lack of gravity forces.
04 14 15 47	CC	Tranquility Base, this is Houston. Could we get both of you on the camera for a minute, please?
04 14 16 00	CDR	Say again, Houston.
04 14 16 02	CC	Roger. We'd like to get both of you in the field of view of the camera for a minute.
04 14 16 09	CC	Neil and Buzz, the President of the United States is in his office now and would like to say a few words to you. Over.
04 14 16 23	CDR	That would be an honor.
04 14 16 25	CC	Go ahead, Mr. President. This is Houston. Out.

THE FOLLOWING IS A MESSAGE FROM RICHARD M. NIXON, PRESIDENT OF THE UNITED STATES; THE MESSAGE ORIGINATED FROM THE OVAL ROOM OF THE WHITE HOUSE, WASHINGTON, DISTRICT OF COLUMBIA

04 14 16 30	PRESIDENT NIXON	Neil and Buzz, I am talking to you by telephone from the Oval Room at the White House, and this certainly has to be the most historic telephone

		call ever made. I just can't tell you how proud we all are of what you *** for every American. This has to be the proudest day of our lives. And for people all over the world, I am sure they, too, join with Americans in recognizing what an immense feat this is. Because of what you have done, the heavens have become a part of man's world. And as you talk to us from the Sea of Tranquility, it inspires us to redouble our efforts to bring peace and tranquility to Earth. For one priceless moment in the whole history of man, all the people on this Earth are truly one; one in their pride in what you have done, and one in our prayers that you will return safely to Earth.
04 14 17 44	CDR	Thank you, Mr. President. It's a great honor and privilege for us to be here representing not only the United States but men of peace of all nations, and with interest and a curiosity and a vision for the future. It's an honor for us to be able to participate here today.
04 14 18 12	PRESIDENT NIXON	And thank you very much and I look forward - All of us look forward to seeing you on the Hornet on Thursday.
04 14 18 21	LMP	I look forward to that very much, sir.
04 14 18 31	CC	Columbia, Columbia, this is Houston. Over.
04 14 18 37	CMP (COLUMBIA)	Loud and clear, Houston.
04 14 18 39	CC	Roger. I got a P22 AUTO optics - AUTO optics PAD for you.
04 14 18 53	CMP (COLUMBIA)	Roger. Go ahead.
04 14 18 56	CC	Roger. P22 landmark ID, LM: T1, 110 26 56; T2, 110 32 06. Three miles south; time of closest approach, 110 33 40. Shaft 353.855, trunnion 46.495, roll zero, pitch 250, yaw zero. Over.
04 14 19 53	CMP (COLUMBIA)	Roger. Thank you. Readback not required.
04 14 19 55	CC	Roger. Out.

04 14 20 06	LMP	Houston, it's very interesting to note that when I kick my foot _____ [surface] material is _____ no atmosphere here in this gravity. _____ [be], they seem to leave, and most of them have about the same angle of departure and velocity. From where I stand, the large portion of the them will impact at a certain distance out, or several _____. There is a percentage, of course, that will impact different ranges out, so it's highly dependent upon the initial trajectory upward. Most of the--the majority of the particles come down ____ ____ [range].
04 14 21 08	CC	Roger, Buzz. And break. Break. Columbia, this is Houston. When you track out of high-gain antenna, then let's request OMNI Delta, OMNI Delta. Over.
04 14 21 20	CMP (COLUMBIA)	So be it.
04 14 21 24	LMP	I've noticed several times in going from the sunlight into the shadow, that just as I go in, I catch an additional reflection off the LM *** along with the reflection off my face onto the visor, makes visibility very poor just at the transition *** sunlight into the shadow. I essentially have so much glare coming onto my visor *** shadow *** helmet actually gets the shadow. Than it takes a short while for my eyes to adapt to the lighting conditions. *** inside the shadow area, visibility, as we said before, is not too great, but both visor's up *** what sort of footprints we have and the general condition of the soil. Then, after being out in the sunlight a while, it takes - Watch it, Neil! Neil, you're on the cable.
04 14 22 40	CDR	Okay.
04 14 22 41	LMP	Yes. Lift up your right foot, right foot. It's still - your toe is still hooked in it.
04 14 22 45	CDR	That one?
04 14 22 46	LMP	Yes. It's still hooked in it. Wait a minute. Okay. You're clear now.

04 14 22 51	CDR	Thank you.
04 14 22 55	LMP	Now, let's move that over this way.
04 14 23 04	LMP	Okay. I've got it.
04 14 23 32	LMP	The blue color of my boots have sic completely disappeared now into this--I still don't know exactly what color to describe this, other than grayish cocoa color. Seems to be covering most of the lighter part of the boot __ __ __ __ color that __ __ __ __ very fine particles, _____.
04 14 24 11	CC	Buzz, this is Houston. You're cutting out on the end of your transmissions. Can you speak a little more closely into your microphone? Over.
04 14 24 23	LMP	Roger. I'll try that.
04 14 24 25	CC	Beautiful.
04 14 24 30	LMP	Well, I had that one inside my mouth that time.
04 14 24 35	CC	It sounded a little wet.
04 14 25 09	LMP	In general, time spent in the shadow doesn't seem to have any *** thermal effects. *** inside the suit. There is a difference, of course, in the ... radiation and the helmet. So I think there's a tendency to feel a little cooler in the shadow than the Sun.
04 14 25 41	CC	Columbia, this is Houston. Over.
04 14 26 05	CC	Columbia, this is Houston. Over.
04 14 26 55	CC	Columbia, this is Houston. Over.
04 14 27 03	CMP (COLUMBIA)	Houston, Columbia in Delta.
04 14 27 05	CC	Roger. You should have VHF AOS with the LM right about now. VHF LOS will be about 40 minutes 15 seconds. Over.
04 14 27 20	CMP (COLUMBIA)	Thank you.

04 14 28 22	LMP	As I look around the area, the contrast in general is {stamped out / wiped out} completely by virtue of the shadows, almost _ _ _ _ . Looking down sun, zero phase, very light gray-colored halo around my own shadow--around the shadow of my helmet. Then as I look off cross sun, the contrast become strongest, in that the surrounding color is still fairly light. As you look down into the sun, the larger amount of _____ shadowed areas looking towards us, the general color of the ___ ___ ___ is darker than cross sun; the contrast is not as great. Surveying the dusty area that we've kicked up, considerably darker in texture [now I've kicked up one], and I imagine that this has been ___ ___ [by] certain [processes] _ _ _ _ that's in _ _ _ _ Surveyor. The same is true as I survey cross sun along the area that we've [been] walking; in general, due to the fact that there are footprints there, the general terrain where I've been kicking(?) up a lot of this surface material is generally of a darker contrast [than the surrounding] color(?).
04 14 31 29	LMP	The panorama I'll be taking is about 30 to 40 feet out the +Z strut.
04 14 31 48	LMP	And right in this area there are two craters. The one that's right in front of me now, as I look off in about the eleven o'clock position from the spacecraft, about 30 to 35 feet [across] and several [rocks to] boulders 6 to 8 inches across _____ various sizes(?).
04 14 34 13	LMP	I'm now in the area of the -Y strut, taking some ___ ___ photographs.
04 14 35 52	LMP	How's the bulk sample coming, Neil?
04 14 35 56	CDR	Bulk sample is just being sealed.
04 14 36 58	CMP (COLUMBIA)	Houston, Columbia.
04 14 37 01	CC	Columbia, this is Houston. Go ahead. Over.

