

ASTP TECHNICAL CREW DEBRIEFING

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PREPARED BY
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1.0 SUITING AND INGRESS

SLAYTON We have no comments on this section. It was perfectly nominal.

STAFFORD The only anomaly we had there was my watchband failed; super-problem. We found the pin later in flight. All the pre-launch sequence occurred as per time line. We saw no problem. The Tygon tubing didn't add any difficulties as far as the launch to countdown. The technique we had worked out before in case of a low-volume suit leak was taken care of.

2.0 STATUS CHECKS AND COUNTDOWN

BRAND At one point, we had low suit to cabin Delta-P but that
 seemed to go away.



3.0 POWERED FLIGHT

STAFFORD S-IB ignition and lift-off went per simulation.

BRAND There was more vibration. Tom, didn't you say there was more vibration than you experienced before?

STAFFORD First stage, we had more vibration, as far as longitudinal oscillation.

SLAYTON Roll program, pitch program, and all that went normal. Max Q, normal. Noisy through there, obviously. Staging, inboard and outboard cutoff S-1B/S-1VB separation and ignition, tower jettison; all that was normal. We felt PU shift, I remember.

STAFFORD All normal.

SLAYTON The only thing I noticed is that, as we got closer to SECO, I think we got some POGO there. No big deal.

BRAND Generally, S-IVB stage was smooth.

STAFFORD Communications was good all the way. Crew comfort was super. Everything was nearly as nominal as far as countdown. Launch and the whole boost phase were nominal and everything went right on schedule. No problems. Communications were clear all the way out. With SECO, we could tell the trajectory was right on with my cue card near the DSKY. So when we shut

off even before Vance hit the sequence from the VERB 82, we knew we had a go because of the velocity and H-dot. Compared to the Titan and the Saturn V, the first stage was really rough. We had more pulsations, like longitude.

BRAND Well, that first stage really shook us.

STAFFORD The second stage was generally S-IVB performance.

SLAYTON There was a definite PU shift at about 7:35 or so.

STAFFORD The acceleration dropped.

SLAYTON Seemed to me that it began to get a little rougher.

STAFFORD Where the longitudinal pulse that you got on the one beat.

SLAYTON As it got lower on fuel, the pulses seemed more pronounced.

4.0 ORBITAL OPERATIONS

4.1 First and Second Days

STAFFORD Evaluation of insertion parameters was normal. S-IVB maneuver was normal. Optics cover jettison was covered on the other tape. CM/DM pressure integrity check was normal. Tunnel/hatch removal, normal. Docking latches, umbilical power was super nominal.

BRAND That was one of the few times that all the latches were perfectly mated.

SLAYTON DM extraction was normal. Doffing PGAs, normal.

BRAND One thing on the docking. The modification caused no docking problem.

SLAYTON Workload and time line. We were busy, but it was reasonable.

STAFFORD The insertion checklist. After insertion we went through the insertion checklist. There was a tight time line to get everything done and ready for TD&E, but everything was done.

BRAND That's right. I might add that part of the thing that made it tight there was having to get out all the camera equipment before you came to the 1 + 12 operations. One thing that helped me a lot was having all the pieces for the TV tied together down in box.

STAFFORD So you follow one line after another.

SLAYTON But everything was normal. We went through all the systems checks the first time. However, it was shortly after we'd gone through the checks that the ground called and said we were reading zero oxygen on the number 1 tank. And there was an RCS transducer, also, that went to zero. We'd already checked that system, too. So there's something funny there.

BRAND That was a temperature on a quad. I saw the optics covers go ... out into space. I'm glad I saw that because when I looked back in the telescope, it was completely black. I couldn't see a single star due to light adaption, partly, but also due to the light loss. And that's something that the simulator doesn't prepare you for.

STAFFORD Of course, you were in daylight when we jettisoned these.

BRAND Yes, but it was just so blacked out.

STAFFORD You still wouldn't see any stars in the telescope.

BRAND Even when we got into darkness, and when I first looked through it, it was completely black. The optics dynamics are a little different from the simulator and there's a little more light loss, so I wanted to bring that point out.

