14.0 TRANSEARTH COAST

CERNAN Passive thermal control was what I would call unusual attitude because of the UV/IR requirements. These unusual attitudes did two things. They required us to remaneuver the spacecraft several times and enter and exit PTC several, several times, which, in itself was not a problem, just additional coordination. Coincidentally, most of these particular PTC attitudes were within 30°, certainly 45°, of gimbal lock most of the time. We were looking at the red apple a good portion of the trip home.

Some of those attitudes where you actually were in attitude or PTC in these relatively unusual positions, change the equilibrium heat load on the spacecraft. RCS quad temperatures were all right, but you could see it in helium package temperatures and, most noticeably, you could see it on the change in condensation from the tall hatch to the forward hatch. The tall hatch eventually, for most of the way home, ended up to be very dry. The second day out on the way home, the center hatch got soaking wet to point that we even took a dry rag and wiped off some of the latch components and some of the gearbox components, externally. Not that it did much good, but there was just that much water on there. I think this is all due to the PTC attitudes required for the SIM bay experiments on the way home.

SCHMITT It was cold in the spacecraft, too.

CERNAN Oh, yes, it wits cold in the spacecraft.

SCHMITT Not as cold as the commander thought it was.

CERNAN Cold enough to warm it up, on the commander's orders.

SCHMITT We mentioned we warmed it up on the ground's suggestion of an extra invertor and going to MANUAL on the temp gain. I think we discussed that.

CERNAN Ron, all your REFSMMAT changes, your platform torquings, all those went very well, I thought.

EVANS They were great, went really well.

CERNAN All the way back home, it was just changing attitudes, changing attitudes, changing attitudes, with the exception of the EVA day, which we'll cover here shortly.

EVANS CSM EVA - On EVA prep, we really didn't have any problem. We didn't know of any at that point. The EVA prep went right down the line, essentially. It was well laid out within the experiments checklist. We checked things off as we went, and stayed pretty much on the timeline. We started about a half hour early, and finished a half hour early.

CERNAN We were a half hour early throughout the whole thing, and we lost that half hour in opening the hatch. We turned out to be exactly on time. Where we lost that half hour was on a comm carrier change.

Post-EVA - One thing that helped us immensely on what ended up to be, I think, a very fine entry stowage was that we backed off after EVA and took a good long look at the long-range stowage as well as the post-EVA stowage. We really started housecleaning, cleaning up the cabin, and effectively stowing some of the articles that were not going to be used any further in the mission for entry at that time. Our entry stowage really started with the EVA timeframe period, and I think that really helped us out in the long run.

The only change to the prechecklist and postchecklist was the order in which we doffed and donned suits. It was very evident there were certain convenient ways, because of the way the suits were stowed and the way that people fit into the checklist, that when we donned the suits. The commander was first, then the LMP, and the CMP donned last. It worked out very fine. The CMP had less work to do in his suit, which also aided him in the long run.

CERNAN (CONT'D) In doffing, the LMP was first, then the CDR and then, the *CMP.* That wasn't exactly the way it was called for, but that's the way it worked out.

We stowed our suits in the L-shaped bag prior to putting the center couch back in. This was another good decision, I believe, in helping us get the suits stowed back in that L-shaped bag.

EVANS Cabin depress - No problems. Normal depress. Hatch opening. Even though the cabin was completely depressed, we were reading zero pressure. As soon as I opened the hatch, there was enough residual pressure, or something, inside the spacecraft that it actually tended to pull the hatch out of my hand.

CERNAN Because your suit is bleeding into the cabin all the time, so you never truly get zero.

EVANS That's right, you never truly get zero. The dump valve was still open, and if I had not been hanging onto the hatch, it would have blown it all the way open.

CERNAN That's not unexpected because it's exactly what we had on the lunar surface. We completely dumped the LM. I'd still have to break that hatch loose and hold it open about 6 or 8 inches until things just vented. Then, I could let go of the hatch and open it all the way. If I didn't it would slam back,

CERNAN (CONT'D) closed. It was basically the same thing. You have to open that door and really let things get down to zero.

EVANS When I opened the hatch, all of the little ice crystals started flowing out. A pen went floating by, and something else went floating by - wasn't quite sure what it was. There's all kinds of little particles and pieces that start coming out through the hatch.

CERNAN I looked specifically for the scissors. I didn't see any scissors go out that hatch. I hate to say it. Ron, I'd like to say they went out the hatch, but I sure didn't see them go.

SCHMITT Sure you didn't see them go?

EVANS I caught the one thing that started to go by me, and I put it in your pocket. Once all particles and junk were out of the way we pushed the hatch open. We disconnected the counter-balance with the tool E. So, that we locked the hatch in the open position, so I just shoved it open, .it went beyond the center position and locked in the open position with no problem.

Egress - I had a tendency to float up against the MDC. I had to cautiously duck to get my face as close as I could to the bottom of the hatch in order to get the OPS past the MDC and get on out. TV and DAC installation worked fine. I could hang on with the right hand on the hatch, the great big D-handle on

EVANS (CONT'D) the hatch, with the TV pole in my left hand. Worked out real fine. Just stick it in there and line it up; make sure it was locked in, then climbed on up the pole to turn the TV on. I turned the back on. You couldn't see the light on the thing, but you could feel the camera running once you turned it on. You could touch it and you could feel it vibrate a little bit.

The lunar sounder cassette retrieval should be on the air-to-ground tapes. Most of it was no problem.

The pan camera cassettes were next. No problem on the pan camera cassettes. It's obviously a bigger mass, and it's quite apparent when you try to move that big mass around. It is heavier and it weighs more than the other things. It's easy to move, but it is it takes a little effort to get it started. You know that if you ever get it started in one direction and it's going to keep on going and you have to stop it. I just tried to keep it under control. Mapping camera cassette had the same problem I had in the SIM bay c^2f^2. That was getting the thermal cover off. It stuck underneath the mapping camera laser altimeter door. I gave it a big jerk and it came off.