04 14 37 09	CMP	Roger. No marks on the LM that time. I did see a suspiciously small white object where the coordinates are--
04 14 37 25		Go ahead with the coordinates on the small white object.
04 14 37 28	CMP	Easy point three, seven point six, but I--I'm not sure of the [coordinates]; it's right on the southwest rim of a crater; I think they would know it if they were in such a location. It looks like their LM would be pitched up at quite a degree; it's on the southwest wall of a small crater.
04 14 37 58	CC	Roger. Copy Echo 0.3 and 7.6, and -
04 14 38 27	CC	Columbia, this is Houston. While I'm talking to you, LOS will be at 111 19 31; AOS, 112 05 43. Over.
04 14 39 04	CC	Columbia, this is Houston. Did you copy LOS AOS times? Over.
04 14 39 14	CMP	Negative, Houston. You broke. Disregard. I'll get them off the flight plans.
04 14 39 19	CC	Roger. Out.
04 14 39 56	LMP	The jet deflector that's mounted on quad 1 seems to be a good bit more wrinkled *** right now on quad 4.
04 14 40 12	CC	You're breaking up again, Buzz.
04 14 40 18	LMP	I say the jets deflector that's mounted on quad 4 seems to be - the surface of it seems to be more wrinkled than the one that's on quad 1. Generally, underneath part of the LM seems to have stood up quite well to the *** get some pictures in the aft part of the LM that will illuminate the thermal effects much better than we could get them up here in the front.
04 14 40 53	CC	Roger. Out.
04 14 40 58	LMP	We're going to get some particular photographs of the bulk sample area, Neil?

04 14 41 07	CDR	Okay.
04 14 41 25	LMP	And, Houston? Buzz here. I'm showing 3.78 psi, 63 percent, no flags, adequate, slight warming *** fingered.
04 14 42 01	CDR	Roger. And Neil has 66 percent O_2, no flags, minimum cooling, and the suit pressure is 382.
04 14 42 14	CC	Houston. Roger. Out.
04 14 42 39	CC	Buzz, this is Houston. Have you removed the closeup camera from the MESA yet? Over.
04 14 42 50	LMP	Negative. Thank you.
04 14 43 18	LMP	*** get the panorama now. Okay.
04 14 43 33	LMP	Did you get it?
04 14 43 50	CDR	Houston, how does our timeline appear to be going?
04 14 43 55	CC	Roger. It looks like you're about a half hour slow on it. We're working on consumables. Over.
04 14 44 03	CDR	All right.
04 14 44 45	CC	Neil and Buzz, this is Houston. To clarify my last, your consumables are in good shape at this time. The 30-minute reference was with respect to the nominal timeline. Over.
04 14 45 03	CDR	Roger. I understand that.
04 14 46 36	CDR	Okay, don't note any abnormalities in the LM. Pads (?) seems to be in good shape, the primary and secondary struts are in good shape. Antennas are all in place. There's no evidence of a problem underneath the LM due to either(?) engine exhaust or drainage of any kind.
04 14 47 17	CC	Roger. Out.
04 14 47 18	LMP	It's very surprising--the very surprising lack of penetration of all four of the footpads. I'd say, if we were to try and determine just how far below the surface they would have penetrated, you'd measure 2 or 3 inches, wouldn't you say, Neil?

04 14 47 37	CDR	At the most, yeah. That Y strut there is probably even less than that.
04 14 47 55	LMP	___ ___ ___ job.
04 14 48 04	LMP	We got a picture of the +Y strut taken from near the descent stage, and I think we'll be able to see a little bit better what the the thermal effects are; they seem to be quite minimal.
04 14 48 48	LMP	This one picture taken at our right rear of the spacecraft looking at the skirt of the descent stage--a slight darkening of the surface color, a rather minimal amount of radiating or etching away or erosion of the surface, even though, on descent, both of us remarked that we could see a large amount of very fine dust particles moving out. It was reported beforehand that we would probably see an outgassing from the surface after actual engine shutdown, but [as(?)] I recall I was unable to verify that.
04 14 50 26	LMP	This is too big an angle, Neil.
04 14 50 34	CDR	Yes. I think you are right.
04 14 51 29	LMP	We're back at the -Z strut now. The stereo pair we're taking [of the pad] will _____ very little force of impact that we actually had.
04 14 52 01	LMP	Neil, if you'll take the camera, I'll get to work on the SEQ bay.
04 14 52 05	CDR	Okay.
04 14 52 07	CC	Columbia, Columbia, this is Houston. I notice that--
04 14 52 16	CC	Go ahead, Buzz.
04 14 52 20	LMP	Better get some closeup pictures of that rock.
04 14 52 27	LMP	I was saying that, Houston, *** stop and take a photograph or something and then want to start moving again sideways, there's quite a tendency to start doing it with just gradual sideways hops until you start getting ***
04 14 52 47	CC	Roger

04 14 52 57	LMP	Can you see us underneath the LM over at the SEQ bay, Houston?
04 14 53 00	CC	Yes indeed, Buzz. We can see your feet sticking our underneath the structure of the LM descent stage.
04 14 53 08	LMP	Okay. I'm just on the other side of the - -
04 14 53 13	CC	Now we can see you through the structure of the minus-Z secondary strut.
04 14 53 38	LMP	All right. The doors are open, and it looks like they are going to stay up without any problem.
04 14 53 46	CC	Columbia, Columbia, this is Houston. We are about to lose you on the OMNI's. Request high-gain antenna, REACQ mode Fish 20, yaw 135. Over.
04 14 54 03	LMP	Going to pick an area, Neil?
04 14 54 05	CC	Make that yaw 175, Columbia, yaw 175 on the high gain.
04 14 54 14	CMP (COLUMBIA)	Columbia is locked up on the high gain, Houston.
04 14 54 16	CC	Roger. Out.
04 14 55 42	LMP	Houston, the passive seismometer has been deployed manually.
04 14 55 49	CC	Roger.
04 14 56 30	LMP	And the manual deployment of the LR cubed, the little spring that is at the end of the string is pulled off of the picks head. However, I was able to reach up and get hold of the picks head and pull it loose. So, it will be deployed manually, also.
04 14 56 51	CC	Roger.
04 14 57 05	CDR	And the panorama is complete at the LM seven-thirty position at about 60 feet.
04 14 57 39	CDR	And the doors are closed and locked.
04 14 57 43	CC	Roger.
04 14 57 50	LMP	Have you got us a good area picked out?

