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MSC-07631

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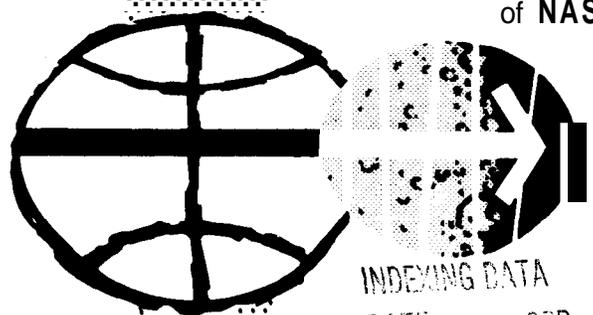
APOLLO 17 TECHNICAL CREW DEBRIEFING (U)

JANUARY 4, 1973

PREPARED BY
TRAINING OFFICE
CREW TRAINING AND SIMULATION DIVISION

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INDEXING DATA		#	T	PGM	SUBJECT	SIGNATOR	LOC
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1.0 SUITING AND INGRESS

CERNAN Except for one small item, the entire suiting and ingress and all equipment supporting it was nominal. There were no complications or problems. Suit circuit checks and cabin closeout were rapid and complete and, to the best of our knowledge from inside the cabin, went very well.

EVANS The anomaly Gene mentioned was my insuit drink bag. Unfortunately, I didn't try it out prior to putting on the helmet. I wish I would have now, because the waterbag itself had gotten twisted sideways underneath the neckring instead of hanging straight down from the neckring. The tube was crimped and I was unable to get any water whatsoever out of it.

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2.0 STATUS CHECKS AND COUNTDOWN

CERNAN Ground communications with the spacecraft and all the launch preps for a nominal on-time launch went well. There were no spacecraft anomalies or problems during the launch prep. All systems checked out well. Controls and displays went well through T minus 30 seconds, when there was an automatic sequencer hold due to a potential problem that the ground support equipment saw on S-IVB pressurization. However, to the best of *my* knowledge, the S-IVB was GO on the cockpit displays. The S-IVB pressures were nominal, but, nevertheless, we had an automatic hold in the sequencer at T minus 30 seconds. From then on, for 2 hours and 40 minutes, we had a series of 20-minute recycles. I don't know exactly how many now. Did we ever get down to 8 minutes one time in the count?

EVANS No. Once we got started below 20 minutes, we went all the way.

CERNAN The problem turned out to be apparently in the software of the ground support equipment. The workaround was caught up, checked out through the Cape and Marshall, and once the count picked up, we had two azimuth updates.

EVANS We had two azimuth updates, because the first recycle was more than 20 minutes, wasn't it? It was more than 20 minutes and we recycled to that point and then they found out that they

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(CONT'D)

weren't going to be able to pick **it** up again in 20 minutes.
And we stopped at 20 minutes and made the second azimuths.

CERNAN

The point here being, both azimuth updates in the spacecraft went well. The *CMP* put them in the computer. The computer took **it**. I watched the IMU torque, After each one of those, they had to reset the GDC, which worked fine. So we launched with a good GDC following the platform. The only difference was a small roll angle, and **it** was reversed, because we had gone through 90° on the azimuth change. But that didn't really bother anything because the roll came in on time in a reverse direction. **It** was a small roll that culminated in just a few seconds.

The count and lift-off, through the yaw and the roll program, were nominal once we got through T-0.

Distinction of sounds in launch vehicle sequence countdown to lift-off - I think the only thing that really comes across in there is that at some point you get a good vibration. At some point in the countdown, you get a good vibration as you're sitting up there. It's not part of the CSM's operation, so you're not sure what's going on. And this happened in the CDDT and, of course, all we did was check and find out we were doing something with the booster.

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EVANS When they ran through some gimbaling programs.

CERNAN The major portion of the launch count has to do with checking out the systems, so the commander stays very busy and many times on separate loops. The entire EDS system checked out very well. We only checked it out once in the initial count and during most of the recycle we stayed in EDS AUTO and then we de-armed EDS AUTO but still maintained a manual EDS capability to abort during that recycle time. We picked EDS AUTO as part of the T minus 20 recycle for final lift-off.

