

CERNAN
(CONT'D)

That's where we pitched over and that's where we would have landed, which was the planned, targeted landing area.

We did not say anything about DOI-2. DOI-2 was slightly smaller than we'd seen in the past, because of the orbit degradation we were in. I think it went down to something like 11 miles, but the DOI-2 just went super. We got the residuals down to 00 and 0.1, something to that effect. We saw a 7.0 perilune out of the PGNCs and a 6.7 out of the AGS, which is exactly the type of thing we expected. We went around to PDI in good shape. We got excellent radar and VHF ranging correlation during that radar checkout.

VHF Ranging and Radar Tracking - Everything was nominal during PDI right through pitchover. We got throttledown on time. We watched the computer and followed NOUN 92. The computer was happy, the GDC was happy, and everything was just perfect. At 13 000 feet, I could look over the edge of the window and see the South Massif. At 13 000 feet, I knew we were coming down in the valley because I could see the South Massif, and I could tell that we were in the valley or coming into it. At 13 000 feet, I had the impression we were level with the top of those mountains. (Laughter) I really did.

~~CONFIDENTIAL~~CERNAN
(CONT'D)

We pitched over, the needles dropped, pitchover occurred, 64, everything was nominal. Our target point was about a crater diameter short of Camelot. I used LPD frequently. I don't know how many times I used LPD, several clicks back, a couple left, a couple right. I just flew **it** where I wanted to fly **it**. I brought **it** back to an area in the vicinity and to the right of Poppy. As soon as I did that, I just sort of tumbled in on that area and did some more LPDs to finally what I'd call a suitable landing site. That suitable landing site became more evident the closer you got. Initial LPD changes to bring the landing site back east were just gross to change the area.

Once I had my area, I started tweaking **it** up to find what I considered a blockless and level area. I ended up taking over in P66 just a little below 300 feet. The reason I took over is that I wanted to slow our forward velocity down. I did not want to go any farther west, because there were more blocks and more hummocky terrain. As a result of all of our aft LPDing, we ended up (1) with a great deal more fuel than we might have anticipated, between 7 and 9 percent, I believe, and (2) the rate of descent, H-dot, was a little bit higher than normal, because of our steeper descent in the latter phases of the braking and landing. But as far as the CDR was

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

9-7

CERNAN
(CONT'D)

concerned, they were very comfortable rates of descent. The LMP passed them on and said they were a little higher. I knew where we were. I think the most significant part of the final phases from 500 feet down, as far as the CDR was concerned, was that it was extremely comfortable flying the bird, either LPDing in P64, and/or flying manually in P66. I contribute that primarily to the LLTV flying operations. That's why the rates of descent and what have you were just very comfortable.

I kept a good rate of descent down through 200 feet, slowed it down at a little bit over 100 feet to 1 or 2 feet per second, and then started it on down again. We started to get dust somewhere around 100 feet.

SCHMITT In my window, I didn't see dust until about 60 or 70 feet.

CERNAN The dust layer was so very thin that I could definitely see through it all the way down. It didn't hamper our operations at all. When I was satisfied that that was my landing site, I made sure we had between 1 and 3 feet per second on the crosspointer forward velocity, and to the best of my ability, zero left and right. We continued on down with about 3 feet per second to landing.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

I saw the shadow come right on up to me, and this is very well done in the simulator. When it passed on under me, I was expecting a blue light. It seemed like it didn't quite come, when the shadow passed on under me for just a split second or two. We got the touchdown light. I had planned to say, "1 potato, 2" and then push the stop button. But I didn't. As soon as we got the touchdown light, I, like most everybody else, hit the stop button. Then things just went "plunk." We plunked down with a relatively good thud, I'd say.

Visibility through the final phase was excellent. The tendency, once you redefine your landing area, is to become a little bit less concerned with your peripheral landmarks out there, because you know now about where you're going to go. You get more tunnel vision, and you are concerned with finding these specific touchdown points within that landing area. That's effectively what I did. I had no Sun angle problems. At that point in time, estimation of distances didn't mean much, because I was concerned more with what was right down below me and in front of me.

I can't say enough for what I consider the accuracy of the guidance. Manual control of the spacecraft was hard and firm, different certainly than the command module operation but exactly what I expected the LM to be. The simulator, I think,

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

9-9

CERNAN
(CONT'D)

does an excellent job of controlling the firm good solid
ATTITUDE HOLD, RATE COMMAND capabilities of the LM. I'd say
that I touched down with about 1 to 3 ft/sec forward, and
0 left and right, and about 3 ft/sec down. We'll just have to
find out what those numbers were. I don't know. The fuel
remaining was between 7 and 9 percent. From the CDR's side,
the systems were excellent.

~~CONFIDENTIAL~~

10.0 LUNAR SURFACE

CERNAN Postlanding powerdown - We got the verb for STAY at T_1 , T_2 , but we got a GO for at least a T_3 , and we started right through the checklist and the power on configuration. Based upon the review of the Surface Checklist, there were no anomalies in powering down the spacecraft. We just followed right on through.

PGNCS and AGS worked fine. Z, once again, had a higher than spec gyro count. It was nothing serious though.

Eat and rest period - We had an eat period on the surface. As we were beginning our EVA-1 prep, we took some pictures out the window. We just followed the checklist, and, all told, we ended up getting out some 30 minutes late. I'm not sure why.

SCHMITT Part of it was that P57.

CERNAN Oh, we had to do a P57 over because we reversed the marks on a spiral cursor, which was just an onboard problem on our part. So, we did the P57 over, and we lost several minutes. We sort of never lost any thereafter, but we never made them up either.