04 14 57 53	CDR	I think right out on that rise out there is probably as good as any.
	LMP	Right over here?
04 14 58 08	CDR	[We'll have to] probably stay on the high ground there and. . .
04 15 58 16	LMP	Watch it! The edge of that crater is really soft.
04 14 58 19	CDR	Yeah, that's real soft there, isn't it.
04 14 58 24	LMP	Get a couple of closeups on these quite rounded large boulders.
04 14 58 44	CDR	About 40 feet out. I'd say out to the end of that next. . .
04 14 58 50	LMP	It's going to be a little difficult to find a good level spot here.
04 14 58 55	CDR	Top of that next little ridge there--wouldn't that be a pretty good place?
04 14 59 03	LMP	How about I put the LR cubed right about here?
04 14 59 07	CDR	All right.
04 14 59 10	LMP	I'm going to have to get on the other side of this rock here.
04 14 59 19	CDR	I would go right around that crater to your left there. Isn't that a level spot there?
04 14 59 25	LMP	I think this right here is just as level.
	CDR	Okay.
04 15 00 00	CDR	These boulders look like basalt, and they have probably two percent white minerals in them--white crystals; and the thing that I reported as vesicular before I'm not--I don't believe I believe that any more. I think it's small craters: they look like little impact craters where shot--BB shot--has hit the surface.
04 15 02 08	LMP	Houston. I have the seismic experiment flipped over now, and I'm aligning it, but I'm having a little bit of difficulty getting the B-B in the center. It wants to move around and around on the outside. ***

04 15 02 34	CC	You're cutting out again, Buzz.
04 15 02 49	LMP	Roger. I say I'm not having too much success in leveling the PSE experiment.
04 15 03 57	CDR	The laser reflector is installed and the bubble is leveled and the alignment appears to be good.
04 15 04 16	CC	Neil, this is Houston. Roger. Out.
04 15 04 23	LMP	Hey, you want to take a look at this B-B and see what you make out of it?
04 15 04 30	CDR	I find it pretty hard to get perfectly level, too.
04 15 04 37	LMP	That B-B likes the outside. It won't go on the inside.
04 15 04 48	CDR	That little cup is convex now, instead of concave.
04 15 04 53	LMP	I think you're right.
04 15 04 56	CDR	Believe it is.
04 15 04 57	LMP	Houston, I don't think there's any hope for using this leveling device to come up with an accurate level. It looks to me as though the cup here that the B-B is in is now convex instead of concave. Over.
04 15 05 19	CC	Roger, 11. Press on. If you think it looks level by eyeball, go ahead.
04 15 05 28	LMP	Okay.
04 15 06 03	CDR	...
04 15 06 20	CDR	There you go. Good work; good show. Hey, whoa; stop, stop! Back up.
04 15 06 34	LMP	Houston, as I was spacing the PSE, the right-hand solar array deployed automatically. The left-hand I had to manually *** the bar at the far end.
04 15 06 56	LMP	All parts of the solar array are clear of the ground now.
04 15 07 02	CC	Buzz, this is Houston. I understand that you did successfully deploy both solar arrays. Over.

04 15 07 10	LMP	Roger. That's affirmative. And there isn't any way of telling whether that's lined up. I'm getting in the way; maybe I can get down here.
04 15 07 38	LMP	Neil, how does that appear to be pointing?
04 15 08 08	CC	Neil, this is Houston. Over.
04 15 08 13	CDR	Go ahead, Houston.
04 15 08 15	CC	Roger. We've been looking at your consumables, and you're in good shape. Subject to your concurrence, we'd like to extend the duration of the EVA 15 minutes from nominal. We will still give Buzz a hack at 10 minutes for heading in. Your current elapsed time is 2 plus 12. Over.
04 15 08 45	CDR	Okay. That sounds fine.
04 15 08 47	CC	Roger. Out.
04 15 09 07	CC	Buzz, this is Houston. If you're still in the vicinity of the PSE, could you get a photograph of the ball level? Over.
04 15 09 16	CDR	I'll do that, Buzz.
04 15 09 18	LMP	Right. We'll get a photograph of that. Houston, what time would you estimate we could allow for the documented sample? Over.
04 15 09 43	CDR	Oh, shoot. Would you believe the ball is right in the middle now?
04 15 09 50	LMP	Wonderful. Take a picture before it moves.
04 15 10 00	CC	Neil, this is Houston. We're estimating about 10 minutes for the documented sampling. Over.
04 15 10 25	CC	Columbia, Columbia, this is Houston. Over.
04 15 10 34	CMP	Go ahead, Houston. Columbia.
04 15 10 36	CC	Roger. Like you to terminate charging battery Bravo at 111 plus 15. Over.

04 15 10 47	CMP	How about right now?
04 15 10 49	CC	Roger.
04 15 11 15	CC	Buzz, this is Houston. You've got about 10 minutes left now prior to commencing your EVA termination activities. Over.
04 15 11 31	LMP	Roger. I understand.
04 15 12 32	CC	Tranquility Base, this is Houston. The passive seismic experiment has been uncaged and we're observing short-period oscillations in it. Over.

04 15 15 13	LMP	I hope you're watching how hard I have to hit this into the ground, to the tune of about 5 inches, Houston.
04 15 15 22	CC	Roger.
04 15 15 35	LMP	It almost looks wet.
04 15 15 46	CDR	Got it--sample.
04 15 15 57	LMP	Wait a minute. Wait a minute. Wait a minute, you cut the cable again.
04 15 16 03	CC	All right, Neil and Buzz, this is Houston. We'd like you to--
04 15 16 04	MS	. . .
04 15 16 10	CDR	That clear?
04 15 16 11	LMP	Not quite.
04 15 16 13	CC	Neil, this is Houston, we'd like you all to get two core tubes and the solar wind experiment. Two core tubes and the solar wind. Over.
04 15 16 25	CDR	Roger.
04 15 16 51	LMP	Okay, while I'm getting the next one, maybe you can square away the box a little bit.
04 15 17 04	CDR	Yeah, I'll take care of it.
04 15 18 04	CC	Buzz, this is Houston. You have approximately 3 minutes until you must commence your EVA termination activities. Over.
04 15 18 14	LMP	Roger. Understand.
04 15 18 22	CC	Columbia, this is Houston. Approximately 1 minute to LOS. Over.
04 15 18 32	CMP	Columbia. Roger.
04 15 18 37	CC	And, do you plan on commencing your sleep on the backside this pass? If so, we'll disable uplink to you while we're talking to the LM. Over.
04 15 18 51	CMP	Negative that.

04 15 18 59	LMP	Houston, were you able to record in a documentary way where the two core-tube samples were taken?
04 15 19 12	CC	Negative.
04 15 19 19	CDR	I didn't get a stereo pair of those two, but they're right in the vicinity of the solar wind.
04 15 19 29	CC	Neil, this is Houston. After you've got the core tubes and the solar wind, anything else that you can throw into the box will be acceptable.
04 15 19 44	CDR	Righto.
04 15 19 58	CDR	Cap ___ ___ ?
04 15 20 01	LMP	I got the cap.
04 15 20 03	CDR	Got the cap?
04 15 20 04	LMP	They're both good caps on them now.
04 15 20 05	CDR	Okay.
04 15 20 07	LMP	And you want to pick up some stuff, and I'll--
04 15 20 09	CDR	Get these aseptic ones?
04 15 20 11	LMP	--move the solar wind in.
04 15 21 05	CC	Buzz, this is Houston. It's about time for you to start your EVA closeout activities.
04 15 21 16	LMP	Roger. That's in progress.
04 15 22 20	CC	Neil and Buzz, this is Houston. Like to remind you of the closeup camera magazine before you start up the ladder, Buzz.
04 15 22 30	LMP	Okay. Got that over with you, Neil?
04 15 22 34	CDR	No, the closeup camera's underneath the MESA. I'll have to pick it up with the [tongs]. I'm picking up several pieces of really vesicular rock out here now.
04 15 22 53	LMP	You didn't get anything in those environmental samples did you?
04 15 22 56	CDR	Not yet.