STAFFORD Now talking in the systems of TD&E. Everything was completed on time as far as camera setup, the systems check leading up to it, separation, and turnaround was done. The only fault we ran into was we got back into the attitude to go in to dock. We were looking down into the S-IVB and docking module. Then we were looking at Earth background, and the reflected sunlight was so bright it washed out the reticle pattern on the COAS. Now the check was gone. I put my hand behind it and once I put my hand behind it, you could see a green reticle pattern there. We turned around about 80 or 90 feet and started in right away. What you do is align the standoff cross in the background and just kind of estimate where the center of the reticle would be. On occasion, I put my hand up there and finally as the S-IVB got more and more towards the horizon, I could barely see a fine line to define roll. I aligned in roll and went in for the dock. And I thrust forward upon contact. When Vance called contact and we docked, the dynamics were very slow and there was no motion associated with the postcontact, so we retracted in approximately 10 seconds and it moved right in. We heard the latches close for the hard dock. Now later on that evening, Vance and I both looked at the reticle and the pattern was splitting. The circles showed that the alinement of the target was right on the money, just couldn't have been more perfect. Vance hooked up the

umbilicals and the extraction went per the time line.

STAFFORD As we continue on, the time line involving the unsuiting and doffing the suits and stowage went nominally. We did run into just minor difficulties always in stowage. The burns for that day, the SPS burns, went right on time and no problem. But at the end of the day we did run into the presleep and sleep period getting things squared away, because that spacecraft was so jammed full. There's always one item you had to unstow to get the other one - to get to it and back and forth. And this was a continued effort as far as the interaction. At the end of the day, we did have a problem with the probe removal tool.

BRAND The probe removal went nominal until the step where the tool was to be inserted. The connector and connector cable was in the way. We discussed the problem with the ground and decided to sit on it until the next morning. And so with this we started day 2. We got up - day 2. We did get a late start, mainly because we had to resolve the probe problem with the ground, but, everything considered, it went fairly quickly. We had excellent coordination with Dick Truly who was the CAP COMM with the probe in front of him, apparently. It was not too difficult to remove the pyro cover to disconnect the offending pyro connector so that we could get the capture latch tool in. We left the

connector disconnected and never attempted to reconnect it again. Incidentally, I think it appeared that the wire lead for the connector was too short and that was one of the problems to begin with. I don't see how anyone could have assembled that thing and have it so that that would work right. Anyway, we were also pressing on. We were anxious to get going with our time line that day and I think we ran into problems making breakfast, simply because we had a lot of rehydratables and we were all standing in line for the water tap. We hadn't really learned yet how to speed that operation up. We did speed it up later, but it was always a little bit of a problem. We also had a little trouble getting the food out, as I recall. It was packed in so tight and, of course, Rita had a good scheme for packing it all. It's packed so tightly that when you pull on something, you'll probably get some other things out with it, so we had a little problem there. Well, we pressed on through the rest of the day always a little bit late on the time line.

STAFFORD We went through the docking module activation. We did extend and retract the guide ring, which gave us a real good feel and it worked the next day. All that worked nominally.

BRAND We did have a scrubbed mapping pass and after that we had a mapping pass of visual sightings. We'll discuss all that later under visual observations, but, as I recall, that was rather

difficult for us partly because the mapping attitude is not optimal for visual observations and it was our first try at it.

SLAYTON Okay, let's see. As far as DM activation, and on day 2, everything was normal there with one exception. We got ready to open the hatch and bled down the DM. I forgot why, but for some reason, I went back down into the CSM for something and that distracted me off the checklist and then I went back up and opened the hatch and suddenly Tom discovered that the pressure in the CSM was down to 4.6 and called up there and we thought we had a leak or something in the DM. It suddenly occurred to me exactly what the problem was. I'd forgotten to close the DM vent valves. I closed those and everything was in good shape. And we went through the activation from there. I think everything was nominal. I can't think of anything other than the fact that it went slower than we expected. It takes a lot of time to get all that equipment out. Arms full of bags and pieces and all that. We got through in good shape. We did the TV checkout with the camera on and I guess that went all right.

BRAND Got to bed a little late that night simply because we wanted to get everything organized before the next day.

STAFFORD Okay, the general electrophoresis was done that day, and everything went nominal except for the last sample number 4 that I removed. When I pulled the plug out for the sample, suddenly it popped and started bouncing around the spacecraft. At that time, Vance was down in the command module helping to get some tissues and we finally corralled it after 20 minutes.

SLAYTON The only other thing I did that day was the UV star cal on the COAS and that was nominal. We had a yaw band about twice what the spec called for. Weren't sure what was right there and the ground came back and said use the middle of it. And we did, and that seemed to work fine in the experiment. I guess that generally covers all of day 2.

4.2 Rendezvous and Docking

SLAYTON Tunnel pressurization and equalization is on the other tape in detail.