Suit doff and don - This will cover all the EV prep and post activities. We both found, LMP and CDR, that donning and doffing the suit in 1/6g was relatively easy. Once again, we

~~CONFIDENTIAL~~CERNAN
(CONT'D)

had no problems zipping up the suits. In the course of doffing, and prior to getting the suit fully off, we mutually lubricated each other's open zippers and all the connectors. When we doffed the suit, we went into a drying mode as the checklist suggests prior to the sleep period. I'm really glad we did because our suits stayed relatively fresh and clean on the inside. We doffed our LCGs every day and slept in CWGs rather than the LCG. And I'm glad we did that because it was much more comfortable. We made it a buddy system in the entire donning and prep when it came to the suit operations, except for putting on the gloves. We found it easier to put them on in parallel and get them locked and verified locked. We actually, each individually in almost all cases, put our own glove dust covers and ring dust covers on. Maybe we had to help each other once in a while. And contrary to some of our initial desires, we decided to go ahead and put those dust covers on for every EVA. After the first EVA, we found out what the dust problem really was.

SCHMITT One of the tabs on the LMP's dust covers did break off on the first prep.

CERNAN But besides that, we never used that donning lanyard that we had available. We never needed it. I can't really say anything else except that the doff and don went pretty much as we both

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

expected it to. We obviously took extreme care of our suits - the best we could - because we had to use them several times. I think that care paid off because even at the integrity check of the CM/EVA, the suits were tighter than a drum. I think the wrist connectors, even with the dust covers, were tending to get a little bit stiff.

SCHMITT Yes, mine were very stiff.

CERNAN But nothing ever really froze up on us.

LM vehicle systems operations - There weren't many systems operating during the lunar surface activities other than the EPS and the glycol system. We set it up per the Flight Plan. We updated the PGCS periodically. It was all nominal operation.

10.1 FIRST EVA, MASSIF

CERNAN First EVA prep activities - And all I can say about the PLSS donning and checkout verification, cabin depress, communications checkout, and power transfers, is that it just followed the checklist and went nominally. The only thing that we might consider as a deviation is the fact that the CDR left his O₂ hoses off during most of the donnings because I felt I didn't need them with the water cooling from the spacecraft. It was easier to get them put out of the way early, and there was certainly adequate airflow. We left the flow on through

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

the hoses to keep circulation in the cabin during that time. I felt very comfortable and less contained by having those two hoses out of the way. All I had dragging from me was the water hose and the comm hose.

SCHMITT LMP wore the hoses most of the time to partly have a convenient place to put them. Also, I like the airflow.

CERNAN And they're more out of the way of the LMP because they're on your side.

EVA 1 - We just commenced the egress very slowly to get familiar, but basically there were no real problems with the egress. I felt you had to get down a little bit lower to the floor than I'd seen in the airplane, but once you understood where you had to get, getting out was no problem at all. Everybody knows that the LM cabin is very small, and you're restricted. You cannot move very fast or get out of each other's way very easily. So when you did have to turn your back to change valves or switches or circuit breakers, you had to move one at a time to get out of each other's way. Once we found out what those requirements were, we were able to work together very well and stay out of each others way most of the time .

~~CONFIDENTIAL~~

SCHMITT Yes. Let me comment about the LMP's egress and ingress and general activities a little bit that I've done in the 1/6g airplane in the mockup. They seem to be more difficult and more constrained in the LM than they were in the airplane. I don't know exactly why. Part of it may have been in the pockets. I kept finding I was hanging my leg pockets up on those things. I don't remember whether I had those on in the airplane or not.

CERNAN The key to ingress was to get all the way in and then bend my legs up. As soon as I bent my legs up, all of a sudden everything broke free. I think it was that the pockets were hanging out on the sill, and as soon as I bent my knees, it took the pockets off the sill, and I just slipped right in. I didn't learn that until the second egress. Work on the platform and on the porch was fine. We got the MESA deployed. The LMP egressed, We got the LRV deployed.

SCHMITT Cosmic ray was deployed nominally. LM description and plan - There wasn't much to say. I had the impression maybe the strut was stroked, but that was discussed and photographed.

CERNAN The whole EVA, as we call it, "closein," went so close to our EVA closeins and eventually closeouts at the Cape that even I was amazed. It turned out that I got to the flag just about the time I always got to the flag, and you were ready. It just couldn't have been a better reproduction of the training

~~CONFIDENTIAL~~

CERNAN (CONT'D) activities at the Cape. I think the transcript and the television better describes and debriefs that portion of the EVAs than we could by just sitting here and saying everything went nominal by the checklist because that's essentially what happened.

SCHMITT You've heard all about the ALSEPs and the LTG problem in real time. It's on the transcript. It was something in the dome removal strip. We pried it off with a hammer. The ALSEP traverse surprised me in that the package seemed heavier than I had expected.

CERNAN You lost a block.

SCHMITT I lost a block. It just came off the Velcro. I may have hit it with my leg. Really the dust was so deep and soft that the blocks were relatively ineffective, and I ended up putting a rock underneath one corner.

ALSEP deploy - In the LMP's point of view, it was slower than I expected it to be. But, everything got deployed. And, the geophones were faster as we expected.

CERNAN The heat flow went very well. It just went bang, bang, bang. Really the only difficult thing in 1/6g is that fact that you cannot bend over very easily to pick things up. I used the

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

drill for a brace almost every time I had to get the wrench off, as you saw and heard in the transcript and pictures. Every time I found out that I reduced a work output and reduced the frustration when I set the drill in the right place, leaned on it, and took the wrench off. The only little thing I had some problems with was with the core and the bore; you have trouble in 1/6g with the gloves on to aline the threads and make sure they get all the way seated on the following bore or core prior to starting to drill. I had a couple of problems with that, but eventually I got them all. I never rammed a thread down with the drill. I always had it all the way flush, which preserved the bores, of course. The whole operation just went well. You saw it; you heard it. We followed the procedures. The TGE could have been taken on and off very easily on the Rover. The only thing that we didn't anticipate about taking readings when it was off the Rover was again the same problem. You have to lean down to get to anything, and the TGE is very low. It's very difficult to get down there and make anything but a swipe at the buttons when it's on the surface. I'm very glad we did not have to take it off the surface for all the readings because it made it much more convenient. It was not a problem of taking it on and off. It was a problem of pushing the button once it was on the surface.