04 15 22 59	LMP	I don't think we'll have time.
04 15 23 07	CC	Roger, Neil and Buzz. Let's press on with getting the closeup camera magazine and closing out of the sample return containers. We're running a little low on time.
04 15 23 19	LMP	Roger.
04 15 24 04	LMP	Okay. Can you quickly stick this in my pocket, Neil, and I'll head on up the ladder.
04 15 24 07	CDR	Okay.
04 15 24 18	LMP	I'll hold it. You open the pocket up.
04 15 24 39	CDR	... that'd kill us. Just hold it right there. Okay. Let the pocket go.
04 15 24 49	LMP	About through?
04 15 24 52	CDR	Got it.
04 15 24 53	LMP	Okay. Adios, amigo.
04 15 24 56	CDR	Okay.
04 15 24 58	LMP	Anything more before I head on up, Bruce?
04 15 25 04	CC	Negative. Head on up the ladder, Buzz.
04 15 25 57	LMP	How are you coming, Neil?
04 15 25 58	CDR	Okay.
04 15 26 22	CDR	Did you get that solar wind rolled up there, Buzz?
04 15 26 24	LMP	Right. That's it right there.
04 15 26 25	CDR	Okay.
04 15 26 47	LMP	Think you can reach the - reach this hook that's hanging over here? You might entertain the idea of sending up the second one that way.
04 15 26 59	CDR	Okay.
04 15 27 05	LMP	Get the film off of that.
04 15 27 08	CDR	I will. Get that up now.
04 15 27 23	LMP	Okay. I'm heading on in.

04 15 27 24	CDR	Okay.
04 15 27 26	LMP	And I'll get the LEC all ready for the rock box.
04 15 28 02	CC	Neil, this is Houston. Did the Hasselblad magazine go up on that sample return container also?
04 15 28 12	CDR	I've got the Hasselblad magazine hooked to the SRC now, yes.
04 15 28 17	CC	Roger.
04 15 28 58	CDR	How are you doing, Buzz?
04 15 29 00	LMP	I'm okay.
04 15 29 34	LMP	About ready to send up the LEC?
04 15 29 39	CDR	Yes. Just about.
04 15 30 01	LMP	Okay.
04 15 30 45	LMP	Okay. That's got it clear.
04 15 31 04	CDR	Oh. Uh - oh. The camera came off. I mean the film pack came off.
04 15 31 30	LMP	Okay. Just ease it down now. Don't pull so hard on it. All right, let it go.
04 15 31 46	CDR	While you're getting that, I've got to get the camera.
04 15 31 55	LMP	Okay. This - This one's in. No problem.
04 15 31 58	CDR	Okay. Stand by a second.
04 15 32 02	CC	Neil, this is Houston. Request an EMU check. Over.
04 15 32 09	CDR	Roger. Got 3.8 and I got 54 on the O_2 and no flags, and my flow is in N.
04 15 33 46	CC	Neil and Buzz, for your information, your consumables remain in good shape. Out.
04 15 33 53	LMP	Roger. How's it coming, Neil?
04 15 33 56	CDR	Okay. I've got one side hooked up to the second box and I've got the film pack on.
04 15 34 01	LMP	Okay. Good.

04 15 34 20	CDR	Boy, that bilge from on the LEC is kind of falling all over me while I'm doing this.
04 15 34 30	LMP	All that soot, huh?
04 15 34 36	CDR	[That's what] it looks like down here.
04 15 34 43	LMP	I think my watch stopped, Neil.
04 15 34 47	CDR	Did it?
04 15 35 01	LMP	No, it didn't either. Second hand.
04 15 35 12	LMP	Okay. If you can just kind of hold it, why, I think I can do the pulling.
04 15 35 16	CDR	Okay. Stand by a minute. Let me move back.
04 15 35 40	LMP	Okay. Easy. All right, easy in the hatch now.
04 15 35 51	LMP	Okay. I'll get it the rest of the way. And I'll give it to you to - No, wait, just a second. Yes, a little more.
04 15 36 32	CDR	Buzz?
04 15 36 33	LMP	Okay. It's unhooked.
04 15 36 39	CDR	How about that - package out of your - brief. Get that?
04 15 36 54	LMP	No.
04 15 36 56	CDR	Okay. I'll get it when I get up there.
04 15 37 02	LMP	... now?
04 15 37 04	CDR	...
04 15 37 12	CDR	Okay?
04 15 37 13	LMP	Okay.
04 15 37 21	CC	Neil, this is Houston. Did you get the Hasselblad magazine?
04 15 37 35	CDR	Yes, I did. And we got about--I'd say--20 pounds of beautifully selected--if not documented--samples.
04 15 37 42	CC	Houston. Roger. Well done. Out.

04 15 37 48	CDR	...
04 15 38 08	LMP	Just keep your head down close. Now start arching your back. That's good. Plenty of room. Now, all right, arch your back a little, your head up against *** Roll right just a little bit. Head down. ... in good shape.
04 15 38 26	CDR	Thank you. Am I bumping now?
04 15 38 33	LMP	No, you're clear. You're rubbing up against me a little bit.
04 15 38 36	CDR	Okay?
04 15 38 38	LMP	*** All right. That's right. A bit to the left. Okay. Now move your foot, and I'll get the hatch.
04 15 38 58	CDR (TRANQ)	Okay.
04 15 39 13	LMP (TRANQ)	Okay. The hatch is closed and latched, and verified secure.

Geologic Excerpts from Description after EVA

Ten-question debriefing

04 18 33 06	CC	Tranquility, this is Houston. We also have a set of about ten questions relating to observations you made--things you may have seen during the EVA--we can either discuss a little later on this evening or sometime later in the mission at your option. How do you feel? Over.
		. . .
04 18 33 59	CC	Tranquility, this is Houston. First question here is your best estimate of the yaw on the--of the--LM as compared to the nominal pre-flight plan. Over.
04 18 34 16	LMP	We got 13 degrees left on the ball, and I think that's probably about right. Looking at the shadow and so on, we're probably about 13 degrees left of the shadow.
04 18 34 31	CC	Roger, that's 13 degrees left of the shadow. And, next question relates to the depth of the bulk sampling that you obtained near the first part of the EVA, and any changes in composition that you might have observed during the bulk sampling interval. Over.
04 18 35 02	CDR	I'm not sure I understand that question, but we got a good bit of the groundmass in the bulk sample plus a sizeable number of selected rock fragments of different types.
04 18 35 22	CC	Roger, Neil. One of the implications here is the depth from which the bulk sample was collected. Did you manage to get down there several inches or nearer the surface? Over.
04 18 35 37	CDR	We've got some down from as much as 3 inches in the area where I was looking at the variation with depth in the bulk sample. There really was an appreciable difference, and I didn't run into any hard bed. Later on, or at some other times and other areas, why I'd get down just a short distance--an inch or two--and couldn't go any further.
04 18 36 06	CC	Roger, believe we understand--down as deep as 3 inches, did not hit any hard bed, and no significant changes in composition to that depth. Next question: the second SRC was packed rather hurriedly due to the time limitations; and wonder if you would be able to provide any more detailed description of the samples which were included in the second SRC.