BRAND The only thing we didn't mention was that the checklist was a bit ambiguous. And we thought that out.

SLAYTON Fuel cell purges were all normal. Stowage of hatch 1 and docking assembly. We had a real boar's nest in there when we got that stuff back down in the CSM. We didn't talk much about that but, boy, we were really balled up with equipment in there.

BRAND We expected it. It wasn't as bad as in the one-g trainer. That hatch, for example, was always in the way. It was like another person. Earth obs activation. You did that, I guess that was normal.

BRAND Earth observations - I was supposed to do it. But we were busy and for some reason Tom did that. Did you do that, Tom? Getting the equipment unstowed and et cetera?

STAFFORD I did that.

SLAYTON Docking systems checkout. That was all normal, right readings. Camera TV setup was normal. Multipurpose furnace prep, normal. Camera and TV setup turned out normal.

BRAND It was handy on our first TV setup to have all the pieces tied together by a piece of string, because we had a short time before TD&E. I must say, that helped immensely. It really paid off.

SLAYTON OBS donning. On day 2, we all were supposed to don OBS and give them some data. I don't think any of that turned out, as I recollect. I know we all got our stuff on. And I know we were always having a conflict with the exerciser and the medical instrumentation. I don't know what else to say about that other than I think it's desirable to separate the two, at least in the kind of exerciser that we had.

SLAYTON Service module experiment activation.

BRAND That went nominal, very nicely.

SLAYTON Phasing maneuver went fine; no problems. Leg volume measurements; did those on schedule.

BRAND NC2 burn was nominal.

STAFFORD Comm with Soyuz. Let me emphasize that was the first time I heard any interference with the ground. That's when it got to be a bit of a problem. That's one thing where somebody missed a bet. I'm still confused how that was getting up to us. I know I turned off both SM and DM and I was still getting that. So, it almost had to be coming up by S-band, which is weird.

SLAYTON Okay VHF ranging. We got lock on there right after the burn where we expected it. We ended up breaking lock there a few times.

STAFFORD Yeah. It kept breaking and it would lock on and hold for a short time and then break again. But I could always get it reset.

BRAND It was breaking when we were getting interference from the ground.

SLAYTON NCC burn, normal. Backup charts, all normal.

BRAND For the benefit of the rendezvous people, we didn't know it before the mission, but we could have done sextant marking pre-NSR.

SLAYTON You were seeing the beacon instead of the orientation lights.

BRAND Yes. The flashing beacon.

SLAYTON Day 3 was the rendezvous day. I guess you guys want to talk about that.

STAFFORD We got up early to be sure to be on schedule. You could get through breakfast, and postsleep took all that time available. All the maneuvers were accomplished in good shape and the solutions came out good and matched with the ground solutions. There was very little scatter, including the HP 65. The VHF range was approximately 120 miles. Down at 50 or 60 miles, the VHF started to break off. This was also when we first noticed the interference with ground stations in both the United States, Europe, and Russia. However, I could reset the range, and we got good data going back into the computer.

STAFFORD TPI slipped for approximately 3 minutes, but the maneuver was nominal and the midcourses were fine. Braking was normal. I did have to thrust up slightly toward the end. Again, the Soyuz was down below the horizon, and I could not see the reticle. By the time that Soyuz was to initial attitude, they

were back on the horizon, so I did have a very faint COAS. It was not as bright as I had hoped it would be. We moved right in and Deke and Vance called contact and capture. It was very smooth.

BRAND Closing was 0.4.

STAFFORD Later that night, we checked the alinement and noticed that the center of the COAS was sitting right on the center of a bolt that held the center of the target in for the Soyuz. From here, we cleaned up the cockpit and got ready for the first transfer and starting the next sequence.

BRAND Just an additional point for those people who wondered whether or not you could see Soyuz in daylight. At a great distance, we could have marked with the sextant leading up to NSR, but chose just to follow the nominal procedure and had only VHF marks.

STAFFORD At one time at sunset we observed Soyuz right around 100 miles by reflected sunlight right in front of us, only higher. He crossed the terminator, then disappeared.

BRAND At pre MCC, I had no trouble picking up the Soyuz, as advertized.

STAFFORD The docking system itself worked as prescribed.

BRAND Yeah. Beautiful, it was beautiful. The lights were solid. I don't remember any blinking lights. The cosmonauts called, "lights off," too.

4.3 Joint Activities

BRAND First day. Removal of the hatch was normal. Connecting tunnel cables. No problem there.