SIM bay inspection - That's all covered in the air-to-ground tapes. TV/DAC removal again was real simple. You just had to squeeze the lever and TV came out. It was easy to hang on

to with one hand and maneuver the TV around and point it toward the Moon. I didn't have to worry about shining it into the Sun. I tried to again hang on with one hand and point the TV around toward the Earth. The Earth was maybe 15° away from the Sun. I tried to be a little more accurate. When I did that I really lost control of my body position. I was trying to maneuver the camera. You need both hands to maintain your body control.

Comm during EVA was loud and clear for me throughout the EVA. There was a lot of background noise; I'm sure it was coming over the VOX circuit.

CERNAN It didn't appear to me that anyone on the ground had trouble reading you.

SCHMITT One thing we did because it was bothering us I turned the VOX sensitivity down about two notches. That really improved the comm performance.

EVANS I don't know if it made any difference or not, but I got the impression that it did help.

CERNAN Comm into the cabin was excellent. I never had any trouble understanding with that hissing in the background.

EVANS Ingress - It seemed to me it was easier than egress. For some reason, hatch closing was harder than I'd anticipated. Maybe this is the same reason in that I must have been exhausting into the cabin all the time. That hatch would come closed to within about an inch of closing on the outer edge. Then it took an effort to pull the hatch closed so you could activate the latching handle so that you could get the latches over center. Of course, once you got the latches over center, it was real easy, a couple more cranks on the hatch for closing.

Repress was normal.

SCHMITT All I did was work in the hatch area. I want to emphasize what everybody's always said that you do your best work when everything's going easy. Move yourself in small increments to where you want to go. You can turn and dip and raise yourself out. I think it's also useful for any hatch or port operation to have somebody available to push you out on your tether towards where you want to go. It just eases the operation. With the struts and everything available there, there was never any feeling there that I could not have a way to control my body position. Sometimes it took a few seconds to get it where I wanted. The one thing, invariably, everytime I went back inside I had the 90° disorientation for a few seconds

until I got the perspective of the cabin again. I'd say okay, that's right. Then I would go back outside and come back in, and once again it seemed that cabin had rotated 90° to my perspective. It's just something that's no problem, it's just a change of perspective. For some reason, I experienced it several times. I guess the biggest problem working in that angle for me, attitude, was I had the Sun full face.

EVANS You had the Sun in your eyes most of the time.

SCHMITT It made it hard to look in detail to see what you're doing. You were clear image; you were there. I could see every major operation, but I could not see specific details.

EVANS I had no awareness whatsoever that I had an umbilical on my back. I never got the feeling that the umbilical was restricting my movements. I didn't even know that it was there, Did you observe at any time, did the umbilical ever get tangled around.

SCHMITT No, the umbilical was easy to tend. There may have been one. I had a vague impression that I asked you to hold up, or maybe I did not say anything, I just moved you away from a handhold or something. The umbilical didn't seem to slink around. You seemed to have everything you needed on it.

EVANS I did not even know it was there. Being tied to the umbilical does not restrict your movement or give you a feeling that it is restricting your movement at all.

Transearth - I did not see a light flash.

SCHMITT That evening I did see them again falling asleep.

EVANS I did, too.

SCHMITT So then, it was just that period during the actual experiment for some reason they were not visible.

EVANS We never really utilized the waste stowage vent to get rid of any odors out of that waste stowage compartment. It was always a crime if you were in that area, if you got real close to it.

SCHMITT The cabin generally turned over the atmosphere in pretty good style. It got saturated sometimes with gas and it took a few minutes to clear. *The* cabin did a good job.

CERNAN Flight Plan updates were super. The Flight Plan was excellent. Changes were held to a minimum, and we really did not change any part of the entire flight except a few dates, times, and attitudes.

CERNAN (CONT'D) Entry preparations began after EVA and continued all through the next day. We had very little final stowage to do on the final entry morning, just those things we had to leave unstowed until we got out of our sleep restraints. Basically, we just had to tie the big bags dawn. Final entry preparations went by the checklist. If anything, we stayed about 5 minutes ahead throughout the entire checklist, including separation and activation of the command module RCS and .05g, which came on time. Communications I thought were very good through this time. I understand the ground heard everything we said right through blackout. As soon as we came out, they still had ARIA, and they could still read us. We could have read them, but they never transmitted anything.

15.0 ENTRY

EVANS Prior to midcourse 7, we did a null bias check and also an EMS Delta-V test. The Delta-V test had been going at about minus 22.2 or 22.1 at the end of the 10 seconds. Then prior to midcourse 7, we ended up with a minus 27. We'll have to check the air-to-ground tapes, but it still was within limits. We'll check the air-to-ground on the actual values of this, but it failed the null bias check by a considerable amount. Since it did that, I went through an extra EMS entry check. It passed that EMS entry check. I can't say for sure whether the .05g light was on during test 1 or not. It was on during the second EMS check. As a result of that, it was determined by the ground that the accelerometer in the EMS was probably putting out a couple of extra pulses. It was decided to change the entry checklist so that we would not put the EMS to normal until .05g time. This is what we did. The .05g light came on, and the EMS functioned correctly throughout the entry. Entry parameters are on the air-to-ground tapes and also on the frames.

The RCS sounds were a little bit louder than we'd been practicing with in the simulator, I thought. I've also mentioned the drifting and the cross coupling and minimum-impulse SPS.

CERNAN Is it louder or more of a bang?

SCHMITT It was less than the LM and more than the service module. That's a good way to put it.

CERNAN Banging on a solid can.

EVANS Communications blackout - You'd never know it from inside the spacecraft.

Ionization - Ionization is bright. It was very bright, very bright.

SCHMITT There seemed to be an early glow. Now, whether that was ionization or the initiation of the fireball, I don't know,

CERNAN They're one and the same.