3.0 POWERED FLIGHT

CERNAN The S-IC ignition - The lights started going out at 7 seconds, and somewhere around 3 seconds they were completely out. You could feel the ignition. You could feel the engines come up to speed. Just prior to lift-off and during the first few seconds of lift-off when we were near the pad, both the *CMP* and I could see the reflection of the engine ignition out the left-hand window and the hatch window in the BPC. We could not see the fire but could see a red glow through the windows reflecting apparently off the surface. Ignition was like a big old freight train sort of starting to rumble and shake and rattle and as she lifted off. We got a good tower clear. As you go through max-q, as in the past, it gets very rough and much noisier, but I don't think we ever had any trouble hearing each other in the spacecraft. I had my intercom very high and all my S-bands and tweaked everything up prior to lift-off. We went through max-q and the only unusual thing going through max-q, considering wind components that we had was that I saw 25 percent on the ALPHA going through max-q. The yaw needle was right on, but the pitch needle had dropped to a degree and a half at the most. I guess I didn't really expect it because of the predicted wind components. After we got through max-q, you could still certainly tell the bird was burning as we pressed on toward staging, but it got much quieter and it was

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(CONT'D)

very evident that you were through max-q when that time came.

We had center engine shutdown on time. We had staging on time.

I don't think it's ever been recorded on a daylight launch before, but as soon as the S-IC shut down during the time involved in recycling and getting the staging sequence going and the S-II lit off, apparently the trailing flame of the S-IC overtook the spacecraft when we immediately went into that zero-g condition. And, for just a second, as the S-II lit off, we went through the flame. It was very obvious. We could see it out of both windows. I particularly could see it out of the left-hand rendezvous window of the BPC. It was not a smoke; it was not an orange fireball; it was just a bright yellow fire of the trailing flame of the S-IC; and it happened for just a split second. Then we got off on the S-II and things got very quiet and very smooth and was a very long, quiet, smooth ride.

EVANS

I really wasn't watching the lights because I guess I didn't expect the thing to shake quite as much as it did. To me, I felt like I was really vibrating. I wanted to find out what was making me vibrate. I wasn't expecting that much vibration when the S-IC lit off. At lift-off, again, once it got vibrating, I didn't feel the yaw. I was watching the needle on the thing but didn't feel the yaw, though. The shaking increased a

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EVANS (CONT'D) little bit up to max-q and then there was a different type of shaking. It was more of a vibration, I think, going through max-q. And there was more noise associated with going through max-q. Of course, with the shutdown of the S-IC, I think that was about 4-1/2g.

CERNAN We pushed 4g.

SCHMITT Just pushing 4g on the thing and it quits just like that. I was prepared for it because Gene had said, "Hey, brace yourselves because it is going to happen," and it happened all right. It just flat quit when we went from 4g to 0.

CERVAN The great train wreck.

SCHMITT I think in all those booster cutoffs, it's hard to see how rapidly the g-level decreases. I guess the only other comment I have is that I think that it is good to do a lot of simulation about malfunctions during launch, but up through max-q it is a little bit unrealistic to think that you are going to analyze a malfunction in the spacecraft.

CERNAN To sum up the S-IC, I personally didn't think it was any different than my previous ride on the S-IC and up through this point being a night launch really didn't make any difference at all. The only thing I did different that I hadn't really thought a lot about until I sat on the pad and began to think

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about staging was, just prior to staging, I took my hand off the abort handle and held the support arm rather than the translation control handle until after staging. I did this just a couple of seconds prior to staging. I had talked about it with John Young a little bit prior to the flight and it turns out that's what he did, also. Probably a good thing.

The S-II ignition was very smooth. We got skirt sep right on time. I could feel skirt sep going. We had tower jett, which was really sort of spectacular at night. I think the LMP is going to add something to it, but from the left-hand rendezvous window, I could not only see the flame, but the inside of the BPC seemed to be lit up. Of course, it doesn't stay there very long; it's gone in just a split second. But it was a very spectacular sight at night to see that tower go against the blackness of space out there. We could see guidance come in very definitely. It was not as big a pulsation as I've seen on the simulator but I did see the needle and the spacecraft did change its attitude slightly.

You could see the mixture ratio shift. It was just a long, smooth, quiet ride. Inboard cutoff was right on time. You could feel it, a definite physiological feeling. Of course, the g-meter saw it also. The S-II cutoff, as Jack said, is again very sharp, almost instantaneous, from almost 4g to 0.

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CERNAN But on the S-II , although it's *sharp* and a very hard hit, you
(CONT'D) don't unload the entire stack like you do when you're on the
S-IC. The staging was very smooth. It did not seem like an
exceptionally long time before we separated and the S-IVB lit
off.

SCHMITT On the tower jett, I wouldn't *say* a split second. As a matter
of fact, I was surprised it lasted as long as it did. It was
a few seconds.

EVANS I couldn't see the rocket go. All I could see was an orange
glow out the center window.