SLAYTON Joint experiment exchange went per Flight Plan. Transfer back to the DM was normal.

STAFFORD We had the time delay.

SLAYTON Soyuz, nitrogen addition, we added 10 millimeters, as I remember. Normal, no big deal. Purge depress, equalization, back to the CSM transfer, all normal.

SLAYTON Day 2. There's absolutely nothing to talk about here. Science demonstrations in the Soyuz. I think you got that on the other tape, didn't you, Vance?

BRAND Yes. The only thing I forgot to mention was that Valeriy Kubasov brought in an additional demonstration, which I thought was a good idea. It was kind of a walk-on. It was just a simple gyro, which we could use to demonstrate precession with. He showed it to me about 15 or 20 minutes before our demonstration, and we added it in. I thought it was nice.

BRAND The only comment I have about food prep is that we had a table full of food. It was only after my description of what I was going to eat that I found out what I was going to eat. Usually, I ate something different.

STAFFORD We had planned an hour stop in the first transfer, but it turned out it was 30 minutes or less.

SLAYTON We lost most of that time when we opened the hatch and drifted on in, and all of a sudden we got this strong smell. It wasn't exactly like the stuff we had the day before. It was kind of a more of a glue-type smell. I also felt lightheaded about the same time. I backed out of there and regrouped. And I went back in and held my breath and checked and the PPO2 was around 200 on both gages. Everything looked normal there and normal down the CSM. We never did quite figure out what that problem was. We referred it to ground, and the requested Vance to go on emergency oxygen as a conservative measure until we psyched that one out.

BRAND We pulled out the masks. They sort of expected nitrogen.

SLAYTON That's the only thing that makes much sense because I went back in there, we got mixing going, and I went back in there and kind of worked into it cautiously and sniffed around and we still had a fairly strong smell but no more problems with

it. That's where we lost most of our time, getting cranked up on that transfer. We ended up going through about half an hour there.

STAFFORD Yes, on the transfer we had to keep pushing through the steps.

SLAYTON We're talking about the first transfer. I think we discussed being off the time line a fair amount due to what we thought was a large amount of picture taking and etc. At that point, everybody seemed to think there wasn't any time criticality. The Soyuz was just kind of muddling along. We just tried to push it, and I don't know if there's anything worth discussing in any great detail. They did have something that they called new food which was strawberries in a plastic bag, and this didn't look like it had been worked out too well. They had to chew the corner off the package and shoot the water gun into it and hold it closed and shake it around a little bit. It looked like it had the potential of filling the cockpit full of grains of strawberry colored sugar. But they got enough water in it to settle it down and we both ate a little bit of that. It tasted good. Then we went on over to get some of the other food ready to eat. We all had some borscht and that's probably all documented on TV, you know how that all went.

In general, it was just kind of a tedious process to get things moving and get back on some semblance of a schedule.

I think we ended up that day at least an hour and a half behind, even though we started the transfer exactly on schedule. The only other thing I recollect was the furnace sample requirement. When we got ready to do that, then we got everything set up and then it was the same problem. We needed to get Kubasov over there with the USSR samples and 150's to put in, and they weren't quite ready for that yet, so we did a lot of muddling around there. I was expecting to give a small 3- or 4-minute dissertation on the purpose of the furnace and all that good stuff, and we were so late at that stage that we just bypassed all of that and I ended up just waiting for him to get the samples there. As soon as he had them, we stuffed them in. And Tom came right on in and we closed up and transferred and that was about the end of that day.

BRAND During all this time, of course I was over in the CM and everything went pretty quiet and nominal, as well as I can remember. We locked up well in the high gain just before the first meeting. The only off-nominal thing to mention is for a time the ground had a hard time getting the cosmonauts voices just around the first meeting time, and I think that was solved by repositioning a switch on panel 10 to AUDIO TONE. I don't know when the switch got out of position, but it did. But I don't think I detracted too much.

SLAYTON I don't think Tom talked about all our joint comms there from the heads of states there and all that stuff earlier. Well, I guess about all I can say in conclusion is that we closed the day late and probably got to bed late, and, as usual, I think we all slept well that night.