~~CONFIDENTIAL~~

SCHMITT The ALSEP photos were not taken in the normal way, I think that by the time we had finished our second and last traditional revisit of the ALSEP, a fairly good collection of photos had been obtained, both on specific request from the MOCR and also random photos I took while they were thinking.

CERNAN The whole EVA-1, all the way through the station 1 activities and the SEP deploy, although there were modifications in it, followed the checklist. The best debriefing is the transcript and the TV. I don't think there's anything we can really add to that or any of the other particular stations that hasn't already been said in real time.

SCHMITT Let me mention again, for the record, that the geophone module package did not constrain the geophone's lines very well. But the net result was a good triangular deployment of geophones, even though they are not anchored at the base of that triangle.

CERNAN We go into ingress and the EVA closeout was again pretty much as planned without anything worth talking about other than what was heard and seen.

SCHMITT I don't know whether you've been told yet or not, but both the SRCs have excellent backings.

CERNAN Good.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

10-9

SCHMITT Number 2 has the best they ever had.

CERNAN I took pains to make sure that that thing was sealed. They did have excellent backings? That's good.

EVA post-activities - Again, the refurbishing of the PLSSs went as was written in the checklist, both with, oxygen and water. Apparently, we got them completely refurbished for every EVA because the total time we were able to accumulate on them in the second and third EVAs. I never had any problems throwing the CDR's PLSS back in the recharge station.

SCHMITT Let me go back to the EVA closeout. The transfer of the gear up the ladder by hand was not difficult, but it was more difficult than I had expected. Getting the EVA pallet in ahead of me looked like it might be a problem, but I found that by pushing the hatch full open and putting the pallet off to the right, I still had plenty of room to move around. I put it to the right, next to your stowage area, and it was out of the way. I got in and then reached over and undid it. Taking the gear off the pallet took longer than it did in training. It was a more difficult job.

CERNAN That whole transfer seem to go very well, the transfer into the cabin and transfer back out of the cabin.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

SCHMITT Tool management reminded me of that for some reason the left-hand pocket down low on the left leg was essentially not used. I couldn't get to it easily. I was able to get to the right pocket and I did stow odds and ends of samples in there occasionally, and once or twice, the hammer. In general, it was only the right-hand pocket that was useful to me. Tool management was as we had trained, with the exception that as the EVA's progressed, the spring-loaded latch that locks the scoop into a given position in the detent ceased to function very well.

CERNAN EVA post activities - You got anything to add?

SCHMITT We did that in parallel with other activities.

CERNAN We approached that relatively casually but with the idea of getting to bed on time, and for the most part, I think we had a little fat in there. Where we didn't we still preserved the 8-hour sleep period because the next day was not necessarily critical, except the day of launch, on which we wanted to get up on time.

Performance comments, equipment - I cannot say enough for the PLSS operation. Cooling capability was there tight as a drum; communications were excellent; and the suit performed well.

~~CONFIDENTIAL~~

SCHMITT The only problem we both had was in the gloves. Just general fatigue and also continual pressure against the nail there bruised under the nails.

CERNAN That pressure against the nail areas was not a pressure caused by short gloves for me. It was just because of use. You required so much dexterity during the ALSEP deploy that it was apparently a pressure that got you across the top of the hands or the top of the fingers, but it was not a fore and aft pressure for me.

SCHMITT But you still got some bruises under your nail? I don't see *my* other way to get that but by pushing against the nail. There was no way to avoid it either.

10.2 SECOND EVA, SOUTH MASSIF

CERNAN Here again, you can talk about the prep activities. We were obviously smarter. Some of the things you do in EVA-1 do not have to be done during EVA-2 because they're only done once in terms of stowage and what have you. We had some OJT on EVA-1, and EVA-2 just went right down the line. We got the cabin depressed, got out, and went to work. I cannot say anything about EVA-2 egress or equipment transfer or anything else.

SCHMITT Yes. I don't want to waste time on the traverses because I plan to do that with the tapes.

~~CONFIDENTIAL~~

CERNAN I've talked about Rover mobility and capability and the requirements of the driver for continuous attention and that became very evident on EVA-2.

SCHMITT Although I made reference to most of the little memory jogs we had in the Cuff Checklist, it turned out they were not specifically necessary to have them in the checklist since our continuous observation and discussion of the surface covered those things as a matter of course, if they were there. I think the most important thing that they did was to force us to review cuff checklists prelaunch to learn, train, and think about the kind of problems they were referenced to. In the actual operation, most of those discussions took place relatively automatically.

CERNAN The CDR's navigation page used in traversing to each station was probably one of the most useful things I carried on my cuff checklist. It kept me very much aware of the general heading I had to go and general large features we were looking for, I just think it was extremely useful. Because of the terrain and the inability to travel on a straight line for very long periods of time, I primarily did not navigate on heading. I primarily navigated to a point. And so the particular points that were shown for jogs in the traverse, or for Rover samples, or charge deploys, or for stations were most

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

valuable to me, because I navigated to a range and a bearing and didn't worry particularly about the exact heading. That seemed to work out very well. And that's why we never, on any of the three EVAs, followed our tracks back to anywhere. We crossed our tracks a couple of times but we never covered the same piece of real estate twice. Performance of all equipment after EVA-2 was excellent. Going into the EVA-3, the prep, again, was familiar.

10.3 THIRD EVA, NORTH MASSIF

SCHMITT

Station 3 - We both did most of that station separately. Gene was working the double core as planned and I was doing sampling. I got a little inefficient at the start because I didn't have a bag to put samples in. Once I got a bag, it was a little hard to handle because I was on a side slope. But in the time that we spent there, I think it turned out that Gene got an excellent double core canned and I got on the order of 10 or 11 documented samples, both surface and trench samples at the edge of that crater. I would still have a hard time evaluating now whether we could have operated more efficiently together or separate in that particular case.