CERNAN While we were on the S-II, we would see no indication of light
from the engines. We were just thrusting out in the darkness
of space. I tried to see stars for potential mode IV and, of
course, at that time, mode II abort and turned the lights down
on the left side once or twice. But even with the lights down
(we had the LEB lights relatively low), in my estimation, it
would have required all the lights in the spacecraft to have
been off and certainly more than a few seconds to become night
adapted to be able to see through the windows and pick up stars
that would have been able to help in an abort situation had
you lost the computer and the SCS. We had looked, potentially
planned to use those stars in an abort condition if we had to.
We had excellent constellations to look at. They obviously

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(CONT'D)

were there, but I could not see through the low glow reflection on the window even with our lights, floodlights, turned almost all the way down. I even went to the extent of trying to shield my eyes on the S-II and looked out the window and I still could not pick up anything that I could have recognized for an abort. I also could not pick up any night horizons during that point in time which I thought I might be able to base on seeing where the stars cut off and where they do not.

SCHMITT

We had another indication of that during entry when we were looking for a night horizon and finally saw it, but it was extremely hard to find.

CERNAN

We got lit off on the S-IVB, and, unlike the flame we flew through on the S-II, we did not do that on the S-IVB. I don't know where the reflection came from, but I could see the reflection from somewhere out the forward window. Either it was the S-II trailing flame trying to overtake the vehicle but didn't quite make it, or it was S-IVB ignition reflecting off the S-II because there's no atmosphere up there at that point. But I did not see a flame, but a residual back light out that window just for a short period of time, either right at staging or just at S-IVB ignition. As I think back, my best guess would be that the same thing happened on the S-II, that the trailing flame, when you go from 4g to 0 instantaneously, tends

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to overtake the vehicle. But in the case of the S-II, it's not nearly as big a pattern and just didn't quite make it up the stack. I just saw some of the glow of it. That's my best guess. After the S-IVB ignited, we never saw anything except the APS firing throughout that burn.

You could see the mixture ratio shift.

SCHMITT But PU shift, both vehicles, was surprisingly noticeable.

CERNAN Communications throughout the booster phase were excellent. I never had any problem hearing either Stony or CAPCOM

Controls and displays performed super.

Crew comfort through powered flight - I felt very comfortable throughout the entire flight in orbit.

As far as I'm concerned, there was no pogo on the burn.

EVANS No, none.

CERNAN Summing up the birds. If you want to put them in more layman terms, I think the S-IC acted and performed like some big, old, rugged, shaky, big monster. It has to be noisy, has lots of vibration, and smoothed out somewhat after max-q, but still was a rumbling bird. The S-II was a Cadillac: quiet, less than 1g flight most of the time until we built up our g-load prior

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(CONT'D)

to staging. It was quiet, smooth, had very little noise, or feeling of rumbling or anything else. The S-IVB: a light little chugger is probably the best way I can describe it, which is not different than I remember it in the past. It just sort of rumbled on, not anywhere near the extent of the S-IC, but just sort of continued to rumble on through the burn. After a while, especially during TLI, it got to be a very pleasant, warm feeling that she was burning like she should burn.

EVANS

Chugging, I think, has two different connotations. I felt the S-IVB was more of a very light rumble in the background, something that is kind of rumbling as opposed to chugging. A chug to me is a bang-bang type thing, and to me it was more of a rumble.

SCHMITT

I agree, it may be a sense of rumbling but the ride was smooth. I could sense some activity behind it, but I wouldn't have said that it was chugging.

CERNAN

I'll modify chugging to say it was a hummocky chug, just a rolling type. Nothing different, and, as I say, the best recollection, similar to the S-IVB I had the opportunity to ride on before, but probably even more steady and continuous flow of light rumbling.

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4.0 EARTH ORBIT AND SYSTEMS CHECKOUT

CERNAN Evaluation of insertion parameters - We got a good onboard orbit. Ground gave us a GO for orbit.

The postinsertion systems configuration systems checkout and the complete spacecraft and booster preparation for TLI went extremely smooth and extremely rapid. By the time we came back over the States on the first pass, we were ready and the spacecraft was ready, and we were configured and could have gone on a TLI-0 without any hurrying and scurrying whatsoever. From that point on, when we got our GO on the booster and a GO for TLI-1, it was an Earth-orbit, an extra Earth-orbit ride to sit back and just monitor our systems in the spacecraft and see what we could see from Earth orbit in terms of viewing. It was an extra 90 minutes of the flight that, if you really had to do without, you could have. And it was not hurried. It was very comfortable, even progressing toward the TLI-0.

SCHMITT Let me add just a couple of things. One thing that we had because of the later launch was a number of LOS/AOS updates to plot which did not interfere with our getting through the checklist. The checklist, I had a feeling went more slowly than it ever had. But, as Gene says, still with plenty of time to meet the zero up time and to have essentially a whole

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SCHMITT (CONT' D) daylight pass to just relax and look at the Earth. We had one note here. I didn't even remember until I read it here that in the ECS checks the hydrogen pressure indicators, or part of the indicators, were reading about 10 percent lower than we expected. But, as I recall, it may have been expected.