EVANS They're one and the same, I think.

SCHMITT Yes, but with the true fireball, it would seem to me that that would be something that you really couldn't look at. I couldn't look at it; it was too bright. I couldn't stand it.

EVANS You couldn't look out the rendezvous windows at the fireball because it was too bright. I felt like I should have put on my sunglasses in order to be able to see. That intensity only lasted for about 10 seconds, maybe a little longer.

CERNAN It was longer than that;.

EVANS It's hard to remember for sure.

Peak-g - The one thing I can recall about peak-g is that I definitely could not see the peak-g value on the EMS because I couldn't see where the pointer was on the EMS. I determined peak-g by looking at the g-meter. I could read the g-meter, and it was something just less than 7. You're pretty well pinned to the back of the seat at peak-g. You definitely have wrist action with no problem, but trying to raise your arm took a lot of effort. I don't think you'd ever get your arm up if you didn't already have it up at 6g.

Guidance Termination - No comment.

CERNAN Let me talk about guidance for a minute. The CMP was in the left seat, monitoring the EMS, g's, and what have you. I was in the center seat, monitoring CMC and passing bank angle information so we could come to a logical conclusion about giving the spacecraft over to the CMC for guidance. I had the impression after peak-g that the two of us were very close to convincing ourselves that the CMC was not going to roll the spacecraft.

EVANS That's right.

CERNAN It seemed like it took a long time for CMC guidance to roll the spacecraft back out of peak-g. I had the impression that you were just waiting for me to say, "Let's take it back," and we would have taken it. It seemed that it was longer than the simulator. It was a long time before the CMC made its first initial roll command, almost too long. In another couple of seconds, I think we might have taken it over.

EVANS We might have taken it over. I think the reason that we felt that way was because most of the runs that we ran in the simulator were nominal runs where you get about 6.1g. If you get 6.1 or 6.2g, you do reverse the bank angle to a one-eighth roll quicker than you do if you have a higher peak-g. We were pretty close to the 7. I don't know if you ever saw 7 on the DSKY or not.

CERNAN No, I never saw 7g, to my knowledge.

EVANS I never did see 7.

CERNAN I saw 6.64 or 6.65, something like that, but that's about as much as I ever saw. It just occurred to us that the CMC was never going to get around to rolling 180'. Once it did roll 180° to the best of my recollection, it never rolled except from left to right. It never rolled across the top again. It went from 90 or 100 one way, and 70, 80, 90, or 100 the other

CERNAN (CONT'D) way but never made the complete turn again. It just rolled left and rolled right, rolled left and rolled right.

EVANS Visual sightings and oscillations - The one thing I forgot to look for was that in the simulator from about 90 000 on down to 50 000, it starts pitching. I don't remember if we ever got that pitch rate going or not. I think most of my comments should be on the air-to-ground tapes throughout the entry. Those would be more appropriate than something I might recall at this point in time.

SCHMITT I think we all had about the same impressions. My standard comments for launch and entry are that there are certain periods of time that lasted for several minutes where I don't think you would be too extensively doing malfunction analysis and problem solving, particularly during peak-g. I think you're mainly concentrating on the g-load, and it would be hard to move your arm anyway to take care of any problem with the switches or otherwise. I'm not saying you shouldn't simulate it. You learn a lot of systems and that sort of thing, but I don't think you can anticipate doing work during that period of time.

CERNAN I thought the droque deployment was violent. I thought the spacecraft oscillations were quite violent. I'm not saying

CERNAN (CONT'D) that there was that much difference than I personally witnessed in the past. I just forgot to expect the violence of the oscillations on the drogue.

SCHMITT I was watching the drogues, and they were moving just as hard as the spacecraft. I think that the drogue movement was being transferred to the spacecraft.

CERNAN We had all drogue deploy, all main deploy, and once we had the mains, apparently we had two good parachutes.

SCHMITT I watched the full main deployment, and I could see all three reefed parachutes after deployment. They stayed reefed probably about the amount of time you'd expect them to. Then you could see the reefing lines start to go, and the two parachutes that were on my right filled fairly quickly and seemed to push the left parachute away and out of the main slipstream. It filled much more slowly. It was clear to me, and it should be in the photographs, that the reefing lines were free. The parachute was not filling. Then gradually, it filled completely. I would say it was 15 or 20 seconds before that other parachute filled completely. It was sluggish. It just got pushed out of the way and couldn't get the full flow of the air to fill it.

CERNAN And I think that some of the people on the recovery team said that they saw the two parachutes plus the streamer.

SCHMITT I wouldn't call it a streamer. It was just unreefed. It was just still reefed.

EVANS I'd like to make a comment about the dynamic visual cues of rotation. Throughout the entry, I didn't really feel that I was rolling. I didn't get a feeling of dynamic roll other than the fact that I was watching the needles. There were no centrifugal forces involved in that operation until we were on the main parachutes. When we were on the main parachutes, I felt like I was lying on my back on a revolving table.

SCHMITT I suspect that might be because of the higher g-loads when all these other things were happening. I don't know how much you were looking at the horizon as you rolled, but that's all I had to look at.

EVANS I could see the roll. I had the visual sensations of it, but I didn't have the dynamic feeling of roll until we were on the main parachutes. While we were on the main parachutes, the roll was not continuous in one direction. It was rolling in one direction at 15° to 20° per second, and for some reason, it would reverse and go back the other way. The rolling sensation on the parachutes was kind of a wind and unwind type of a roll.

SCHMITT The DAC operation was normal. We took a little bit of extra footage early of the horizon which I hope turns out. I don't

SCHMITT (CONT'D) understand why you turn the DAC off after you're on the mains. There's no reason to. We ended up with some unexposed footage.

CERNAN Oh, you did? I thought you let it run out.