We slipped on over to day 4 and the second transfer, and, let's see, you guys did that, I know. Let me just comment before I get into it. I think we started that day a little early, also. We made it a point to because we had that Earth obs pass. I had two Earth obs passes earlier that day and in the middle of the transfer, and the first one was site 10, which was our only chance to get it. Then the process was trying to get back to stowing and get started. We weren't too well set up to do that. That was an IF mag and orange filter, and I did see the Johannesburg area. I never did see what I thought was the Great Dyke up through there. We'll talk about that more on Earth obs. The mapping part of that, I think, we got going good and, far as I know, went well. However, for the photography with the orange filter, I was looking through that lens and I wasn't seeing much. I kept shooting pictures and figured that was due to the orange filter and discovered later that we were out of focus on that lens, and I doubt whether we got anything too great with the silver camera on that pass. Most of India was clouded over, and I doubt if we got much of anything

on either camera over that area.

BRAND The transfer went nominally as Tom and I went over to the Soyuz. Upon opening the door, I saw Valeriy and Alexey there and was going to go in and greet them, and I take it that the same thing happened with me that happened on the first transfer. They were busy with their cameras and they really weren't ready for me yet. They said hello and shook hands and then they said something in Russian like "Okay, now go out and try again. We want to take your picture when you come in." So we had the entrance and went in there and stayed for over 4 hours. It went pretty well as planned. I guess I'll try to hit the high points of what we did and anything interesting I did not photograph Valeriy during the ZFF experiment. That was mainly because when I went in there, they were busy with photography and we got a little bit behind in the very beginning. So Valeriy and I agreed that, well, that didn't take long and he could do that later and I could get his picture. It turned out that later on the time just never came. Everything went nominally and we used the exerciser expander. I don't know how all that TV came out. It all seemed to go well enough from where I was and I think Valeriy's tour seemed to, from my point of view, come out pretty well. The time passed faster than I expected it would. Over 4 hours was a long time but we seemed to comfortably use it and after that, Valeriy and I transferred

back to the CSM and that went quite nominally.

SLAYTON Okay. In the CSM site of the second transfer, everything was normal over there. It was a busy time line that morning, but I was ready by the time Alexey got over there. He came in on schedule along with Tom and everything went okay. We got set up for the CSM TV tour. As far as the command module tour went, I think we got the equipment set up right and got started on time. As I recollect, we did have some problems getting good comm established prior to Tom's starting the tour. But once we got going, I think it went along okay. It seems like Alexey kind of got involved in some talking too there at one point. Maybe you remember better than I do about that. I don't think he ever got down to the LEB on that tour.

STAFFORD Once he started talking, he asked a couple of written questions. And Alexey said, "Tom, will you answer these, please" in Russian. So I feel up to that time all I did was just give him about the sextant and telescope briefing.

SLAYTON Right. I still think it went off good though. It went off on schedule. Other than the COMM problem, I don't know anything there. Then we went into that pass that was carried out in the Soyuz and I was suppose to be doing earth OBS during the first part of that and that didn't work out too well either, mainly because we had too many things going on between two vehicles,

too much air-to-ground COMM and everything. That was just kind of poor time to even try to fit that in and I don't think we got that much out of that; we'll have to go back again and look at it exactly what we did there. And Alexey did make some comments on the end of various statements as I recollect. Then we went from there into the exercise thing and I was supposed to demonstrate to Alexey and actually that was not necessary we just got out the exerciser and gave it to him and he went to work and worked at it for a while and I think we got some good pictures of him doing that during the flight. Then the next activity was the meal period and we prepared the food.

STAFFORD We were still hurrying around trying to catch up on various items and I ate my meal in pieces and I think you did the same.

SLAYTON I was staying back in a corner trying to make sure his was ready so he could do it on the TV. It was his show anyway at that point.

STAFFORD I was trying to get the TV aimed over to him and you so I ate my meal in pieces also.

SLAYTON I don't think I really ate it at all. It didn't matter. The name of the game was for him to demonstrate our meal to the

Russian People and that got done accurately. Let's see, also then you guys joined the plaque together. We got photo's of that and - -

STAFFORD Yeah, we signed the documents.

SLAYTON That went all right. The plaque didn't fit too well till you finally got it jammed together there, but that again is no big deal. And that was about the end of that transfer. I can't think of anything else. I think we terminated it pretty much on schedule. We set the clock for the next transfer and started over.

STAFFORD The activity in the docking module got slowed a little while I took out the furnace samples and put them in Alexey's little pouch, but we were able to make up some of the steps on the transfer so basically we opened the hatch to where Vance and Valeriy were, just about on time maybe a couple minutes late at the most. And from that period on, as we did in the simulations, there would be a pretty leisurely time over there. And besides taking some pictures and exchanging the seeds, the other thing was the press conference. Reportably it came out good although the Russian side jumped off early on that simulation. The voice check was good and I thought it went good. The press conferences were well coordinated on both sides.