CERNAN

EVA-3 closeout was nominal. It was modified because the LMP had to go back to the ALSEP again, As far as I'm concerned,

~~CONFIDENTIAL~~CERNAN
(CONT'D)

the recovery of the neutron flux, parking the Rover, turning off the SEP and going through all that worked very well. Here again, any modifications to those closeouts are really not bad at all because we used the checklist as a reference and not as a cookbook. We understood what had to be done and what had to be closed out so that we could accept modifications and also pick up each other's task. And we did that quite frequently on the closeouts. We could see what the other guy was doing, and picking up the other guy's task occasionally, when you had a free moment or an easier reach, was a very simple thing to do. That comes from having done this together many, many times. Probably the most difficult job of all the closeouts was trying to dust the suits. It's a difficult and awkward position. It's hard to make fast sweeping movements in a stiff suit. We did our best, and I think probably the time spent was well spent. But I think also it was a bit more time than we had anticipated. The real-time transcripts will show just how much time and effort was spent in dusting. Both of us found that our lower limbs and boots could probably be better dusted by jumping up and down on a ladder or clapping your feet together on a ladder, which, incidentally, the CDR had to do in every case because he was the last one in. His feet were always in the dust prior to getting on the ladder. But I think that worked out pretty well.

~~CONFIDENTIAL~~

SCHMITT
(CONT'D)

Third EVA was pretty much operationally like the second. We worked on slopes on both EVAs. On the third we did have the Rover on the slope. That didn't seriously perturbate the operations. I intended to rake larger areas for samples than I had planned to, but that was mainly because we weren't getting very many samples per rake swipe in most places. I think the only place we got a large number of samples was at station 1. After that we were dealing with no more than 10 in raking over a very large area in any of the other rake samples. But that's clearly documented in the samples. I don't know how many LRV samples we actually took, but it wasn't a problem. And the sampler was used whenever I worked around the LM or went out to the ALSEP or anything. As a result, I picked up maybe a half a dozen more samples just because it gave me something to carry a sample in.

CERNAN

The only piece of hardware I remember that broke was the bag fastener on your camera.

SCHMITT

Somehow or another I strained that and I taped it on in the cabin between EVA-2 and EVA-3. That taping job, using the food-pack tape, worked very well. We had no further problems. The EVA-3 post comments are the same.

~~CONFIDENTIAL~~SCHMITT
(CONT'D)

Equipment jettison went smoothly with no problems. You had the feeling that if you had an infinite amount of oxygen and water, you could have used those PLSSs indefinitely. Good systems.

CERNAN

In closing, as obvious and as always true in the past, the efforts put forth on the surface of the Moon, or any place else, are based upon a great deal of work by a lot of other people. In general, the most significant group of people that supported us in excellent fashion, and probably the best I've ever been associated with, is our team led by Dave Ballard. Those guys continually went out of their way to make sure that things were done right. I just can't say too much for the effort that they expended. They performed in a super professional manner. Without that team and the training, the debriefing that we've just gone over here for the last 2 days might be a lot different. The success of Apollo 17 is due to a lot of people. In particular, the LM activities went so smooth. The LM stowage, in which there were a few changes right at the end, the interior cockpit stowage and the exterior descent stage stowage, was really in outstanding shape, and it was due in no small part to the efforts of Terry Neal. Terry's had a great deal of experience in the past on previous flights, and that experience really showed itself. He was a tireless worker. He supported every activity without being asked to at the pad, and came back

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

10-17

CERNAN
(CONT'D)

and told us what he had to support. He kept us informed. He made sure that people who were in charge and responsible for all the training gear had all the knowledge to keep it up to speed, based upon flight configuration of gear. He was concerned about the type of details and things that the crew is either too busy to handle or certainly would have let slip by. He's the guy that got the job done for us so that when we got up there, to unstow the gear and to put it to work, it was not only like we had planned it to be, but it was all there and it was properly and professionally done.

SCHMITT

Your statements are certainly echoed in my mind with respect to the entire team. Every time something needed to be done there was somebody there who had already done it, generally. It wasn't a question of asking. It was a question of doing, or of utilizing the results of the team's effort. Terry Neal certainly made the lunar surface stowage and equipment operation, both in flight and in training, outstanding. There is no other word for it. We had no difficulty at all in learning where the equipment was and how to use it in its storage locations. I'd also like to congratulate the EVA operations group for their work in putting together three, very complex Cuff Checklists, and in keeping a general trend of training going that was just about at the right level. We reviewed the various EVAs in a reasonable sequence. And by the time we

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~SCHMITT
(CONT'D)

launched, I think we had enough of a feeling for what was in the cuff checklists that we really, as you said earlier, only used them in the review and that can't be to anybody's credit but the people who organize the training program.

CERNAN

And the entire support team - it wasn't a case of them keeping up with us getting ready for the flight, but a case of us keeping up with them. Because they were going to be ready for the flight and they made it a point of making sure that we were going to be ready also.

SCHMITT

I think it's also worth mentioning that we have nothing to give but praise for the ability of the suit technicians not only to keep our gear in working order and up to date with the changes that might be coming along, but also in training us on how to use the gear. That is perhaps not in their job description. No small part of our ability to get in and out of the suits, and understand what you can do and can't do with the suits, in terms of doffing and donning, goes to the four guys who were our suit technicians.

~~CONFIDENTIAL~~

11.0 CSM CIRCULUNAR OPERATIONS

EVANS Operation of the spacecraft - The CSM solo operations are essentially nominal. One time on the back side of the Moon, after I'd done the zodiacal light, where you had to switch to CMC free during the pass to prevent any jett fires and then you switch back to auto, I missed the switch back to auto and proceeded on into the waste-water dump and urine dump. Unfortunately, I locked the spacecraft control switch and CMC free. The waste-water dump evidently puts in quite a torquing force or perturbs the spacecraft such that I was getting a master alarm with the gimbal lock light. As soon as I had the caution and warning, I checked back and found that it was getting close to gimbal lock. I switched to SCS, and it backed away from gimbal lock. Then I pushed back to auto and got back to P20 attitude.