SCHMITT No, the checklist said, "Stop DAC," and I stopped DAC and it was a little while later that I wondered why I stopped the DAC.

CERNAN I'm sorry. I thought you let it run out.

SCHMITT I don't know if we would have gained anything by it except some more pictures, but there was no reason to turn it off.

EVANS Communications - From 90 000 feet until about main parachute deployment, I had a time trying to hear Jack. There was a lot of background noise.

SCHMITT That's right; I remember that.

EVANS It just gets noisy in the spacecraft from about 90 000 feet on down. Once you get the altimeter off the peg, I had a time hearing you call out.

SCHMITT I was shouting, too. I realized you were having trouble hearing. There was noise. It must have been air noise coming through the hull.

EVANS It was something.

CERNAN You were on VOX that whole time. You could have been keying, and that noise could have been coming through your VOX. I'm not sure. That takes care of entry, which was a good one.

SCHMITT Let's mention ECS. I never was uncomfortably warm in the cabin at all, even through hatch opening,

CERNAN We cooled the spacecraft effectively. Just normal powerup of the ECS systems cooled the spacecraft down prior to entry, and it was comfortable. Even after we landed when it normally does warm up because of humidity et cetera, it was still very comfortable. I never thought it got hot or extremely humid throughout the whole recovery operation. The altimeter read about 100 feet when we hit. We'd been warned that we might hit with 17 feet on the altimeter. We made callouts all the way down on crew condition, altitudes, and the DSKY read-out in terms of position. They had a visual on us all the way down. We were right next to the ship, apparently right at the zero aim point.

16.0 LANDING AND RECOVERY

CERNAN We hit with a pretty good thud. As soon as we recovered from the thud, the LMP went for the main parachute release breakers and I hit the switch. The parachutes, apparently from the lack of a great deal of wind, just rose petaled in an almost 120° position around the spacecraft. We had no tendency of ever going stable II, partly because of the seas and the wind and also because we released the parachutes in a hurry. We proceeded to go through the postlanding checklist. In addition to what we said about the temperature and humidity, I think the postlanding vents certainly did help. We had that running. We had communications with Recovery all the way down on the parachutes. We monitored the recovery all the way through by communicating with the recovery chopper. Spacecraft status was excellent. We followed through the checklist; and, although it was not needed, the checklist calls out to inflate the bags after you've been on the surface 10 minutes. We inflated the bags for 7 minutes after we'd been on the surface for 10. It is a good idea in spite of the fact that they were not needed because it does give you that added protection of staying in in stable I in case you might end up going over. There was no seasickness.

SCHMITT We did not put the postlanding vent ducts up although they were available. There was plenty of air moving in the cabin from the normal ventilation. You could feel it. You could feel it move. I don't know about you fellows, but I had plenty of air.

EVANS I had plenty of air coming across on the left couch, too.

CERNAN The CDR climbed out of the center couch, went down to the LEB and got the cosmic ray prepared and available. We stood by for hatch opening. When the hatch opened, we received the bag with the lifevest, the cosmic ray protector box, and the temperature gage. We put the temperature gage on, the cosmic ray was stowed in the waterproof package, and we put on our vests. When we were ready to open the hatch for the final time, we powered down the spacecraft via the checklist and panel 250.

SCHMITT I would call the touchdown a very sharp crack rather than a thud. It is an obvious sensation. It's not one that seriously jarred you or hurt you in any way. It was a sharp and abrupt stop. I think it might have taken me 2 or 3 seconds to start making a motion towards the breakers. There was enough jar to say, "Okay, I better recover from it," and then I reached for the breakers. The windows fogged up inside almost immediately and there was also material on them on the outside. It looked like something other than moisture on the outside. It was sort of a brownish yellow. I had no motion sickness at all, but

SCHMITT (CONT'D) I didn't really care whether I got up out of the couch or not for a while. I didn't have the desire and that's about all I can say as far as any change of feeling from zero-g to one-g. I noticed that my neck muscles seemed to be really working to hold up my head up. It was much more than normal and this persisted for about 24 hours. It gradually went away until about 24 hours later I felt perfectly normal raising my head.

EVANS I guess I didn't even notice the transition from zero-g to one-g. I didn't pay that much attention to it.

CERNAN I didn't really notice any difference either. I particularly got up on the LEB to see if I would but I didn't.

SCHMITT On the egress, my lifevest did not inflate automatically. That might be worth looking into, because apparently they were a new set sent out specifically because the first set sent out had not gone through inspection. These presumably had and they still did not inflate. Only one out of the three inflated all right.

EVANS Another point I want to make is that if we're going to put that temperature gage in I would recommend that you send in a roll of tape, a bungee, or something so you can strap it to the strut. We just happened to have a piece of tape in the LEB so we could tape it to the strut.

SCHMITT Crew pickup for the LMP was exactly as I'd been told it would be. We practiced on Apollo 15.

CERNAN I don't think there is any other comment on crew pickup other than to say that it was done in an outstanding manner.

EVANS I concur. It was good.

17.0 TRAINING

EVANS CMS - The crew station was always in good shape. Some of the interior storage was boxes, but the items of storage equipment that needed to be used were always there. Jerry Stoner and his crew kept it in excellent orbital storage most of the time. If we wanted it restowed for a SIM, for lift-off, or anything, all we had to do was let him know and they were in there all hours of the day and night to get everything squared away. Fidelity of the CMS - I've mentioned the differences in the actual vehicle and the CMS in the various other sections of the report. They are minor. Availability - The CMS was always available any time I wanted it - more than I could use it in some cases. The people involved in the CMS training - knowing full well that Apollo 17 was their last shot - were outstanding in their desire to continue training and to put out their best efforts in insuring that I was trained and ready to go. Visual systems. I didn't seem to have any problems with that. The biggest problem was in the star ball. Every once in a while it would get fouled up. That and the sextant drive were a little bit jerky but it worked great. Software - F computer was going all the time. If it ever conked out, they fixed it fast.