SLAYTON We did but we were strapped pretty hard in the Apollo getting set up ready for that.

STAFFORD The people who had the duty in Apollo were always busy because of all the things that had to be done there; where as in the orbital module like when Vance was there and I was there, it was a pretty relaxed time period. After the press conference, we just stood by. In fact, I went down and looked around the descent vehicle and stayed there for a while and shot some pictures of Valeriy. I then waited for the next transfer.

SLAYTON Okay. Let's see, we didn't have too much over there really - we had the microbial samples we did on each guy and then that's when Vance picked up for the U.S. tour. And I was again supposed to be doing another job out of window 1 in parallel with that. We had the same kind of a problem in that everybody in there was trying to do different things; it just wasn't very effective earth obs, plus some cloud cover. I can go on into the microbial sampling of the vehicle which we did after that pass. And that again was no big deal. It took a little longer than we expected. I stood over in the left couch and Vance traveled around the spacecraft and we got those things as rapidly as we could, but we were a little behind schedule on that again too and kind of pressing to get on with the last transfer by the time we got there. No big deals. Everything

was done properly as far as I know. Oh yeah, Vance and Valeriy signed the documents at that time too and joined the two coins together and we got that documented.

BRAND Briefly my TV excursion went pretty normal. We got a good lock on MILA over the Gulf of Mexico in a timely fashion. Valeriy introduced me and we got off on sort of what had been prethought out on the way of a tour and only two comments. One is, we had overcast over the central eastern states which gave me a little bit of a hard time. I had to explain that away somewhat. Also, if I had it to do over again, I would have had Deke and myself reversed. He was looking out the commander's rendezvous window, I was looking out the center hatch window. My vision was displaced from my TV camera's view by some number of degrees. And, I wasn't always sure what the camera was looking at because it was looking at things before I was. I thought the Sealy Costums preparation was a tremendous help in getting me ready for this. That's all.

SLAYTON On the fourth transfer, we started on time for the cue cards, the clocks were synched, and I took Valeriy across that time with Alexey over there and that was our final farewell. And it seems like there again, kind of like the first one, we ended up doing a lot of photo's and running around trying to get organized and get things done on schedule. They apparently

had a lot of pictures they needed to take yet to fill the squares. I think we were about 35 behind before we got through with that one. I don't remember anything very specific though, do you, Tom?

STAFFORD No. A couple of times when Valeriy got tangled up in the snakes again down there.

SLAYTON Yeah.

STAFFORD And we were scurrying around and jumping up and down for film.

SLAYTON We got all of our part of it done and we were kind of standing by there waiting for them to get sorted out. And I guess this is where we ought to mention we finally got ready to close the hatches and closed them. We thought we were all ready to start bleeding the tunnel and they weren't.

STAFFORD Yeah, they were supposed to bleed the tunnel.

SLAYTON And they didn't. And then we discovered that they had the hatch open again and they were playing around with the solar eclipse device on their hatch.

STAFFORD That's what happened. We opened up our hatch again and then took a look.

SLAYTON And they said they were still working on it; you just opened the hatch and looked at them.

STAFFORD And Valeriy was down working with the solar eclipse box.

SLAYTON So we were pretty far off schedule by the time we got through that point. However, again in our side, I thought everything was nominal, just a matter of trying to stay on the time line and not being able to do it. I think we went ahead and closed the hatch and, when they finally got around to shutting it off, they had the same leakage they had the other time we tried it. We had all agreed at that time that we weren't going to worry about and we went ahead and vented on down and went on into the CSM. And that was the end of that.

STAFFORD Actually we all went up to the DM and had a crap up there.

SLAYTON Is that the night? We were up in the 30's so that took around 2 hours for that data.

STAFFORD That's right. We had a lot of housecleaning to do that day.

SLAYTON Yeah. I think again, as usual, we got to bed late that night.

BRAND As much as we did get to bed late, I would say that I did not require quite as much sleep. And I would have given up 45 minutes at anytime just to know I would be a little ahead the next day.

STAFFORD That's right. In fact I think I would rather do that than have them wake us up early. Everything the fifth day was involved with the undocking and the solar eclipse, the re-docking and all that.

BRAND I rather liked the morning timeline. I remember that.