Navigation, normal state vector updates - When the down range error got to about 30 000 feet, I let go and shifted up a state vector. The RQ model being used over in mission control to project the orbital decay didn't work quite right, so I ended up with the orbit not decaying down to the circular orbit prior to the plane-change burn. I ended up making the high adjust maneuver or trim burn to bring the orbit down to 63 by 63. The trim burn was performed about an hour before

~~CONFIDENTIAL~~EVANS
(CONT'D)

the plane-change burn. Trim burn was a 9-foot-per-second RCS burn.

LM acquisition - Nominal in all respects. The thing that is somewhat of a surprise to me, and I should know this, you get molded into a false sense of security by doing rendezvous in the CMS. You look through the telescope, and there's a big blob of light. The telescope is indicating where the LM is. In the real world you look in the telescope, and you can't see. It's very hard to see 150 miles away. As a matter of fact, the LM was at about 80 miles before I actually saw the flashing light in the telescope. As I went into darkness, I could see the flashing lights in the sextant. I did not get LM acquisition prior to going into darkness, and I did not have it in the first part of the rendezvous. I did not have the Sun in the sextant. There was no Sun in the telescope, and it was about 3 minutes prior to spacecraft sunset before I had the Sun in the sextant and in the telescope. I could not pick up the LM in either the sextant or the telescope. Once I had picked the LM up in the sextant, I had no problem from then on.

Update pad and alinements - No problem. We kept the P30 pad in R-11 where it was always available in case I needed it. I always realined to different REFSMMAT. In translunar coast

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

11-3

EVANS
(CONT'D)

or transearth coast, I always switched to SCS minimum dead band and gyro torqued. As I picked stars on the dark side of the Moon, I would coarse align to the new REFSMMAT. It might be interesting to note that on PDI day prior to LM separation, there's a P52 scheduled about the same time the LM crew is getting suited up. I delayed the P52 until they were in the Challenger. By this time, the SEP attitude pointed the optics right down to the Moon. The PICAPAR didn't work, so I just started the spacecraft roll and kept recycling the 404 alarm until I finally was able to get it to work. After I got to P52, I maneuvered back to the LM sep attitude.

Lunar sounder boom deployed - We had a little test to extend and retract the booms. Extend worked okay. Retract and HF 1 never did get the gray. The antenna retracted to the extent that there was no problem for RCS or SPS burns. In trying to retract prior to plane change, we looked out the window and could see it start back in. The extensions on HF 2 - Number 1 always extended all right, but number 2 would go out for a little way and stall. We retracted it for 5 or 10 seconds and then switched it back to extend until it deployed fully. At any rate, with a little bit of work, we got the booms in and out.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

EVANS
(CONT'D)

Monitoring lunar activity - I did not attempt to monitor it but I could put on VHF and talk to them. I was usually operating during VOX during the solar periods, so I just left the VHF off. Prior to lift-off, we had MSN relays activated that worked real fine.

Lunar sounder pad experiment - No problems. Everything worked fine.

SIM bay daily operations - On the mapping camera, the first extension took longer than anticipated, so it was elected to leave the camera extended throughout that day. It took about 4 minutes to retract when we retracted it. On one of the mapping camera oblique passes where we were starting at the spacecraft sunrise terminator, I went to operate and got the barber pole. The Malfunction Procedure is to go to standby, which we did. We left it in standby until we just about came up to AOS. At that time, the barber pole disappeared. Evidently it was caused by the mapping camera area being too cool. And as soon as I got the gray indication, I went to operate and had no problems the rest of the time.

Laser altimeter - It seemed to work fine. There were no anomalies.

~~CONFIDENTIAL~~

EVANS
(CONT'D)

Pan camera - There were no anomalies that I know of with the pan camera. There was some concern at one time if it was getting a little warm in there and also some concern as to whether the lens had really stowed.

UV spectrometer - As far as I know, we got outstanding data. The information that was passed up to me indicated that there isn't as much hydrogen in the atmosphere around the Moon as was originally thought.

IR scanning radiometer - It worked real fine. We're still getting good information, and we were getting good information on the way back. It was on most of the time.

The SIM bay photos - Let's see, that means photographs by the LM. It seemed to work all right. The Challenger was easily maneuvered around to the right viewing attitude. They got some good pictures. Sunlight was okay.

Dim light photography - The dim light photography was the zodiacal light and the solar corona. It was okay.

Terminator photos - Hopefully, those are going to come out. I used a lot of Nikon film for terminator photos. We should have a lot of 35 mm stuff that was not planned or not scheduled in the Flight Plan. We used the Nikon with a red filter and a

CONFIDENTIALEVANS
(CONT'D)

blue filter and took three shots with the red filter and three different shots with the blue filter of the landing site area. We also used two different polarizing filters in one direction and then in the other direction. That information should be in the Flight Plan. In each case, the zodiacal light with the filters worked out real fine. The timing and the settings worked correctly. I've got it noted in the experiment checklist that I had the wrong setting for half a second. I ended up on the 1-second mode. I think that was in the polarizing part. In any event those pictures should be good. In sketching the zodiacal light as you come up to the spacecraft sunrise, I think we probably didn't get the longest streamers that are just half a second or quarter of a second prior to the Sun popping over the horizon. In each case of the zodiacal light passes, the sequence ended 7 to 10 seconds prior to spacecraft sunrise. I think we probably missed the longest streamers. I didn't really observe this phenomena until the last day of lunar orbit and didn't have the opportunity to take a hand-held target of that particular phenomena.

Solar corona - The sequence worked real fine, no problems.

Earthshine photography - We worked it differently than it is indicated in the experiment checklist. I used Aristoteles and Copernicus starting out with a 1 second and taking two

CONFIDENTIAL

~~CONFIDENTIAL~~

11-7

EVANS
(CONT'D)

1-second exposures. As we rotated around about every 30 seconds, it ended up a little closer than I thought. We were passing up the target too fast because we'd never get everything. The timing sequence may not be correct. It may not be exactly 30 seconds between each one. We would cycle down the exposure setting to 1 second, 1/2 second, 1/4 second, 1/8 second, and 1/16 second on Aristoteles and Copernicus. We'd leave it on one-sixteenth of a second following Copernicus and switch over to window three and pick up Reiner Gamma and do the same type of sequence. Then we stopped on 1/8-second exposure and carried it out until the end of the film mag.