SCHMITT I echo all of Ron's good words about the quality of the training and the dedication of the troops down there. From the systems point of view, I think the fidelity of the systems was all that was required and was generally very high. Only those differences that were spacecraft peculiar were the ones that were not simulated. Where there were other comments to be made, they have been made in conjunction with systems work. Availability was fine as far as I'm concerned. The visual systems were good. The only ones that really concerned me were the entry visuals and they were certainly adequate, although they do not give full representation in drogue and main deployment.

LMS - we never really stowed the LMS. The gear necessary for general training was perfectly adequate. All of our crew-station-type training was done in the mockup of the LMS. We've also mentioned the fidelity of the training and wherever there was differences, the L&A and the AOT were excellent representations, based on a little bit of comparison that I did. The AGS software in flight was just like the AGS software in the simulator with one well-known exception. You get your displays faster in the simulator than you do in the flight but this was never a problem. My work with the PNGS is limited and confirms what the CDR has already said, that the PGNS in the simulator and PGNS in flight are essentially the same.

SCHMITT (CONT'D) The LRV navigation simulator - The main usefulness I received from this simulator was working over the traverses and understanding and knowing what we were supposed to do. The comparison of driving on the lunar surface with that of the simulator was very poor. I think the problem is that the simulator has to give you a much higher point of view. The simulator is 20, 30, maybe 40 feet higher above the surface. When you're down at 4 or 5 feet, as you are in the LRV, it's a different world. It makes a big difference in what you recognize. The other side of that coin is that once we started moving on EVA-2 and EVA-3, there was never any difficulty on the lunar surface of recognizing the larger features that we had seen on the LRV simulator. So it worked out very well.

CMS/LMS simulations - In general, the integrated work we did always went very well.

EVANS I think it did. We lost 1/2 day on an integrated sim.

SCHMITT I think the few places where we ran a little bit behind in flight were those portions we never really simulated, such as suiting operations and the tunnel operations. They went smoothly, too., I think not simulating them in detail was a good decision, and I don't think it affected our operations.

EVANS I don't think so, either.

SNS - I don't know how you can ever overcome this, because in the SNS you are training the crew and you're also trying to train the MOCR. There isn't that much for the CMP to do to keep busy all the time from a training standpoint. I don't know if that's necessarily bad or not.

SCHMITT We had a few excellent SNS, from the standpoint of fairly continuous activity. In general, Ron's comments are valid for Apollo 17. If my memory serves me correctly, Apollo 15 SNS were much more active. And I don't know why there might have been that difference.

EVANS On Apollo 14 backup crew, I was more in a learning stage at that point than I was on Apollo 17. In Apollo 17, it was more of a review stage for training than anything else.

SCHMITT I think that's a natural point.

EVANS DCPS - We tried to get it once every 2 weeks, which we did in the first part of the training cycle. The last 3 months we were lucky to get into the DCPS once a month. I feel it's a necessary part of the training and should definitely be continued. The CMPS was shut down after Apollo 16, so all of my rendezvous rescue procedures and training was accomplished

EVANS (CONT'D) prior to Apollo 16, with a final review of the rescue book about a month prior to the Apollo 17 launch.

SCHMITT I'd like to make a general remark about CMPS and LMPS type simulators for future programs. If you ever have a program where you're bringing in a new group of people to fly your spacecraft, this type of facility is extremely valuable. It gives a new man a chance to train without the constraints of simulator ties. He doesn't have the pressure of other crewmen looking over his shoulder and evaluating his performance. He can figure out how to do things, what a simulator really is, and what many of the more standard procedures are. I think it's a very valuable type of simulation. When you're dealing with a large pool of experienced crewmen, then that type of simulator is not necessary. This type of simulator develops habit patterns which are necessary in order to move on to the total mission simulators. Let me go back to SNSs. I had a feeling - and again I'm comparing with 15 - the total readiness of the combined MOCR and crew team came up more slowly than it did on 15, sometimes more slowly than I expected it to. But, at the end, I had the feeling that we were every bit as ready as a team as we were on 15. There was a lot of Skylab work for a lot of people there and I think that may have affected the rate in which we came up.

EVANS Command module egress training - The mockups over in building 5 were utilized from an EVA standpoint for the CMP. The probe and drogue mockup was utilized several times. The last was a review and a final check. This is an absolute necessity for the drogue operations and also for the command module EVA operations. You need to utilize the mission simulator once or twice to tie in the systems procedures with the mockup procedures.

SCHMITT The lunar module pilot's egress training was largely accomplished on Apollo 15. We did procedures reviews or mockup reviews and I did not get into the water tank for Apollo 17. The launch pad final walkdown came at a good time. The normal training we did in the hy-pergolic building was standard and excellent. I think it was good familiarization.

EVANS It was good familiarization and also a must.

SCHMITT It's a confidence builder and I think you ought to do it. The altitude chamber work tends to give you a little bit of egress training just because you have to deal with a real vacuum. I think that also is something you just pick up but that adds to your total readiness as far as egress is concerned.

EVANS The water tank is where I received most of *my* EVA training. The water tank is a pretty good representation of zero-g.

EVANS (CONT'D) It was a lot better for me than the zero-g airplane. I became sick in the zero-g airplane every time except one. I never became sick in flight and never felt like I was going to be sick in flight. Every time I got on the zero-g airplane I always wanted to get as much done as possible before I started throwing up. I don't have too much confidence in the zero-g airplane even though I flew in it four or five times.