SLAYTON We weren't pressing hard to get into the first undocking and the solar eclipse. We did that as an active undocking on our side so we got that exactly on time. And everything looked totally normal and we get the three seconds in our 15 and - which I consider 30 seconds backing out of there and our rates were good and attitudes were good and I think that - somewhere around 250 feet in 2 seconds - somewhere in that ballpark before 3 minutes anyway. Looking like we're beginning to get some sunlight on their reflector down there I called them and told them about it and they acknowledged so I figured that was the end of the data take. And then we made our 16 seconds of thrusting back into them and after that point everything went perfectly normal. And there were no problems at all. The thing I really remember happening then is I forgot what the EMS reading was exactly at that point but it was one hundred and something point something and I figured we had a good solid rate going and then all of a sudden I looked down there and it clicked up another 1 and didn't watch it for a little bit and

then looked back and all of a sudden it had increased to 3 or 4 clicks on that damn thing.

STAFFORD On the EMS?

SLAYTON Yeah.

BRAND The EMS seemed to go bad when we got in. Well, I was thinking we were locked on VHF.

STAFFORD It was just drifting. We never saw an SPS burn with a drift in the EMS.

SLAYTON No. But it was sure there that time. As a result, I wasn't sure whether I might have inadvertently banged into Alexey to keep in line of sight. I didn't think I had but when I say that, I thought I might have and so I started backing a little bit, earlier than I should have and as a result we ended up with a slower closing rate than we should have had. I think we probably were all right. But that cost us a little fuel because then I had to speed it up again when we got in closer. That was exactly the same problem here that you guys had. On the first go-around, we had them against a sky background initially and could see pretty well through the COAS but we couldn't see the COAS while it was on the Soyuz. You could see it outside against a dark sky. At about 100 meters or so, it went against the a earth background and zap. Man, I didn't

have anything. And that was the same old problem that you had on the TD&E and the first docking. So we pressed on end by the seat of the pants and I guess we got a little closer than they or the ground contemplated. I remember Houston called up and wanted to know what our range was as they were looking at a TV. We were in close and I knew it but it was the only place I felt comfortable. When we were close enough to see the standoff cross against the red one in the back, that was a very good reference and I felt pretty comfortable about being able to make a good dock until we got in and got a good look at that and then I wasn't so sure I knew the COAS wasn't going to confuse us. We went ahead and did the docking on schedule. They did their maneuver but again they seemed awfully slow getting around to doing it. The docking was normal, you guys gave me contact as usual and then I gave it thrusting. The only thing that happened then was they seemed to torque off. I was surprised at the angle they banged off there after we had contact.

BRAND After you finished thrusting, I was looking out center hatch window. Straight down on the stack, and there were big oscillations; something was bending a lot.

SLAYTON They yawed off to our right.

BRAND The Soyuz had a fair amount of bending but the docking system had the most.

SLAYTON That surprised me because I thought we had pretty good contact velocity there. In fact, Tom, you said I was going a little slow so I pumped it up a bit. We went CMC, FREE, and then the whole stack drifted out of attitude, and we had to get back into attitude later. Let's see, we just kind of powered down to eat there, didn't we?

STAFFORD Yes, we had an eat period there.

SLAYTON The next thing was the final undocking. That was the Soyuz active undock. And there again I don't remember the exact time exact I think it was 99:07, which is what we carry nominally. We carry 99:04 as when they start their sequence. I remember we were trying to synch times here, and we got into a discussion in a couple of occasions about which was right. Finally, I realized that what they were talking about was when they started their sequence and we were talking about when it was to time out. I started the DET to count up when I knew we had separated, and it took something close to a minute. No problem; we turned the clock on and started timing it. Earlier Vance and I had been reviewing the checklist. We never had any problem in simulation; in fact, I was always concerned about getting the EMP operating quick enough. So I just told

him to zip through it as fast as he wanted to. Man, he really went through it, and by the time we had 40 seconds out there which was 18 meters approximately I was ready to take out that opening velocity and I banged in with plus X and nothing happened. I thought what in the hell is going on in here. Well, you already had P31 in and running, so I was only getting a 0.1 ft/sec pulse. When I realized that, I zipped into a bunch of quick ones and I got the opening rate killed; in fact, I got it to close just a bit. Then I am not too sure what happened. I didn't like their attitude; they were looking wierd. We were trying to pitch up, and when we did we were losing them under the nose, and it was the kind of thing that had happen in the simulations a couple times. My immediate instinct was that the EMP wasn't working right, so I decided to go to SCS and get this thing straightened out. As I went over to get into SCS, I apparently knocked off the THC instead. Because the next thing I decided was that I'm closing here a little bit and I had better stop it, and I went to back and nothing was happening. I think it took Vance about 2 seconds to discovered what had happened. He zipped the THC switch back on again. Anyway we sailed around a little bit and finally got in the right position. We did the UVA burn on schedule, but by that time we are a little farther out than I preferred to be. We knew we were slow getting onto the

cone; I think we ran like 6.5 minutes and we were still off the cone, so we decided to burn to the cone which took another 2 seconds, I think. That worked out just fine and gave us plenty of time then to track out from there. We were in good shape as far as I could tell.