EVANS The optics cover jettison worked as advertised. We jettisoned the optics cover in the daylight and you could see the two covers flipping off straight down the optics path.

CERNAN I think everyone reacted normally to weightlessness. There was no feeling of disorientation or vertigo or any other disturbances at that point. The CMP is the only one who left the couch prior to TLI and that was for his P52.

EVANS I didn't get that fullness in the head at that point at all. That wasn't until we'd been up there for 5 or 6 hours.

CERNAN Launching at night, we just had a somewhat different view of the Earth than most other flights have had. The first real view we got of being in orbit at that point was pretty spectacular because it happened to be Earth sunrise and that's a very intriguing and interesting way to get your first indoctrination to Earth orbit.

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SCHMITT The transcript contains some descriptions, by all three of us, of sequences of that sunrise which, in the color banding, may be of some significance for other people.

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5.0 TLI THROUGH S-IVB CLOSEOUT

CERNAN The TLI burn from the ground targeting point of view and targeting went just as written. We went down the checklist and cue card without any problems or any anomalies, without any changes except to the manual. We had a change to all our manual angles to monitor the S-IVB burn because of the late lift-off. We wrote those down on our cue cards and were going to use those in case we had to take over during the burn. We had to change to the nominal and we rewrote both of those on our cue cards. That's the only basic change I think we had.

SCHMITT The communications all through Earth orbit were excellent, as I recall. There was no difficulty getting the pads up. They came up expeditiously and well read. We actually gained a little time because we didn't have television. But we didn't need it. We could have configured it for use.

If there's ever any attempt to do weather observing from Earth orbit, in the low orbit like that, you're going to have to have a very clear plan of where you're looking at what time you're looking in order to make reference as to where you are because you're moving so fast. You can't really keep track of where you are and specifically in terms of weather observation. Later on, once you get the whole globe in view, it's

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(CONT'D 1)

a relatively simple thing to pin down to within a few degrees of latitude and longitude where you are looking on the Earth.

CERNAN

On **all** these lunar missions, we've never really done much in Earth orbit except get prepared for the TLI burn. Future Earth-orbit flights need this continual map update, you're right. You have to do that. As **I** think back to 3 days in Earth orbit, unless you continually **follow** a map and a **map** update as to your rev as you progress around the world, what part of that world you're looking at is very difficult to follow except the precise piece of real estate you're flying over.

SCHMITT

The lunar orbital operation is somewhat different because you stay in the **same** groundtrack much longer **I** think.

CERNAN

The S-IVB performance was outstanding. She **lit** off on time and burned for 5 minutes and some odd seconds as **I** recall. And we had shutdown on time. The residuals **and** the EMS on the spacecraft are written down somewhere, but they were all very nominal, very excellent. **We** stayed in IU. As the S-IVB maneuvered, we flew through a sunrise during TLI, which in itself was also very interesting, very spectacular. **We** had nominal **S-IVB** performance after shutdown; **and** maneuvering

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CERNAN
(CONT'D) to the sep attitude, we went through checkout load NOUN 17 and NOUN 22. There was again no noticeable pogo. The S-IVB sounded and performed just like it did on the insertion phase burn and I'll let the CMP pick up the separation and the transposition and docking.

SCHMITT We all were very aware of PU shift.

CERNAN I guess I could have called that or I was looking forward to seeing it. It is on my checklist. It's on my cue card and I've looked for it and I've seen it in the simulator.

SCHMITT It just didn't register in the simulators, I guess. And the other thing flying through that sunrise, it did to a small degree interfere with visibility in the cockpit.

CERNAN It didn't bother me from the standpoint of monitoring on my side at all.

EVANS As far as the separation from the SLA, it was nominal. There's a louder bang than I expected from pyros. This is the first time that I really noticed that in the plus-X translations, or in any translations as far as that goes, you get about 0.4 per second rates within the dead band. As opposed to the simulator, it has about 0.1' per second on any of the translations maintaining attitude.

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(CONT'D)

Formation flight was great. The S-IVB by itself was as steady as a rock out there. No problems. I couldn't tell it was dead banding or moving at all. I came in relatively slow, about 0.1 ft/sec, somewhere in that area.

Docking was nominal. As soon as he got capture on the thing, there were no rates. Everything was steady. I didn't have to handle the translation controls or null rates at all. We went directly to hard dock. There's more spacecraft movement during that period because I feel that the COAS and the docking target were off a little bit. And I don't say misaligned, but it's a little bit off. But, of course, it was in limits and was no problem.

CERNAN

When we went to retract, we got our big ripple fire - bang on the latches, so we had a relatively good hard dock. We only got one gray indication on the talkbacks. The other one was barber pole.