04 18 36 40	CDR	We got two core tubes and the solar wind, and about half a big sample bag full of assorted rocks, which I picked up hurriedly from around the area. I tried to get as many representative types as I could.
04 18 37 09	CC	Roger, Neil. Next topic here relates to the rays which emanate from the DPS engine burning area. We're wondering if the rays emanating from the--beneath the engine are any darker or lighter than the surrounding surface.
04 18 37 42	LMP	The ones that I saw back in the aft end of the spacecraft appeared to be a good bit darker, and of course, viewed from the aft end, why they did have the sun shining directly on them. It seemed as though the material had been baked somewhat, and also scattered in a radially outward direction; but in that particular area, this feature didn't extend more than about 2, maybe 3 feet, from the skirt of the engine.
04 18 38 24	CC	Understand that near the aft end out to the east, that the rays did appear darker. I understand, Buzz, that these were--this was the appearance of the material which had been uncovered by the rays, that appeared darker for 2 or 3 feet extending outward. Is that correct?
04 18 38 49	LMP	No, I wouldn't say it was necessarily material that had been uncovered. I think some of the material might have been baked or in some way caused to be more cohesive and perhaps flow together some way; I don't know. Now in other areas, before we started trampling around out in front, why we could see that small erosion had taken place in a radially outward direction, but it had left no significant mark on the surface other than just having eroded it away. Now, it was different back in the--right under the skirt itself. It seems as though the surface had been baked in a streak fashion, and I think a couple pictures on film will show this. But that didn't extend out very far. Over.
04 18 39 48	CC	Roger, Tranquility. And this baked appearance that you've described--at least the suggestion is that it was due to the heat of the engine at any rate. Next subject: did--

04 18 40 01	LMP	I believe so.
04 18 40 02	CC	Roger. Next subject: did either of the solar panels on the PSE touch the surface of the moon during deployment? Over.
04 18 40 19	LMP	I think that two corners did touch just when it was deployed; both of them didn't come out the same time. It unfolded a little unevenly, and of course the terrain that it was on was a little bit--not quite as level as it was--as I would like to have it. And I think that two corners did touch to about 1 inch, on--3/4 to 1/2 an inch deep, and maybe along the bottom it might have been maybe 3 inches--leaving a small triangular coating on two of the corners. And I think these are on the western ones. Over.
04 18 41 06	CC	Roger. Understand the description there; and the next subject--on the two core tubes which you collected, how did the driving force required to collect these tubes compare? Was there any difference? Over.
04 18 41 27	LMP	Not significantly. I could get down about the first 2 inches without much of a problem, and then as I would pound it in about as hard as I could do it--and the second one took two hands on the hammer, and I was putting pretty good dents in the top of the extension rod--and it just wouldn't go much more than--I think the total depth might have been about 8 or 9 inches. But even there it didn't--for some reason--it didn't seem to want to stand up straight. In other words, I'd keep driving it in, and it would dig some sort of hole, but it wouldn't--just penetrate in a way that would support it and keep it from falling over--if that makes any sense at all. It didn't really to me. Over.
04 18 42 22	CC	Roger, Buzz. I think I've got the picture. You indicate that--little difference between the two samples, and that in each case you got down about 2 inches without any problems and then had to continuing hammering rather vigorously in order to continue driving it in to a total depth of 8 or 9 inches, and even at that point the rods did not want to stay vertical--that they'd tend to fall over on you even after pounding in that far. Is that correct?

04 18 42 59	LMP	Yeah, that's about it. It wasn't a rapid change in resistive force. And also I noticed when I took the bit off, that the material was quite well packed, a good bit darker, and it--the way it adhered to the core tube gave me the distinct impression of being moist. Over.
04 18 43 23	CC	Roger. Understand the general impression of being moist as it packed in the core tube. Next question: we did copy your comments prior to the EVA of your general description of the area. We wonder if either of you would have any more lengthy description or more detailed description of the general summary of the geology of the area. Over.
04 18 44 01	CDR	We'll postpone our answer to that one until tomorrow, okay?
04 18 44 08	CC	Yes indeed; that'll be fine. Just a couple more here, and I think these may not be quite as lengthy as number 7 there. Can you estimate the stroke of the primary and secondary struts? Over.
04 18 44 31	CDR	Well, I could do it like this, Owen: about all the struts are about equally stroked, and the height from the ground to the first step is about 3 feet or maybe three and a half feet.
04 18 44 52	CC	Roger. Understand, Neil. Next topic: just after landing you pointed out that there was a hill to the west along the +Z axis from the LM. Are there any large rocks in that direction that might block the solar array during the sunset; as sunset approaches in your locality, are there any large rocks that might tend to obscure the array? Over.
04 18 45 32	LMP	No, I don't believe so. I think that it's about as level as any other areas that we chose. There's nothing large anyway that's going to get in the way.
04 18 45 50	CC	Roger. Copy. That's also the way it appeared from the television, I think; and now the final question: you commented, Neil, that on your approach to the landing spot, you had passed over a football-field-size crater containing rather large blocks of solid rock, perhaps 10 or 15 feet in size. Can you estimate the distance to this football-size crater from your present position? Over.

04 18 46 25	CDR	I thought we'd be close enough so that when we got outside we could see its rim back there, but I couldn't. But I don't think that we're more than a half mile beyond it. That is a half mile west of it.
04 18 46 45	CC	Roger, so you estimate your present position less than half a mile approximately west of this large crater. Over.
04 18 46 56	CDR	That's correct.
04 18 46 58	CC	Okay; well, that takes care of the questions from our geologists for tonight, and unless you have something else, that will be all from us for the evening.

Geologic Summary

05 03 10 32	CDR	And, Houston, Tranquility Base is going to give you a few comments with regard to the geology question of last night. We are landed in a relatively smooth crater field of elongate secondary--circular secondary craters, most of which have rims irrespective of their--raised rims--irrespective of their size. That's not universally true. There are a few of the smaller craters around, which do not have a discernible rim. The groundmass throughout the area is a very fine sand to a silt. I'd say the thing that would be most like it on earth is powdered graphite. Immersed in this groundmass are a wide variety of rock shapes, sizes, textures, rounded and angular, many with varying consistencies: as I said, I've seen plain--what looked to be plain basalt and vesicular basalt; others with no crystals, some with small white phenocrysts, maybe 1 to less than 5 percent. And the bould--we are in a boulder field, where the boulders range generally up to 2 feet, with a few larger than that. Now, some of the boulders are lying on top of the surface, some are partially exposed, and some are just barely exposed; and our traverse around on the surface, and particularly working with the scoop, we've run into boulders below the surface, probably buried under several inches of the groundmass.

05 03 12 55	CC	Tranquility, Houston. Roger, very fine description.
05 03 13 05	CDR	Now I suspect this boulder field may have some of its origin with this large sharp-edge {blocky / rocky}-rim crater that we passed over in final descent. Now yesterday I said that was about the size of a football field, and I have to admit it was a little--little hard to measure coming in, but I thought that it might just fit in the Astrodome as we came by it; and the rocks in the vicinity of the--of this blocky-rim crater are much larger than these in this area--some 10 feet or so and perhaps bigger; and they are very thickly populated out to about one crater diameter beyond the crater rim. Beyond that there's some diminishing, and even out in this area, the blocks seem to run out in rows and irregular patterns, and then there are {paths / spans} between them where there are considerably less surface evidence of hard rocks. Over.

Questions on PSEP location and dust during liftoff

05 17 17 11	CC	Roger, Neil. We're seeing some temperature rises on the passive seismic experiment that are a little higher than normal and were wondering if you could verify the deployed position. We understand it's about 40 feet from the LM in the eleven o'clock position. Over.
05 17 17 37	CDR	No. It's about in the nine or nine-thirty position, and I'd say it's about 50 or 60 feet.
05 17 17 50	CC	Roger. Copy. Also, did you notice - was there any indication of any dust cloud as you lifted off? Over.
05 17 18 02	CDR	Not very much. There was quite a bit of Kapton and parts of the LM that went out in all directions, usually for great distances, as far as I can tell. But I don't remember seeing anything of a dust cloud to speak of.
05 17 18 21	CC	Roger. Understand all you could see was parts of the LM going out. What was your - your first - first comment? Over.
05 17 18 35	CDR	I don't remember. Just that the Kapton and other parts on the LM staging scattering all around the area for great distances, but I didn't see much dust.