Orbital science photography - It worked according to the Flight Plan. We would have the initial setting, and on the orbital monitor charts, we would have the inpoints and then pick out specific craters and have these noted on the chart as to change settings. I did notice that it is very easy to bump and change the camera settings as you bounce around in the spacecraft - trying to keep track of the camera pointing as you try to maintain your own equilibrium. A couple of times at the end of a particular sequence, I noted that it had changed from what I had started with. The orbital science photography was accomplished with no particular problems other than trying

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

EVANS
(CONT'D)

to maintain a constant camera setting. We had two magazines of what we call CM option or option-photography colored film. Those two magazines were completely filled up with just targets of opportunity.

Plane change 1 - I previously mentioned the trim burn part of plane change 1. Plane change 1 was a little larger than anticipated because of nondecay of orbit, Plane change 1 is where I had 0.7 ft/sec and it seems to me like an X. I did not trim it because we were only trimming Y. There was also a plane change where I ended up with a different roll because the pan camera was looking right into the Sun. No real problem. If I were going to trim anything, I would trim Y and Z just to make sure I didn't perturbate the apogee and perigee orbit. To keep the pan camera out of the Sun, I went into P40 trim and utilized that roll angle. Communications were outstanding. Maneuvers done to support the lift-off presented no problem.

Rest and eat periods - I never got to sleep on time. It just took a great amount of time for one man to go through that Presleep Checklist - to go down and chlorinate the water, take the panel off, pull the return valve and clean the hoses - it just takes a lot of time to get it all done. But, there's no real problem.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

11-9

EVANS
(CONT'D)

TPI backup - My TPI solution agreed quite well with the Challenger, no problem.

Midcourse backups - I ran into a bit of a problem. I ended up with 5 ft/sec as a Z-value, and the LM ended up with 1 ft/sec. I don't understand why there's that much difference between the two midcourse solutions. Of course, the Challenger made all the burns during rendezvous and braking, so I didn't have any problems there.

Prep for docking - There is no time to get all the cameras and things squared away prior to going into rendezvous, so I strapped the TV monitor to the XX strut by the CDR's couch and utilized it during the rendezvous and braking phase or final phase of the burn. I used a P79 to point the X-axis out the LM. And once it got close, I essentially pointed the spacecraft such that the LM was always in the center of the TV field of view while coming in for docking.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

12-1

2 LIFT- OFF RENDEZVOU AND DOCKING

CERNAN LM powerup and launch preparation went well. We did not do the P22. Everything else just went *as* advertised on the LM. She powered up beautifully. The lift-off was normal. Obviously, we got all our pyros, and we lost no changeover, Parker valves, or anything. Very soon after lift-off, we had apparent loss of comm, a lot of noise in the S-band. It turned out that we were down-linking, but there was something wrong with the up-link. So the CDR watched most of the guidance and would call out, in the blind, altitudes and GOs and what have you as we pitched over and pressed on up. For about the first 2 or 3 minutes, the lunar module pilot had to concern himself with trying to get comm back.

SCHMITT Apparently, Goldstone dropped the up-link. When they were getting it back, I was switching omnis, and for a while there, it was just completely out of phase. They had a continuous down-link on us.

CERNAN It was a very inopportune time, I might say, because it happened just right after ignition. I think that's something, though, that the INCOs are going to be able to clarify. We certainly can't give you the details. It's just that there was essentially no comm on all the antennas.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

We flew into a trajectory that appeared to be nominal. The AGS showed us slightly out of plane. As a result, our tweak at 9 ft/sec was minus 4, minus 9, and plus 1. We burned out X, Z, Y, in that order.

SCHMITT

It was about 7 ft/sec, a little over 7 ft/sec.

CERNAN

it looked like we might have had a g-sensitive drift in our Y-accelerometer in the PGNCS. The tweak was excellent because our rendezvous was just as nominal a rendezvous and as nominal a trajectory profile as I've ever been involved with. The drift in accelerometer did not bother us anywhere else in the tracking or in the rendezvous at all.

Rendezvous navigation followed the checklist; we got right off the form very well. We got all the updates into the AGS. The residuals in the TPI burn were greater than what I had expected. We did *not* record them because I wanted to get them nulled out just as soon as possible. I don't know the tenths, but they were minus 7 in X, and they were 4 and 4, and I'm not sure whether they were plus or minus in Y and Z. They were large, larger than I'd expected. They were minus 7 and 4-point something and a 4-point something. We reduced those to less than 0.2 ft/sec. From then on, we continued to plot right through the midcourses right up the pike on a nominal trajectory.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

12-3

SCHMITT The comm was good. I have a couple of comments about the AGS. Early after insertion, I always checked the accelerometer. They looked real good. About 5 or 10 minutes later (I can't remember exactly), I looked and I'd accumulated maybe a foot and a half per second in X. I did a gyro cal, and after that, there was no significant accumulation in X. It went very well. I did that without talking to the ground, but I felt I had an understanding with them on that.

On the TPI solution, the AGS was essentially within 2 or 3 ft/sec, a good TPI solution after six marks. The insertion solution was not very good. It was off by a number of feet per second in X and even more in Z. This was the first one of 17 marks. The PGNS recycle and PGNS final were very close, within a couple of feet per second.