SCHMITT

There's a lot of descriptive material, I think, in the transcript on that. As I recall, we got two pulses in the ripple fire. It seemed like there was one or two latches and then the ripple fire.

CERNAN

I just recall a woomph!

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SCHMITT I think, if you look at the transcript, we said that there were two pulses to **it**.

CERNAN Subsequent inspection of the latches showed that there were three latches which were not made entirely. One of them, as I recall, had to be recocked. Anyway, **it** turned out that once we got those three latches (which at that time looked like they were operating properly) reset, we got two barber poles on the talkbacks. Ultimately, latch 4 was found to be unseated on the ring, although, at that time, **it** looked nominal. The attitudes given us were excellent; we were able to watch the S-IVB maneuver. We were able to see the S-IVB vent and **it all** went well and nominal.

SCHMITT It was very clean as far as any debris or anything coming out during the docking phase, and I could see a few little things that were bouncing around inside around the LM, particles of some kind. It was nothing like previous flights where they had a lot of debris. It was very clean.

CERNAN As I recall, we undocked and separated just a little earlier than had tentatively been planned, but that was no problem because we were ready to do **it**.

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6.0 TRANSLUNAR COAST

EVANS The IMU realignment and optics calibration - We've mentioned the visibility of the stars in talking about the systems in the section on systems. Systems anomalies - We already hit that one. Heat flow demonstration - it worked great. There were no real problems on it. It was a real time operation with ground. Everything is recorded on the down-link.

SCHMITT There was some problem with the orientation of the experiment. As I recall, you reoriented it between the two experiments. I never quite understood why there was that problem. It was a checklist problem or something.

EVANS The problem was something about the orientation of the radial experiment with respect to the X-axis. I pointed the radial experiment along the X-axis. It was supposed to be perpendicular to the X-axis, but it shouldn't have made any difference in the results anyhow.

PTC - We got it started and had no problem.

Cislunar navigation or navigational sightings - It's already mentioned in the systems part.

SCHMITT You mentioned apparently you had a very good Delta-H determination - horizon determination.

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EVANS The P23s worked out great. The vehicle is heavy enough that you can control it quite easily with minimum impulse. I used the EMP on P23 so that once you had the star in the field of view and all lined up you could recycle through the program without getting all the maneuver data on the thing. While it was recycling, I could just watch the spacecraft and not let it drift too far out of field of view. When it came back in, I would maintain the star in the middle of the crosshairs of the sextant and maneuver the spacecraft so I could get the substellar point and maintain the substellar point. As it turns out, I guess the resulting Delta-H is within the limits that are recorded in the E-memory.

Midcourse correction - I think that's all recorded on the down-link. There should be nothing anomalous about that.

Photography - Jack, I guess you've taken most of the pictures on the translunar coast.

SCHMITT Most of the photography came to GET within a few minutes. It was almost a continuous effort at the beginning of the day and maybe in the middle and at the end with some irregularities - getting a continuous record of a very nice view of the Earth and the weather patterns. We had about three-quarters to two-thirds Earth through most of the translunar coast period. And that should be in the photographic logs on the ground.

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SCHMITT (CONT'D) High gain antenna performance - Through the whole mission, not just translunar coast when I was using **it**, **it** was perfectly nominal. The ground did most of the calling on **it**. Between omis and high gain when they didn't call, **it** was easy enough to get the high gain to peak up. Usually in MANUAL and WIDE and either AUTO or REACQ depending on the occasion, **it** seemed to work very well. I wasn't aware of any high gain anomalies.

EVANS Daylight IMU realine and star check - Again you can't see the stars through the telescope. Most of the time you can't see the stars through the telescope. However, if you have a good alinement and **it** shows up in the sextant, there's no problem.

ALFMED experiment - I think that's all recorded on the down-link. The one thing that I might add to that is that prior to this time I hadn't seen a light flash. So I put **it** on anyhow and sure enough the light flashes are there. And that's all recorded.

SCHMITT In the experiments notebook, where the LMP was taking notes on the ALFMED experiment comments, **it** was necessary in this translunar coast period because we were on omnis and PTC. It is very difficult with two guys observing to take notes if they both start seeing marks at the same time. Interestingly enough maybe even for the experiment the marks seem to come in batches.

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SCHMITT (CONT'D) They'd be periods of quiescence, then both of us would start seeing marks. So the notes are relatively incomplete and, hopefully, the DSE plus the down-link will fill in all the gaps. It's feasible to take notes but they will be incomplete compared to the verbal description.

EVANS CM/LM Delta-P - Nominal.

Orbital science photos - We really didn't have any on trans-lunar coast.