Questions on Location, Documented Sampling, Craters

06 77 33 33	CC	Apollo XI, this is Houston. While you're waiting for the CSM to settle down and for us to look at the tapes on your latest maneuver, would you feel like answering some more questions with relation to the lunar surface? Over.
06 07 33 52	CMP(?)	Go ahead, Houston.
06 07 33 59	CC	Roger. For 64,000 dollars--we're still trying. to work out the location of your landing site, Tranquility Base. We think it is located on LAM-2 Chart at Juliet point five and seven point eight. Do you still have those charts on board? Over.
06 07 34 24	CMP(?)	Stand by one; they're packed.
06 07 34 31	CC	Roger. You may not have to unpack it. The position which I just gave you is slightly west of West Crater. I guess it's about two tenths of a kilometer west of it, and we were wondering if Neil or Buzz had observed any additional landmarks during descent, lunar stay, or ascent which would confirm or disprove this. One thing that we're wondering about is that if you were at this position, you would have seen the Cat's Paw during the ascent, just up to the north of your track. Over.
06 07 35 18	CDR(?)	We were looking for the Cat's Paw too, thinking we were probably down range, beyond the Big Z. But I think that it's likely that that might have been West Crater that we went across in landing, but--stand by.
06 07 36 22	LMP	We're hoping, Bruce, that our 16-millimeter film was working at that point in descent, and we'll be able to confirm our touchdown position. We thought that during ascent we might be able to pick up some recognizable objects close to the landing site, and we did see a number of small craters and crater rows and things like that, which we may be able to pick out after the fact, but we haven't been able to yet.

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06 07 39 15	CC	Okay, XI, very good. With respect to the documented sample container: on television it appeared to us as though the samples for that container were in fact being--given--being {selected / collected} in accordance with some thought or consideration being given to the rocks themselves; and we were wondering if you could give any further details from memory about any of these samples, and the context of the material or the surface from which they were taken. Over.
06 07 39 56	CDR	Yes, you remember I initially started on the cut(?) side of the LM that the TV camera was on, and I took a number of samples of rocks on the surface and several that were just subsurface, and about 20--15 to 20 feet north of the LM; and than I recalled that that area had been probably swept pretty well by the exhaust of the descent engine, so I crossed over to the southern side of the LM and took a number of samples from the area around the elongate double crater that we commented on and several beyond that and tried to take as many different types--of rock types as I could see by eye--as I could in the short time we had available. There were a number of other samples that I had seen earlier in our stroll around the LM that I had hoped to get back and pick up and put in the documented sample, but I didn't get those and I'll be able to comment in detail when we get in the debriefing session.
06 07 41 17	CC	Roger. Did you observe any small craters with conspicuously blocky rims? Over.
06 07 41 28	CDR	Well, aside from the real big one that we went over, I guess there were none in our area. I took a stroll back after putting up the PSEP and while Buzz was starting to unpack the documented samples--took a stroll back to a crater behind us that was maybe 70 or 80 feet in diameter and 15 or 20 feet deep and took some pictures of it. It had rocks in the bottom of pretty good size--considerably bigger than any that were out on the surface, but there was no--apparently at 15 feet or so [we] had not got below the regolith. We were essentially showing no bedrock, at least in the walls of the crater at that depth. Over.

Part B: Paraphrased Geologic Transcript

Description during Descent

(approximate GET 04 06 46)

CDR Just before landing, we flew over a crater the size of a football field; it's surrounded by a large number of big boulders and rocks, extending out one or two crater diameters.

LMP The rocks here appear to have just about every variety of shape, angularity, and granularity you could find. The color varies with the direction you're looking relative to the zero-phase point. The terrain is generally almost colorless, but some of the numerous nearby rocks and boulders appear to have some interesting colors.

(Houston suggests LM is pitched up 4.5°.)

CDR That's confirmed by our local observation.

We were unable to pick out landmarks during descent, and I haven't yet been able to pick out landmarks on the horizon.

The area out the left-hand window is a relatively level plain, cratered with a fairly large number of craters 5 to 50 feet in diameter and literally thousands of little craters 1 to 2 feet across. There are some ridges I'd estimate as 20 to 30 feet high. Several hundred feet in front of us there are angular blocks probably 2 feet in size. There's a hill just about on ground track ahead of us, very roughly one-half to one mile away.

CMP At that very low sun angle yesterday, it looked rough as a cob.

CDR The targeted landing area really was extremely rough, Mike: it was heavily cratered and had large numbers of rocks, many of which were larger than 5 or 10 feet in size. So we landed long.

The color of the local surface is comparable to that we observed from orbit at a sun angle of roughly 10°. It's pretty much without color, i.e., gray, but varies from white or chalky gray as you look toward zero phase to considerably darker gray, say ashen gray, as you look perpendicular to the sun. Some of the nearby surface rocks that have been broken by the DPS plume are coated with this light gray on the outside, but have a very dark gray interior. They could be "country" basalt.

EVA Descriptions

GET			
04 13 22 59	CDR descends ladder	CDR	The +Z strut isn't collapsed too far.
04 13 23 38	CDR at foot of ladder	CDR	The LM footpads are depressed into the surface about 1 or 2 inches. As you get close to it, the surface appears to be very, very fine grained--almost like a powder.
04 13 24 48	CDR steps onto surface	CDR	The surface is fine and powdery. I can kick it up loosely with my toe It does adhere in fine layers like powdered charcoal to the sole and sides of my boots. I only go in a small fraction of an inch--maybe an eighth of an inch, but I can see the footprints of my boots and the treads in the fine sandy particles.
04 13 25 45	CDR tests mobility	CDR	The descent engine did not leave a crater of any size. It has about one foot clearance on the ground. We're on an essentially very level place here. I can see some evidence of rays emanating from the descent engine, but a very insignificant amount.
04 13 27 13	LMP feeds out LEC	CDR	It's quite dark here in the shadow and a little hard for me to see that I have good footing.
04 13 28 55	LMP changes SC film mag		
04 13 30 23	CDR installs camera on RCU bracket		
04 13 30 53	CDR takes pictures		
04 13 33 27	Contingency sampling		

04 13 33 58		LMP	Contingency sample is taken. Looks like it's a little difficult to dig through the [surficial crust?].
		CDR	This is a soft surface, but here and there where I plug with the contingency sample collector I run into a very hard surface, but it appears to be very cohesive material of the same sort. I'll try to get a rock or two in here.
04 13 34 56		CDR	A lot of the hard rock samples out here have what appear to be vesicles in the surface. Also I am looking at one now that appears to have some sort of phenocrysts.
04 13 35 43		LMP	The contingency-sampler handle pushes into the surface about 6 to 8 inches.
		CDR	It's pretty easy to push in. I'm sure I could push it in farther, but it's hard for me to bend down farther than that.
04 13 36 32	CDR stows contingency sample		
04 13 37 40	LMP sets SC to 1 frame/sec		
04 13 39 11	LMP descends to surface; CDR watches and photos LMP		
04 13 43 47	CDR and LMP inspect LM		
04 13 44 11		LMP	Right in this area I don't think there's much of anything but fine powder. It clods together; it's hard to tell whether it's a clod or a rock.