CERNAN I'll make some general comments about the CMS training. The CMS, from a hardware point of view, supported our mission in an excellent fashion. I think the crew at the Cape made themselves particularly available and were a vital part of the training. They did an outstanding job. The CMS is always limited in a visual and a dynamic system because it is a fixed-base simulator. I think within the capabilities that it has to reproduce the visual, we received a good preview of what this flight was going to be about. It was mentioned earlier that for launch and reentries there are certain periods of time that you can not do in the real world that you can in a simulator because of the dynamic g-forces. It was also mentioned that this method of training in solving systems problems during those phases is still an excellent way in which to train as long as you realize that there are certain phases in the dynamic portions of the mission in which you will not be able to exercise the freedom that you can in the simulator. The LMS

CERNAN (CONT'D) from a hardware as well as an individual instructor support point of view supported our mission, in outstanding fashion. The entire system was excellent. The L&A, from a gross recognition point of view, was a duplicate of Taurus-Littrow. When we pitched over, it was almost like being in the L&A, except you very obviously got the realistic three-dimensional feeling. All of the software practices we used in the simulator were used in the spacecraft. The duplication of the spacecraft's software on the ground in the simulators was outstanding because I never had any problems or overloads. Everything performed just as advertised. I want to mention something about the LRV navigation simulator. It's a very good area familiarization simulator. I anticipated it would be a real great navigation driving simulator, but it's really just an area familiarization simulator in terms of driving from station to station and completing your EVA traverses. I think its major shortcoming is you never get the feeling of size or distance on this simulator, because on the Moon you have to at least double or quadruple your estimate of size and distance. You do not get that on the lunar Rover navigation simulator. You do not get involved in what it takes to drive the lunar Rover on the simulator and I don't just mean the 1/2-g effect. I mean the effect that in the real world when you drive the Rover you are continually avoiding rocks, holes, and craters. Some

CERNAN (CONT'D) you can see and some you can't quite see. It's a continuous requirement to watch where you're going. The duty cycle of the controller is almost 100 percent. You do not have this requirement on the lunar Rover navigation simulator, and it's a little unrealistic from that point of view. We didn't spend that much time on the LRNS and I'm thankful we didn't. I thought it would be more valuable. The simulations we had with Houston and the integrated sims at the Cape went very well. We had very few hardware problems. The LMS in the last couple weeks had hardware problems now and then, but the people were able to recover and we only lost 1/2 day, and I think we made that up.

WARD The backup crew essentially lost a day.

CERNAN The DCPS in Houston was used extensively until 3 or 4 months before the flight. I'm very glad I did that because it was not just abort training, but it was abort and booster familiarization work. I felt very comfortable in flying the aborts as well as the manual takeovers on the booster. The rest of that training was done at the Cape in the CMS and I never felt anything but at home and quite knowledgeable about that part of the training.

CERNAN (CONT'D) CM/LM egress - The altitude chambers speak for themselves. We did the launch pad work. We did water tank and not Gulf egress work and I heartily recommend that.

Systems briefings went hand in hand with our simulator briefings from the simulator people. We did a lot of those very early and then just kept up the speed as we felt we needed them throughout the last 4 or 5 months with the other training.

SCHMITT I spent a lot of time, the first 6 or 8 months, with the flight control division people going over the various systems that I was concerned with. I found this very valuable, not only in learning the systems but in learning how they were thinking about these systems. Once we were at the Cape, most of that kind of training was done directly with the simulator people, who did an excellent job. I was in fairly continuous phone contact with the Flight Control Division people to whom I talked earlier. This combination kept my system's knowledge pretty well up to date. I think it was an excellent way to approach the problem.

CERNAN Simulator training plans - Eight to ten months *ago,* I sat down with the training coordinator and the senior simulator people at the Cape and asked the people there to go into the back simulator training history of the entire crew, because each crewman had a little different background. We found out

CERNAN (CONT'D) where we all stood in terms of our simulator background looking forward to our future total simulator requirements. We tried to emphasize scheduling to fill in our weak spots. We reviewed this periodically - about every month - just to see how our training was going. This type of review with the simulator people did two things. I made them work out a particular schedule which we did our best to live up to, and it gave them a schedule that they could work on, plan on, and get ready to brief on. It made sure that we covered all areas which we could have skipped if we just randomly went out and told them what we wanted to do. In addition, I asked them to make sure the backup crew did not go off in one direction while we went off in another. The backup crew ran within the same time frame, the same type of training that we ran. In addition, they verified all our flight procedures and checklists. They could uncover possible errors or shortcomings in the procedures, due to their experience, that we might not. I think that all paid off. In the end we had all the important squares filled. The initial simulator requirement time was now an academic number because we knew exactly what we had done and where our strong points were. We reevaluated our entire simulator background and found out we were in pretty good shape. We probably spent more time in science training, both in the mechanics of ALSEP development and SIM bay

CERNAN (CONT'D) operation as well as from orbital geology to geogeology work, than any other crew in the past. And at the time it seemed like we were expending almost too much time in this area. But, in retrospect, I've got to say, it was time very well spent although it was time that had to come at the expense of something else. But I think those things were reasonable in terms of our previous training and background and not compromise the entire training and readiness for the flight.

SCHMITT Let me add a comment to science training. We made a very special effort, and many people in the Science and Applications Directorate went out of their way, particularly people associated with contractor support, to see that we had extensive exposure to the lunar sample. I think that in itself also paid off handsomely in recognition of rock types on the lunar surface. Those people are to be complimented doing what - in a time of tight budgets - is a difficult thing to do and let us see the lunar rocks. They also supported very frequently with 2- or 3-hour discussions on various lunar problems, which also was above and beyond the call of duty.