SCHMITT Nothing was called out. We used about a half a mag on the Earth, maybe more.

EVANS More than that. We used a full mag before we got to the Moon.

LM and tunnel pressure was okay, no problems.

Removal of the probe and drogue - Went as advertised. Worked great.

Odors - Every time I got up in the tunnel after docking or anytime, there was always a musty burned odor or something. It's hard to describe.

SCHMITT Like a powder burn.

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EVANS Kind of like a powder burn, I guess. This was there both in lunar orbit docking and transearth docking. This was the second day we were out when we finally went up in the tunnel. Every time I opened up the tunnel, that's what it smelled like.

We didn't mention the SIM door jett. I guess I never did see the door. You guys wouldn't let me up to the window.

SCHMITT Yes, we saw the door. I didn't get it right away. I was supposed to be taking pictures out of the window.

CERNAN I saw it right away out of the hatch window. You should have been taking pictures out of the hatch because it wasn't immediately obvious out the window. It came off just as clean as a whistle, with almost no tumbling until it got 20 or 30 feet away from the spacecraft. Then you could see that there was just a little roll and a little pitch as it drifted on away, but very very little. Not a great deal of debris and garbage as I recall came off with it either. You could probably sum up all the pyro operations by saying there are absolutely no questions. They're just good, solid, hard thuds, including SIM door jett. Just a big solid bang, really not that much different than some of the other big bangs when you separate the spacecraft. They're just all big, hard, solid clunks.

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SCHMITT I don't remember what Apollo 16 said about **it**. Apollo 15 was suited, and they commented they didn't even know **it** went.

CERNAN I'm surprised at that, even suited. **It** was a very definite jolt to the spacecraft when the door was jettisoned.

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7.0 LOI, DOI, LUNAR MODULE CHECKOUT

CERNAN The only thing leading up to LOI that had to be changed in the Flight Plan or in the Cue Cards, since we did a 2-hour and 40-minute clock update which by the way went perfectly, was the fact that I had to replot **all** the LOI abort parameters on the card. But the words came up very smoothly, and we just replotted the curve and changed the numbers. We had all our LOI abort constants and numbers for the new LOI configuration.

SPS burn - I thought the SPS burn was very smooth. We had an on time burn. The burn report came back to you, and the residuals and everything were just as nominal as could be. It was just a short little "g-thud," if you want to call it that, at ignition; throughout the burn, it went smoothly. Jack, you got anything about either one of the LOI or DOI SPS burns?

SCHMITT They were all auto shutdown. We covered the problems before.

Gravitational Effects on the Spacecraft Attitude - That was on rev 1, wasn't it, where we had the pan camera going and we had it all figured that we had one jet firing and the gravitational effects were supposed to keep the spacecraft within that dead band. Sure enough, it did. At least, we didn't get out of the dead band at all and didn't have to change the DAP at all on

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SCHMITT
(CONT'D)

the first rev. This is to keep the jets from firing into the mapping camera.

EVANS

Communications - We never had any problems with communications at all throughout the flight.

CERNAN

FGA Donning - Our FGA donning practice was a worthwhile exercise. It takes a lot of work to get the suits unstowed and stowed, because putting the suit on in zero-g is just a little bit different. Unlike the previous flight or two, none of the three crewmen had any problem in donning or doffing their suits. I'd say donning is easier in zero-g than doffing. The CDR and the LMP helped each other with the zipping on every donning and doffing, as we've done in training. We had no problems at all. I'm glad that we were aware of the problems that Apollo 16 had. I think we were more conscious of the potential problem that existed when zipping the restraint zipper. We were conscious of it and had sort of trained in a direction to cover all bets on being able to zip up. I would say that in zero-g the zipper was a little bit more difficult to zip, but certainly I can't really say it was a problem for either one of us.

SCHMITT

The only problem was that little blue donning aid always got in the way.

CERNAN

Every time we zipped it, we hooked the zipper coming around.

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SCHMITT One time, I can't remember whether it was on the surface or in orbit, I got some s'ing in the lower portion of your outer zipper, and we lost maybe 5 minutes while I worked that over. Other times, I learned that you just have to move through that smoothly, and it's no problem.

CERNAN Tunnel mechanics and pretransfer operations - They all went as advertised.

SCHMITT We might mention that we did take that extra film magazine over there. That was purely because that was preplanned in our minds, an extra 16-millimeter magazine, mag EE, because we felt that we just didn't have enough film to get the orbital CSM/LM activities in addition to the planned activities for descent/ascent and lunar surface.

CERNAN If you're going to use that film during that period of time, it's better to have it in the LM than in the command module, and if it weren't used, you could always bring it back and use it in the command module. That worked out fine. I think we used it all.

SCHMITT We used it but there was something wrong with the mag though.