		CDR	You can kick it up.
		LMP	Yeah, and it bounces and then. . .
	LMP checks his mobility	LMP	Getting my suit dirty at this stage. There's a slight tendency to [fall] backwards due to the very soft texture.
04 13 45 45		CDR	You're standing on a big rock there now.
	CDR and LMP inspect LM	LMP	This pad sure didn't ___ ___ ___. There's absolutely no crater there at all from the engine. I wonder if that right under the engine is where the probe might have hit [moving to the side like that].
		CDR	I think that's a good representation of our sideward velocity at touchdown. It folded(?) the probe.
		LMP	See that probe on the -Y strut? Broken off and bent back up.
		CDR	The other two both bent over.
		LMP	Poor visibility right here without the visor up--pretty dark. It looks like here's the surface of a rounded rock. Incidentally, these rocks have a very powdery surface. They're rather slippery, because the powder, when it's on there, fills up all the little pores, so you tend to slide over it rather easily.
04 13 48 30	LMP checks balance; CDR works on MESA		Traction seems quite good [in this area].
04 13 49 37			Here's a purple rock with very small sparkly fragments that are [___ the rock], [especially strong] in places. I would make a first guess of some biotite. Soil compacts underneath _ _ _ _. You don't sink down more than a quarter of an inch.

04 13 50 59	CDR changes TV lens		
04 13 52 19	CDR unveils plaque		
04 13 53 38	LMP gets camera		
04 13 53 53		LMP	I'm afraid these soft materials are going to get [the camera] dusty. The surface material [is] powdery. I don't know if you can [see the] smudges on my gloves. The material is very much like a very finely powdered carbon; it's pretty sooty(?) looking.
04 13 54 58	LMP pulls out TV cable; CDR carries out camera		
04 13 56 14		LMP	The -Y strut traveled from right to left.
04 13 56 51		CDR	Something interesting in the bottom of this little crater here. It may be. . .
04 13 58 22	LMP starts on SWC	LMP	That's all the cable we have for going out. I'll start working on the solar wind.
04 13 59 28	CDR pans TV	CDR	That is the first picture in panorama, taken just about north northeast. Okay, I'm going to move it.
		CC	Okay, we got that one.
		CDR	This one is right down sun, straight west. Can you see an angular rock in the foreground, sticking up out of the soil?
		CC	Yes. And it looks like there's a much smaller rock a couple of inches to the left of it.

		CDR	Right. Beyond that rock about 10 feet is an even larger rock, that is very rounded. The rock closest to you--the one that sticks about a foot out of the sand--is about 1.5 feet long and 6 inches thick, but it's standing on edge.
04 14 01 26	LMP has table out, bag deployed		This view is straight south.
		CC	Roger. We see the LM shadow.
		CDR	The little hills just beyond the LM shadow are a pair of elongate craters. The pair together is probably 40 feet long, 20 feet across, and 6 feet deep. We'll probably describe them more fully later.
04 14 02 22	CDR orients TV camera		
04 13 03 20	LMP finishes deploying SWC		
04 14 04 05		LMP	Some of these small depressions are pretty soft(?), and you tend to sink in about 2 or 3 inches. I see what the Surveyor pictures showed when the scoop moved the surface soil: force is transmitted through a surface crust, so that small thrusts are developed 5 or 6 inches away from the scoop--or, in this case, from my foot.*
		CDR	In soft spots, where our footprints were nearly an inch deep, the soil is very cohesive, and retains a slope of about 70° on the side of the footprint.
04 14 06 30	CDR and LMP deploy flag		
04 14 13 15	LMP evaluates mobility		
04 14 16 09	CDR and LMP converse with President		

*(considerably paraphrased)

04 14 20 06		LMP	When I kick the surface material, most of the particles leave with about the same velocity and angle of departure, and a large proportion of them impact about the same distance out--several _____. Some, of course, impact at different distances, depending on their initial trajectory.
04 14 21 24	LMP evaluates visibility		
04 14 23 32		LMP	The blue color of my boots has been completely obscured by the grayish cocoa color of the dust. It seems to be covering most of the lighter part of the boot_ _ _ _ color that _ _ _ _ very fine particles.
04 14 25 09	LMP evaluates thermal effects		
04 14 28 22		LMP	As I look around the area, the contrast in general is [obliterated(?)] completely, by virtue of the shadows almost - - - -. Looking down sun, that is, at zero phase, there's a very light gray halo around the shadow of my helmet. The contrast is strongest when you look across sun, because the surrounding color is still fairly light. Looking into the sun, the larger amount of shadowed areas looking toward us, the general color of the ___ ___ ___ is darker than when looking across sun, but the contrast is not great. *The dusty area that we've kicked up is considerably darker than undisturbed areas, as was the case with Surveyor. The same is true looking cross sun into the area disturbed by our footprints; there much of the surface material has a greater contrast than the undisturbed areas.
04 14 31 29			I'll be taking a panorama 30 to 40 feet out from the +Z strut. There are two craters in this area. One is about eleven o'clock from the spacecraft and is 30 to 35 feet [across] and several [rocks and] boulders 6 to 8 inches across. *(considerably paraphrased)

04 14 34 13		LMP	I'm now near the -Y strut taking some ___ ___ photographs.
04 14 35 56	CDR seals bulk sample		
04 14 39 56	LMP inspects LM; CDR photos bulk-sample area		
04 14 46 36		CDR	There is no evidence of a problem underneath the LM due to either(?) engine exhaust or drainage of any kind.
		LMP	All four footpads have penetrated surprisingly little. I'd estimate they've penetrated 2 or 3 inches below the surface.
		CDR	At the most; that Y strut there has probably penetrated even less than that.
04 14 48 04	LMP photos +Y strut		
04 14 48 48		LMP	This one picture taken at the right rear of the LM looking at the DPS skirt shows a slight darkening of the surface color. There's a very slight etching or erosion of the surface, even though on descent, both of us saw large amounts of fine dust particles moving out. We expected to see outgassing from the surface after engine shutdown, but I've been unable to verify that.
04 14 51 29	CDR and LMP at -Z strut		We are taking a stereo pair at the -Z strut, which will [show] how small the force of our impact actually was.
	CDR takes camera		
04 14 52 20			Better get some closeup pictures of that rock.
	LMP and CDR(?) at SEQ bay PSEP "deployed manually"		

04 14 57 05		CDR	Panorama is complete at the LM seven-thirty position at about 60 feet.
04 14 57 50		LMP	Have you got us a good area picked out?
	CDR and LMP move to PSEP, LR^3 area		I think out on that rise right out there is probably as good as any.
		LMP	Right over here?
		CDR	You'll probably have to stay on the high ground there.
		LMP	Watch it, the edge of that crater is really soft.
		CDR	Yeah, that's real soft there, isn't it.
		LMP	Let's get a couple of closeups on these quite rounded large boulders.
		CDR	We're about 40 feet out. I'd say out to the end of that next. . .
		LMP	It's going to be a little difficult to find a good level spot here.
		CDR	Won't the top of that next little ridge there be a pretty good place?
		LMP	How about I put the LR cubed right about here?
		CDR	All right.
		LMP	I am going to have to get on the other side of this rock here.
		CDR	I would go right around that crater to your left there. Isn't that a level spot there?