CERNAN Midcourse Solutions - The first midcourse solution agreed effectively all systems, except AGS out of plane was a little bit high. The decision was made to burn the onboard PGNS solution out of the LM, which was minus 1.2, plus 0.4, and plus 0.3. We continued to track right up the pike. Midcourse 2 came up, and we again prepared all the solutions. The AGS out of plane was still a little bit high and actually in the opposite direction from the PGNS. We had a slight variation in the CSM solution in Z. I don't know why. It came up with

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~CERNAN
(CONT'D)

plus 5.4 ft/sec in Z. So we really didn't get a very good correlation between the CSM and the LM on the second midcourse. But the PGNCS was still performing, the radar was still performing, and based upon our trajectory plot and based upon our following a nominal inertial line of sight rate, we decided to burn the onboard PGNCS solution in the LM. It was minus 0.4, minus 0.7, and minus 1.6. From there on out, we just continued to follow the inertial line of sight angles. There was very little tweaking in either Y or Z. We just sort of floated right through the braking gates. At 1 mile, I think we took about 6 or 7 ft/sec off to hit 30. We met all the gates as prescribed and just came moving very slowly into the final stationkeeping. We went into a formation flight around the CSM. We got a good inspection of the spacecraft and the SIM bay, the report of which is in the transcript. Everything looked good to us. The command module maneuvered to the docking attitude. The LM just took its docking attitude, gave stationkeeping control to the command module, did pitch and yaw maneuvers, and stood by for docking.

EVANS

One of the noticeable differences between this docking and the docking with the S-IVB is the fact that the ascent stage did dance a lot more than the S-IVB did. The S-IVB is steady as a rock. The LM dead band would change attitude, and you'd try to

~~CONFIDENTIAL~~

EVANS
(CONT'D)

follow it. On the first attempt, I must have had less than 0.1 ft/sec, just barely closing. I was just taking it nice and easy. We made contact and did not get capture. As soon as we didn't get capture, it was obvious we were closing too slowly. We backed off a couple or 3 feet, renulled the rates, initiated the closing rates, and got capture. As soon as we got capture, both vehicles went to CMC FREE. I looked out, and I had some rates in the CSM and I'm sure that the LM had rates also. He must have had.

CERNAN

We went FREE. Upon capture, the LM went FREE. The CSM trying to null the rates ended up perturbing the LM and giving us rates.

EVANS

We finally gave up on that mode and had the LM go to ATTITUDE HOLD. Once you get ATTITUDE HOLD, the CSM could null the rates. We got it lined up and attempted the hard docking. There was no problem. The probe retract came back. This time, it didn't sound like it was as much of a ripple fire. It was more of a "phhtt." It was a quicker hard dock than it was the previous time.

CERNAN

I want to say something about the visual sighting during rendezvous. From the LM, I was able to see the command module when it was sunlit at somewhere around 100 miles. I definitely defined that that was the command module. After the command

~~CONFIDENTIAL~~CERNAN
(CONT'D)

module went into darkness, I could not pick up his tracking lights until we were well within about 40 miles. I could not pick up the docking light, the rendezvous light, of the command module until we were well within 40 miles. It was initially a very dim, faint flash. I was able to verify on board that the LM tracking light was working. I finally figured out how; it was reflecting off the underside of the EVA handrail on the left forward side of the LM. I could see the LM tracking light flashing. There were some particles we took with us that stayed with the spacecraft, and you could see the sequential flash off the particles as the result of our LM tracking light.

SCHMITT

Regarding the television and photography from the LM, we'll just have to wait and see how it turned out. I took a lot of footage. We put it on not only the ascent mag, but we put it on the other mag. That includes the SIM bay. Right or wrong, we did have a Hasselblad on board, so we have a lot of Hasselblad photography.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

13-1

13.0 LUNAR MODULE JETTISON THROUGH TEI

CERNAN Postdocking Check and Pressurization - The general comment I want to make about the postdocking operations is that both pilots in the LM took their helmets off to keep the dust off, primarily. The commander took off his gloves almost immediately after insertion, and flew the entire rendezvous that way. Jack took his off some time later.

SCHMITT I kept mine on for some time. I can't remember exactly when I took them off. I did most of my preinsertion work with the gloves on, because I didn't want to take the time. I wanted to get that initial AGS solution. I could get that fairly rapidly with the gloves. I didn't take the gloves off until maybe 10 or 15 minutes after insertion. I kept the helmet on all the way through most of the transfer, just to avoid breathing the dust. I had the sinus irritation on the surface.

CERNAN The commander kept his helmet on throughout the rendezvous and docking. I took my gloves off after insertion and left them off. As soon as we were hard docked, the commander took off his helmet. As I look back at that, because of the dust debris in the LM spacecraft, I'm sorry I did. I could have left the helmet on, and I would have had a lot less eye and mouth type of irritation. You knew you were in a very heavily infiltrated atmosphere in the LM because of the lunar dust. I don't know

~~CONFIDENTIAL~~

CONFIDENTIALCERNAN
(CONT'D)

how much lunar dust previous flights had, but I think we saved a great deal of grief by sweeping all the dust we could find on the floor into the holes and putting our tape covers over those holes. I think that had to help a great deal. There was an awful lot of dust on the floor that we didn't see.

The commander had his helmet and gloves off all throughout the entire transfer. We handled the transfer the way we'd planned. The LM pilot did most of the preparation of the gear in the LM, and the commander stayed in the tunnel and passed things on. The inventory was going on in the command module side and on the LM side, both. We vacuumed each other's suits the best we could and everything else that got supposedly transferred, unbagged, or uncovered.

SCHMITT

In spite of the CMP's comments to the contrary, I think we got things remarkably clean. There wasn't an awful lot of dirt in the command module coming back.

EVANS

That's true.

SCHMITT

In contrast, he may have thought it was dirty, but I was surprised we were able to keep the level of contamination in the command module down.

CERNAN

After I took my helmet off, I could go halfway through the tunnel and stick my head up in the command module, and it was a

CONFIDENTIAL

CERNAN (CONT'D) totally refreshed, unpolluted atmosphere up there. It never did get polluted.

SCHMITT I think having that vacuum cleaner running in the LM had a lot to do with keeping the flow in the other direction, filtering out the air.

EVANS We never did vacuum in the command module because it just wasn't necessary.

SCHMITT The suits were noticeably cleaned by the vacuum cleaner. You could tell you were pulling stuff off them, although they were still dirty. Every subsequent time we handled them, we got our hands dirty. I think most of the free dust was taken care of.