CERNAN We had a gear strip in the mag, apparently.

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SCHMITT It showed a half a magazine of film usage, so we did something with it.

CERNAN The condition of the CSM thermal coating was excellent.

SCHMITT Comm checks - We did have an S-band comm problem initially. I talked to some guys a little bit last night about it. As near as I can tell, it was primarily the combination of two things: (1) Up-link data dropouts which were causing the problem on the lockup, plus (2) some phasing, when I would switch antennas when they would just about have lockup. I think we're going to have to wait until we get with the communications people in the systems debriefings to really work that out exactly what was happening. It was a combination mainly of ground problems of getting lockup plus the unfortunate switching on my part.

The transfer and restowage of equipment were nominal. I can't think of anything right now that was a problem.

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8.0 ACTIVATION THROUGH SEPARATION

CERNAN That's probably one of the most nominal parts of the mission. It really went smooth. We oscillated on the timeline. We'd get a little ahead, and then we'd get a little behind; we'd pick up a few minutes, then we'd lose a few minutes. Basically we worked around the nominal timeline. I certainly wouldn't want to shorten it any, but we came to the milestones on time and met the ground at the right places.

EVANS Prior to LOI, we manually pressurized the SPS, which was no problem. It was because of the oxidizer helium.

In all the sims we never got suited in the spacecraft. We never have all three guys in there trying to get suited and going through the sims. So the sims for the CMP were fat, dumb, and happy. There is all kinds of time in the sim; you could go out and get a cup of coffee and come back and still pick up everything. It's not that way in the real world. You get into the real world out there and you work your tail off trying to keep up and get things going and get suited. When I'm scheduled to do the P52, the CDR and the LMP are down in the LEB getting suited. There was no way I could do the P52 at that time. By the time I had a chance to do the P52 at the sep attitude, the optics were looking down at the Moon, so

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EVANS (CONT'D) I'd have to manually roll and do some pitching to get the optics back up in the air, in the daylight, until I could get picapar to work. And when I finally got the P52 on, I had a little bit of a problem getting *my* suit on that day. There was evidently an "S" or something right in the back part of the crotch. I had a heck of a time getting the zipper across that little S-band thing by *myself*, which was back there where I couldn't pull *it* through with the lanyard. I finally backed *it* off the other way to make sure everything was all clean and cleared out. A little squishing sideways and a contortion here and there, and I finally got the zipper all the way around. I think the rest of *it* was nominal. I was down in the LEB when you guys lowered your gear, but I could still feel the clunk in the CSM.

CERNAN You could feel *it* in the CSM?

EVAN'S Yes.

CERNAN We could feel *it* in the LM, and we could also see the forward gear and the ladder.

EVAN'S Once I went back up to the couch, I could see the gear sticking out, too.

CERNAN Which one?

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EVANS Whichever one is over there.

CERNAN Did **it** have the ladder on? Probably not. I think the ladder is on one of the Y-struts.

EVANS I think so.

CERNAN Well, anyway, that's interesting. I didn't know you could feel **it** over there.

EVANS Yes, I could feel **it** when you dropped.

CERNAN In the rendezvous radar or the landing radar self tests (the transcript will have **it**) there were some residual numbers in the registers that I had not seen before during these tests, when I brought up VERB 63. They didn't affect the test. The tests came out very well, and there's only one other slight anomaly in the rendezvous radar and that was during the rendezvous radar test. **It was** either on this rendezvous radar test or the rendezvous radar test prior to lift-off - I think **it** was shaft. I did not get the cyclic oscillation in the DSKY on shaft. But the interface was good, and I'm not sure what the particulars of that problem were. At undocking we had P47 running in the LM, and I got zero in all three registers, zero residual velocity as a result of the CSM soft and open

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(CONT'D)

total undocking. Systems operation throughout that time was normal. Vehicle performance was as expected, in terms of attitude control.

Lunar landmark recognition - We were able to be in attitude and recognize and look at the landing site on that first pass when we went over. The MSN relay worked. Generally throughout the flight, I think MSN relay is more of a pain when you've got good VHF with the other vehicle than it is anything else, because you end up getting a repeat on the voice. I recommend against MSN relay when you can use direct VHF voice.

SCHMITT

Yes, I agree. On the systems, I was surprised that the component lights in the test positions were very dim. But when they are activated by the caution and warning system, they are bright. I guess I never realized that before. Purely academic interest at this stage.

CERNAN

The secondary glycol pump start up was, I recall, a somewhat ragged start up, as if the pump was slightly cavitating for about 15 seconds. Then it was smooth. There was no subsequent indication of the problem with the secondary loop because we didn't use it subsequently.