		LMP	I think this right here is just as level.
		CDR	Okay.
04 15 00 00			These boulders look like basalt. They contain about 2 percent white crystals. What I called "vesicles" before are probably actually small craters: they look like little impact craters where BB shot has hit the surface.
	LMP levels PSEP; CDR levels LR3		
	CDR photos PSEP level		
04 15 15 13		LMP	Notice how hard I have to hit this core tube to drive it in about 5 inches. It almost looks wet.
	LMP gets first core tube, starts second; CDR prepares SRC		
04 15 19 19		CDR	I didn't get a stereo pair of the core tubes, but they were taken very near the solar wind.
	CDR and LMP cap core tubes		
04 15 20 04		LMP	Both core tubes are properly capped now.
04 15 22 34		CDR	I'm picking up several pieces of really vesicular rock out here now.
04 15 34 20			That bilge from the LEC is falling all over me while I'm doing this.
	CDR transfers up second SRC.		All that soot, huh?

Descriptions after EVA

Ten-question Debriefing (GET 04 18 33 59 to 04 18 46 58)

CDR The yaw of the LM is exactly 13° left of the nominal flight plan; and looking at the shadow, I think we're probably about 13° left of it.

LMP We got a good bit of groundmass in the bulk sample, plus a sizeable number of selected rock fragments of different types.

We got some of the bulk sample from as deep as 3 inches in the area where I was looking at variation with depth; there really was an appreciable difference, and I didn't run into any hard bed. At other times and in other areas, I couldn't get down more than an inch or two.

LMP In the second SRC we have the two core tubes, the solar-wind foil, and a big sample bag about half full of assorted rocks that I picked up hurriedly from around the area. I tried to get as many representative types as I could.

LMP The rays from the DPS engine that I saw at the aft end of the LM appeared to be a good bit darker than the surrounding surface, and they had direct sunlight on them. The material seemed to have been baked somewhat and scattered radially outward; but this feature extended no more than 2 or 3 feet from the engine skirt.

The difference in appearance doesn't necessarily mean that subsurface material was uncovered; the material might have been baked or made more cohesive somehow, or have flowed together. Before we started trampling around out in front, we could see that a little erosion had taken place in a radially outward direction. But it left no significant mark on the surface, other than just eroding it.

Right under the skirt, it was different: the surface there seems to have been baked in streaks. I think a couple of our photos will show that. That didn't extend out very far. The baked appearance was probably due to the heat of the engine.

LMP I think that two corners of the PSE solar panels touched when it was deployed. The panels unfolded a bit unevenly, and the terrain was not quite level. I think that two corners did touch. . . , leaving a small triangular coating on two of the corners; and I think these are on the western ones.

LMP The force required to drive the two core tubes didn't differ significantly. I could get down about 2 inches without much of a problem. But then I'd pound as hard as I could. The second tube took both hands on the hammer, and I put pretty good dents in the top of the extension rod. It wouldn't go in more than 8 or 9 inches. Even at that depth, the tube wouldn't stand up straight. In other words, I'd keep driving it in, and would dig sort of a hole, but it wouldn't penetrate in a way that would support it and keep it from falling over.

There wasn't a rapid change in resistive force. When I took the bit off, the material was quite well packed and a good bit darker. The way it adhered to the core tube created the distinct impression of its being moist.

CDR All the struts were about equally stroked. The height of the first step was about 3 to 3.5 feet.

LMP The solar array would not be shaded by the hill to the west that we noted just after landing, nor by any large rocks off in that direction. That area is about as level as any other.

CDR I though we'd be close enough to the football-field-sized crater so that we could see its rim when we got outside, but I couldn't. But I don't think we're more than a half mile beyond, that is, west of it.

Geologic Summary (GET 05 03 10 32 to 05 03 14 16)

CDR We're landed in a relatively smooth crater field of circular secondary craters, most of which have raised rims irrespective of their size. That's not universally true, however: a few of the smaller craters do not have discernible rims.

The groundmass throughout the area is very fine sand to silt. The thing that would be most like it on Earth is powdered graphite. Immersed in this groundmass is a wide variety of rock shapes, sizes, and textures; the rocks are both rounded and angular, and many have varying consistencies. There is apparently both vesicular and non-vesicular basalt. Some rocks are aphanitic, others have about 1 to 5 percent small white phenocrysts.

We are in a boulder field, with boulders generally less than 2 feet, but a few are larger. Some of the boulders lie on the surface, some are partly exposed, and some just barely exposed. In our traverse, particularly when using the scoop, we've run into boulders below the surface, probably buried under several inches of groundmass.

Many of the boulders may be derived from the football-field-sized crater, which has a sharp, block rim. I'd revise my earlier estimate

of diameter to say that as we came over it, I thought it might just fit in the Astrodome. The rocks near that crater are much larger than those in this area; they're 10 feet or so, perhaps bigger. They're very thickly populated out to about one crater diameter beyond the rim. Beyond that, the population diminishes, but even out in this area the blocks seem to extend in rows and irregular patterns, with paths between them having considerably less evidence of hard rocks on the surface.

Questions on PSEP Location and Dust during Liftoff (GET 05 17 17 01 to 05 17 18 50)

CC Apollo XI, Houston. We have a couple of questions. First: we have a slightly abnormal temperature rise on the passive seismic experiment. Could you verify its position as 40 feet from the LM in the eleven o'clock position?

CDR No--it's about in the nine to nine-thirty position about 50 or 60 feet out.

CC Roger. Second question: was there any indication of a dust cloud during liftoff?

CDR Not very much. Quite a bit of Kapton and parts of the LM apparently went out in all directions, usually for great distances. But I don't remember seeing anything of a dust cloud.

Questions on Location, Documented Sampling, Craters (GET 06 07 33 59 to 06 07 36 58 and 06 07 39 15 to 06 07 42 48)

CC We're still trying to work out the location of your landing site, **Tranquillity Base.** We think it is located on the LAM-2 chart at Juliet point five and seven point eight. That position is about 0.2 km west of West Crater. We were wondering if Neil or Buzz had observed any additional landmarks during descent, lunar stay, or ascent to confirm or disprove this location. Specifically, if you were at this location, you would have seen the Cat's Paw during ascent, lying just north of your track.

CDR We didn't see the Cat's Paw, although we were looking for it, too, thinking we were probably downrange--beyond the Big Z. But that probably was West Crater that we flew over in landing.

LMP We're hoping Bruce, that our 16-mm film will confirm our touchdown position. We thought that during ascent we might be able to pick out some recognizable objects near the landing site, and we did see a number of small craters, crater rows, and things like that. We may be able to locate these on the maps later, but we haven't been able to yet.

CDR We selected the documented samples with some care. I started on the side of the LM that the TV camera was on. I took a number of rock samples on the surface and several just below the surface about 15 to 20 feet north of the LM. Then I recalled that the area had probably been swept pretty well by the exhaust of the descent engine, so I crossed over to the south side of the LM and took a number of samples from the area around the elongate double crater and several beyond that. I tried to select as many different rock types as I could in the short time available. Earlier, in our stroll around the LM, I'd seen a number of other samples that I hoped to get back to and collect for the documented sample, but I didn't get them.

CDR We didn't see any small craters with conspicuously blocky rims--only the one crater the size of a football field. After putting up the PSEP, while Buzz was starting to unpack the documented sample container, I strolled back to a crater behind us, 70 to 80 feet in diameter and 15 to 20 feet deep. I took some pictures of it. It had pretty good-sized hard rocks in the bottom--bigger than any out on the surface. But there wasn't any bedrock exposed--at least not in the crater walls.