EVANS Orbital geology - From my standpoint, three people were indispensable in this respect. Dick Laidley, Jeff Warner, and Farouk El Baz, each in their own little areas. Dick Laidley was indispensable in that he had been the pilot and the CMP's

EVANS (CONT'D) geologist so to speak for Apollo 16 and for the field trips involved - getting ready, knowing where to go, how to follow flight plans, what to expect, what photos to take, and this type of thing - he's indispensable from that standpoint. Jeff Warner took over and organized the rest of the scientific briefings for the CMP, got these squared away, and participated in the field trips from the low-altitude standpoint and also with the site specialists. Farouk came into his own along towards the end of the training cycle when we were involved primarily in the crew familiarization and training of the lunar geology itself. I think in each case we had the right amount of field trips. We just about exhausted all of the field trips that were available, since we got an early start on them. Even though you like to get a refresher field trip along toward the end of the training cycle, there just doesn't seem to be time to get it in. The lunar geology should also begin close to the end of the training cycle and continue on up to launch, which it did. You really don't need to make a recommendation any more, but El Baz should have been on the primary contact list.

SCHMITT Well, I think that would go for any activity, in Earth orbit or anywhere.

EVANS It's hard to work through a window. It can be accomplished, but it's a lot easier to be side by side. One more for

EVANS (CONT'D) identification training. We had good landmark maps. We only had four or five of them and so not a whole lot of time was involved in that because they were pictured quite well.

SIM bay training - In the early part of the training cycle, I was essentially following the manufacturing and the design really of the the lunar sounder, so I was somewhat involved in the initial part of that. And then you get down to the final stages of it and work through the ASPO people and the FOD people as well as the people on the CMS who keep you up to date on the nitty gritty and the systems diagrams and that part of the training. And it was sufficient and adequate.

SCHMITT The 1/6g aircraft - I always felt that there's an important but limited area for the 1/6g procedures. I think if nothing else it paid off in evaluating the LRV sampler and convinced us that it was a feasible way to sample. I think for general familiarity with part tasks that could be accomplished in 20 seconds or so that the 1/6g aircraft was extremely valuable and those people did an outstanding job of supporting us. I mean Jack Slight and the Air Force and NASA in general. I also think the K-bird is a good vestibular trainer in spite of the fact it's very uncomfortable. I think it's probably worth doing a couple of times - for myself, anyway, to keep my vestibular system in some kind of condition.

SCHMITT (CONT'D) One-g walkthroughs - Well, mainly that's familiarity, and that's exactly what it did and it was extremely useful. Field trips - If we checked the number of trips, we probably had a little less than 15 or 16 did, but nevertheless they were well organized. They were mostly to brand new areas, so the people should be complimented on coming up with trips that had never been done before. That was mainly in order to keep the LMP from seeing a lot of familiar terrain. The support we received, the cooperation of the U.S. Geological Survey and the Science Mapping Directorate, was outstanding. I think all problems that existed several years ago and continued to exist to a limited extent were just about gone if not completely gone. The groups are working together extremely well and I understand continue to work together through the mission in various capacities in supporting our operations on the surface. We appreciated it very much.

The LRV trainer - The LMP did not have too much to do with that. He went through the normal familiarization to drive it and knew the systems remarkably well. I think the one unit we got the most out of was the Grover, which was a U.S.G.S.-built machine that we used on field trips. It had a lot to do with getting us used to the problems and advantages of using a four-wheel drive vehicle for geological explorations. In particular, I know the CDR would comment and he may yet that the Grover was

SCHMITT (CONT'D) good for emphasizing the amount of time you have to spend in driving versus what you would normally expect to see on the LRV simulator.

The CSD chamber work was extremely valuable. The two runs on the PLSS and going through the EVA prep and post operations in the chamber and using our flight PLSSs, and backup PLSSs was some of the most valuable EVA training we received in my opinion.

EVANS I think I can just pretty much second that although my training was strictly on the umbilical, the O_2 umbilical and OPS. In both cases, the first one was strictly a familiarization and confidence-type builder, knowing that you can survive and move in a vacuum with all of this equipment. The second run was more a refamiliarization with the equipment and also, as far as I'm concerned, a necessity.

SCHMITT The two CSD runs were probably all you needed. We did one early and one late, and I think that was excellent scheduling. The people in the chamber should be complimented for the quality of the training. The schedule is to be complimented for having it in there because it really topped off the EVA prep and post training that we received.

CERNAN And the late one really meant something in terms of us remembering how much pressure there was to put water connectors on. Also, it gave us a closed loop matrix on handling all our EMU gear. As it turned out, we changed out the commander's PLSS. The Grover, I think, was very useful for extending our geology training and putting us in the right environment in terms of distance to cover and getting on and off and what have you. The dynamics of the vehicle were nowhere what the real vehicle is, but it was certainly an advantageous device to have for field training and geology without question.

SCHMITT I mentioned on the Grover, and see if you agree so it's clear on the record, that you commented several times that the driving tasks as termed to workload was comparable in certain kinds of trips.

CERNAN That's a good point, Well worth mentioning again is the fact that even on Earth terrain the guy in the left seat is not going to do much geology. He's going to navigate and he's going to pay attention to the driving task. The Grover brought that home very clearly. I convinced myself that that was going to be the job in a real world.

The one-g trainer that we had down at the Cape I think certainly did more than an adequate job. I felt very much at home in a hardsuit in the Rover in 1/6g because of the work

CERNAN (CONT'D) we had done with the one-g Rover trainer down at the Cape. The reach capability, the control capability with the hand controller, studying the low-gain antennas, the surprising reach on LRV sampling, and taking the sample out of the container bag and reaching over and putting it in the LMP's bag was almost exactly like the one-g trainer.

I personally felt that simulating zero-g contingency EVA training was not worth the time doing. You'll never know, but I still feel that way.

EVANS I concur with you, Gene.

CERNAN Now, you've had some EVA training. Tell us.

EVANS Walking the handrails was a piece of cake. I felt confident in everything that I was doing out there.

CERNAN And it's a case of exercising the procedures in lg. There was no question in my mind but that we could have transferred if we had had to with the training background that we had.

EVANS The next item there is the EVA prep and post training. Jim Ellis had the procedures essentially all squared away from Apollo 16. He made a few modifications to account for the differences in the stowage so all I had to do was to come in,

EVANS (CONT'D) follow through the procedures, and get trained and do it. I think we had the right amount of EVA preps.