SCHMITT

Referring to that radar test, it was the PGNCSS turn on self test. I had a 400 in R-2 initially, and I had never seen that

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SCHMITT (CONT'D) before in FGCS turn on. That's what I was referring to about something different in the registers. It was on the initial FGCS turn on, and self test.

CERNAN All the alignments went well. One thing that we discovered - the gimbals apparently were mistrimmed on the descent engine prior to lift-off. Someone is going to have to resolve whether that's true or not. The pitch and the yaw gimbal trim in the DAP were reversed as to our checklist. When I inquired about it, I found out that our checklist was correct, which gave me an impression that the gimbals were both mistrimmed. But they were so close to each other that the ground indicated we should press on and we should see no reaction to that mistrim, and to start up. We did and we did not see any indication of the mistrim. If pitch and yaw had been separated quite a bit, I'm sure we probably would have had to go through a retrim of the gimbals during the DPS throttle check.

SCHMITT One clarification comment with respect to the AGS. I mentioned yesterday that I thought it was a Z-gyro that indicated greater than spec calibration. It was the Z-gyro, just slightly greater, about 0.4.

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9.0 SEPARATION THROUGH LM TOUCHDOWN

9.1 COMMAND MODULE

EVANS In optics tracking, I tracked RP-3 which is about 5 minutes prior to the subsolar point. And that's too close to the subsolar point to be doing any optics tracking. As soon as I got to the TCA on that thing, I completely lost the visibility of the landmark. So the only good marks on that are going to be prior to TCA.

CERNAN What was that landmark?

EVANS That was the landmark for updating the mapping camera film. Actually, it is a recalibration of those particular points that had been tracked on previous launches.

The circularization burn was a good burn. The only anomalous-type thing on that is that the residuals prior to trimming were plus 1.70 and minus 0.6. The minimum impulse is a 4-second burn. It underburned in the minimum-impulse case by 1.7 ft/sec. It turned out to be no problem. The ORDEAL worked as advertised throughout the flight.

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9.2 LUNAR MODULE

CERNAN Prep for PDI - We just went out of the Activation Checklist into the Timeline Book. There are no notes concerning any anomalies. We stayed on the time line and as I said, we met the milestones with the ground. We came around the horn for PDI and established comm, and the ground had a load waiting for us. We had no NOUN 69 prior to P63.

SCHMITT We did have the communications problem prior to PDI. The thing that started it off was the ground started up-linking on the omni, which they had never done before in the sims that I remember, unless it was a situation where we hadn't gotten the steerable. They started on the omni. I was not watching that, and I switched out of the omni to the steerable in the middle of the up-link. That started the problem, which apparently was compounded, as I found out last night. Anyway, the Goldstone antenna went belly up somehow, and the men who talked to me last night still do not know how. Somebody may, and I'm sure it'll be worked out. The up-link did get in and all you had to do was proceed on the VERB 33. We did have a good up-link, and that whole thing was in there but nobody's quite sure how it actually got in there. The ground surprised us by coming up almost immediately with that up-link, which

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SCHMITT (CONT'D) we've never seen before. In fact, I expected it would be quite late.

CERNAN We'd seen them come up fast, but they always waited for the steerable.

SCHMITT Yes. That's what caught me by surprise. At any rate, we got it in there and there was no subsequent problem. The comm thing did delay us, and we were running a little bit behind the time line.

Let me mention one thing on the DPS start which I didn't mention yesterday. And that is monitoring 471 in the AGS showed essentially no Delta-V accumulation in Y. That was a good idea, although it was unnecessary.

CERNAN As far as the start was concerned, the LMP confirmed ullage. I had my physiological cue, and I knew we had ullage. I was prepared to back up the ullage and back up the start, but we got an automatic performance in both.

SCHMITT It was very clear that the SHe tank had opened up within a few seconds. We got our first jump in pressure a lot sooner than I expected.

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CERNAN All the pyro functions prior to PDI in the IM we could verify with a physiological cue. We could feel, and/or hear all of these functions.

SCHMITT And this was suited.

CERNAN In some cases, it was suited; not all.

I covered the performance of the engine. The PGCS performed admirably. I called up the NOUNs I needed: 68s and 92s. We loaded NOUN 69s, and she just spit them out just like she always has.

SCHMITT The She pressures during descent held low. About 30 psi, as I recall, beneath the predicted number.

CERNAN NOUN 69 was plus 3400 feet, and that sounded very familiar, as I recall. Didn't we almost always in the sims have a plus? Even the nominal ones have a plus. Is that the problem they had? As it turns out, as soon as I pitched over, I took it right back out to get to our landing area.

SCHMITT Is that right?

CERNAN It was almost exactly the same number, which means that their targeting was essentially perfect, because the planned landing area was about at least a crater diameter short of Camelot.

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