CERNAN We effectively stayed on the transfer list. I say effectively, throughout the transfer. However, some things got transferred out of order and temporarily stowed in the command module. We effectively used the transfer list not as a cookbook recipe type of thing, but as an inventory list. We inventoried it several times from both ends and were satisfied we had everything transferred. We then pressed on with the LM closeout.

The IM closeout went nominal. We got back into the command module, and the LMP closed out the LM. For convenience, the commander went back and closed out the LM hatch and put in the command module hatch. Because of the slow tunnel vent, or the

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

long duration of tunnel vent, the commander stayed in the tunnel, the LMP in his seat, and the CMP in the left seat. We suited up and prepared for our integrity check. As soon as the LM tunnel vent was complete and we were satisfied with the integrity of the hatch, we went into the suit integrity check.

EVANS

I bet it must take at least three or four times longer than the simulator did for the tunnel vent.

CERNAN

I think that's going to be applicable to Skylab. They're going to have to vent before they undock, I think.

The tunnel closeout was easy. We had no drogue and probe which were stored in the LM for LM jett. We just followed the checklist, and it all seemed to happen just as advertised.

EVANS

We got a little bit intrigued with the LM jettison. It was great. It just sailed out there nice and pretty, and we got a lot of good pictures of it. We should have been maneuvering. We ended up getting into P41 after jettison for sep burn, a little bit late. That was no problem either, because we just trimmed the residuals for P41 and got a good sep burn.

CERNAN

Cleaning control in the command module was excellent, considering all the dust and dirt that just seemed to adhere to everything in the LM. When we got back in the command module, with the exception of the suits, and LMP and CDR, everything was

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

13-5

CERNAN
(CONT'D)

clean. Everything was clean because everything was bagged before we brought **it** over - bagged and zipped. ~~We~~ never did open anything once we got **it** zipped up. So the command module stayed exceptionally clean throughout the remainder of the flight.

SCHMITT

In the bagging of the decontamination bags, I made a special effort, after requests prelaunch, to pull those zippers as tight as I could. They should be pretty tight.

EVANS

High gain always worked good; omnis and S-band were good. Photography went as advertised. ~~We~~ had lots of targets of opportunity. SIM bay operations have been mentioned before.

TEI updates, normal. Sextant star checks were good for TEI.

CERNAN

Every one **all** through the flight was good, which made me feel real good. I made sure I got **it** on those last few. I wasn't going to change any mode of operation. I made sure I got **it** on TEI. Just to make you guys feel at home. I figured you'd think I didn't do **it** right, if I didn't get the master alarm.

SCHMITT

The TEI, at 1/2g, or whatever we were pulling there, seemed like more than that.

EVANS

It sure did; **it** seemed like **it** was really pushing you back in the seat.

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

SCHMITT Ron and I both started out holding our heads up and eventually relaxed them back on the couch.

CERNAN I guess we must have had the spacecraft pretty well stowed, or tied down. I briefed the CMP and LMP, and, as I recall, those kind of burns back on Apollo 10, lots of things start moving through the spacecraft and find their way to the aft end of the spacecraft because of the g-load. Much to *my* surprise, all we had was an initial thud as we moved away from the station, and we didn't have any gear flying through the spacecraft.

SCHMITT I found a white tag, wetwipe.

CERNAN Other than maybe one or two of those things, in looking back, I would have expected more gear to come from somewhere, but we prepared for those burns pretty well.

EVANS That reminds me of **all** this water condensing on the ECU unit, the pipes, and what have you. When we put our suits on for the EVA the next day, your suits were noticeably wet. When I pulled the PGA bag up, it was damp down underneath the PGA bag. As a normal procedure, we should have, either after the burn, probably before the burn, made sure we wiped up the water in the LEB.

CERNAN Our suits were damp when we put them on, but I could not find any real water down there.

~~CONFIDENTIAL~~

EVANS There's always water down there in the ECS. I just assumed that's where all of it came from. There's not a puddle of water. Like I said, it's just damp.

CERNAN It's almost as if it was colder down in the LEB, and water was condensing all over the suits. It wasn't as if they were in a puddle.

EVANS The simulator is set up such that in roll dead band, it goes over to one side of roll dead band and just kind of stays there. During the TEI burn, it was bouncing back and forth from one side of the dead band clear over to the other side of the dead band. When it's bouncing back and forth, the roll rate is up around, oh, 0.4" per second, arcing back and forth across the roll dead band.

I'd like to mention chlorination at this point.

CERNAN Without fail, almost every chlorination leaked. Sometimes large quantities of water, other times just small quantities of water.

EVANS Water or chlorine?

CERNAN A combination. Where it leaked appeared to be around the bag. It was the cylindrical chlorine dispenser that was continually wet. It was not where the dispenser fit into the needle or

~~CONFIDENTIAL~~CERNAN
(CONT'D)

where the needle adaptor fit into the spacecraft. It was within the chlorine dispenser itself. Chlorination was a case of always cleaning your hands with chlorine because you always had it available down there within that dispenser. In some cases, you had a larger quantity of water that had to be wiped up with a tissue. That plagued us throughout the whole mission. It turned out not to be a serious problem because we learned how to handle it. That was one system anomaly that hadn't really been brought up.

EVANS

In two cases, I'm almost positive, it did not puncture the ampule. The reason I believe that's correct is that, when you started to crank the outside of the cassette down to push the chlorine into the water system - it was very hard to turn. If you tried to force it, you could force it on down there, and I'm sure that's a good way to break an ampule on the thing. In two cases, we took the bayonet fitting loose again and put it back on there, and in both cases, then you'd start to squeeze the chlorine out of the ampule into the system, and it would turn easier.

CERNAN

We got the chlorination done. We didn't miss any injections of chlorine, and we didn't miss any of the buffer samples. I guess we got the job done; it was just a little bit messy. The

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~

CERNAN
(CONT'D)

chlorine was evident because the CDR eventually peeled all the outer skin off his right hand. I'm convinced it was due to the chlorine, and had nothing to do with the EVA.

~~CONFIDENTIAL~~