CERNAN All of this EVA, both command module and LM prep and post-EVA training - we really walked in the footsteps of the guys who had prepared and exercised the procedures in training and in the real world. And we really altered them very little. We just based our training efforts upon their experience and it paid off. They were good procedures. They worked well in flight, and we did not make many small personal changes to these at all.

SCHMITT I did a couple extra mockup and stowage training exercises and I'm glad I did them. It made me more generally familar with where things were in the command module and I can't say that I really needed it but I felt a lot better once we were up there that I know where A-1 and A-2 were. I didn't have to keep asking Ron quite as often where things were. So if you have the time, it's still useful to the whole crew if you have that familarity.

EVANS I'm also a firm believer in having the CMS fully stowed in whatever orbital operation you're doing, because this space-craft is a lot different when it's fully stowed than when it isn't.

EVANS (CONT'D) Photography and camera training - This flight was essentially review for me. I was familar with the cameras, the photography, and this type of thing.

CERNAN I think that's the case for all three. But we did have a session or two anyway in that area.

Let me say something about the lunar surface experiment training. This goes to the SIM bay, too. When we first got introduced to the new experiment packages, we started out by having briefings by the PIs. It gave us a chance to meet personally and know each other's basic objectives. I think it gave the PIs a feeling that we were interested personally and professionally in carrying out to the greatest extent possible every objective of their experiment. I think, when we launched, every PI was satisfied that everything humanly possible had been written into the Flight Plan to meet the objectives of their experiment. It was a very, very good relationship and I'm very glad we did it.

The LLTV besides being a very enjoyable machine to fly from the pilot's point of view is just one of those things I feel just makes a landing on the Moon that much easier. Puts you in a familar situation. The dynamics of actually being out there on the front of that LLTV are slightly different possibly than the real lunar module, but the roll and pitch and rates

CERNAN (CONT'D) of descent in our actual lunar LM landing were not new and different because of the LLTV experience. I consider it a very valuable piece of time spent in preparation for our lunar landing.

SCHMITT The LMP doesn't have too much activity with respect to lunar landing. We might use manual throtle from the LMP side, and the simulator, with Gene more less in a GCA mode, showed that that was a perfectly adequate way to land the vehicle. I'd also like to compliment the use of the helicopters. The LMP continued to fly those because, in general, that kind of two-handed control has a direct feedback into handling two hands, ACA and PTCA in the LM. Whether you're landing or not, it gives you a two-handed coordination proficiency required to perform those tasks to a fine degree. Particularly, I found that in MI aborts, where we were doing manual attitude control, that the more I flew the helicopter the more finely I could control it for those particular maneuvers.

EVANS In the planning of the training program I thought it was outstanding. I didn't at any time in the training program have to worry about, "What do I have to do next week." It was all taken care of. All I had to do was look at the schedule and say, "Hey, this is it." And press on. I don't believe I ever felt I was doing something unnecessarily. Nor did I feel like

EVANS (CONT'D) I completely missed anything that I should have been doing. You can never get enough training. However, I felt I was confident and ready to go at the right time.

That same logic can be tied into the fact that the trainer requirements were organized many months ago and we took a good look at them. Once they were established and down on paper, you didn't really have to worry about whether you were getting extraneous training or not enough training at that point in time. You knew you were eventually going to get what you needed and it did work out that way. The last week or two you begin to vary from that a little bit, based upon what you want to emphasize, maybe eliminate something you think that you're very familar with. I flew a lot of manual descents and manual launches and manual TLIs the last week or so just to make sure that that would not be the thing that would keep us from going or doing the job. But beyond that, we followed the original planned training program.

SCHMITT The LMP concurs with all of that.

18.0 COMMAND MODULE SYSTEMS OPERATIONS

EVANS The first one is subsystem modes. All we did was utilize the nominal modes of the inertial subsystem. We had no problems, with the exception of one. And I think I should let the CDR talk about that one. The ISS worked real fine. The drift on the platform was phenomenally low. Most of the torquing angles were, within a 12-hour period - .0 blank, blank, or something most of the time.

With the LM aboard, I seldom saw any stars through the telescope, *so* I had to rely on PICAPAR to put a star in the sextant. Once the star was in the sextant, you could assume that it was a correct star because we always had a good platform. If we had needed to do a realinement or a P51, I think the only way we could have done that was to get an initial alinement on a Moon/Earth type of system. The only degrading factor about the optical subsystem was the focus of the sextant, and you just couldn't quite bring the reticle of the sextant into focus. If you cranked the reticle brightness all the way up, you could see the center of the sextant. However, if you cranked it down a little bit, it was hard to see. And even with full bright, it was a little difficult to see, so you never really had it in focus. If you pointed the sextant close to a bright object, for instance, close to the Moon or

EVANS (CONT'D) close to the Earth or close to the Sun, the reticle brightness would be completely blanked out and you'd end up with a black line and two sets of reticles. One would be a heavy black line, and then there was kind of a ghost reticle behind that which wasn't superimposed on the heavy black reticle. I don't know what that was, so I always used the heavy black reticle.

SCHMITT It's not of major importance, but it's interesting that you were continually saying that it was hard to pick groups of stars and to identify groups of stars in the telescope when. you could look out the window, as long as the Sun was on the other side of the spacecraft, and identify constellations with no problem.

EVANS This was particularly true on translunar coast. Even if the Sun was behind you, the reflection off the LM's radar box or RCS quad would interfere with the telescope's field of view. Now on transearth coast, if the optics were looking down-Sun, you could pick up constellations; however not as bright as looking out the window. Around the Moon, even in earthshine, which was very bright, you could pick out constellations. However, they were considerably dimmer than they were in the double umbra on the back side of the Moon. On the back side of the Moon with the double umbra, you could