BRAND Your burn starting to sweep must have been perfect, because you had an almost perfect trajectory.

SLAYTON That was the end of the cone when I started the data take. We got into the data take in great shape. We have been concerned about how the reflector was going to show up and that little penlight and that was a pleasant surprise to know that we could see it.

STAFFORD I had the 20-power scope and when I opened to look I could count the individual reflectors.

SLAYTON Anyway starting that sweep we looked great from our end; you guys were really stirring along there and got everything opened and in beautiful shape, and there they sat with a beacon on. And we couldn't get the thing off.

BRAND We made repeated calls to the Russians. We just couldn't raise them.

STAFFORD We had to call our center to tell Moscow to tell them to turn their beacon off.

SLAYTON We went through almost half of that sweep with that beacon on.

BRAND As I recall we were within about a 3 degrees of the middle plane when they turned it off.

STAFFORD They turned off the orientation lights and left the beacon on. And we had to go back to tell them to turn off the beacon.

BRAND I think this is an example that you can't simulate everything with those guys. We never really got to simulate that phase of our coordination.

SLAYTON The only other glitch was that they had their lights on in their window. I know that the reflector was bright and I could see the dimmer light personally and it was way down on the bottom. I had no problem sorting them out. But I guess there was concern that they were going to get bum data with their instrumentation on the ground. I remember they called back after the pass and wanted us to establish what the relative brightness of the thing was. I don't know anyway to evaluate that sort of thing. We terminated the sweep; that went all right. Tom must have been getting good data down there because he was telling me that that was beautiful. With Tom giving me the trends there, it worked like a charm. Vance had the plot going there and the checklist going and everything I thought went smooth as glass.

BRAND Just like in the simulations, Bob Anderson's plot was really a good deal, track right where you were going and where you had been and see trends.

SLAYTON Coming back in, everything looked perfect. The only problem there was that suddenly it was obvious that we were going to get in there pretty close before we got into daylight. So we put the floodlight on and we could see them out there 100 meters.

BRAND That floodlight was really great.

SLAYTON That was great, I'm sure glad we had that beauty. I was kind of nervous about closing too fast on them.

BRAND Well, you had a bias in EMS.

SLAYTON That's right; we couldn't move the thing on that ranging. It was reading 100 meters and we were out at 150, and it read zero range when we were out about 50 meters.

BRAND I think we realized that. Yes, we did.

SLAYTON But the only disadvantage to that was we were stationkeeping in the darkness with the floodlight on, and shortly thereafter the sun come up and zap there he was between us and the sun. I had a time there for a while; it seemed like a hell of a long time. It was probably only 10 minutes.

STAFFORD I could shade my eyes a little bit and give you some help, but eventually the sun got to me.

SLAYTON It's all I could do to kind of look around to try to keep one little piece of him to keep my eye on. We got kind of far out of position there. We weren't really doing very good station-keeping. All I was concerned about was seeing him at that stage; once we got the sun by, we got back into position. We could have done that 180 roll a lot sooner if we hadn't had that problem. Fortunately, we had plenty of time on that frame anyway. Then we got ready to do the 500 meter. Let's see. I screwed something up there. I'm trying to remember how I did that. We were stationkeeping and it was a little more comfortable closer in that it was further out as usually. So we were probably within 30 to 40 meters most of the time. We got ready to do the 500-meter sweep and I'm still not sure how this happened. I got ready to do the burn and I thought I went to SCS, but I must have gone to ACCEL COMMAND on all three instead of RATE COMMAND. I can't explain it.

BRAND I think, as Tom pointed out, you slide up and down on that couch and it's not like the simulator; you can be up high on the couch and you are looking straight down at those switches and it looks like they are in the center position.

SLAYTON Well, that's all I can figure, because I was sitting up there high in that window and looking down and everything sure looked normal. But when I went out of MIN IMPULSE I must have inadvertently gone into ACCEL COMMAND instead of RATE COMMAND.

SLAYTON We got back into stationkeeping position after we flubbed that first start and started all over again a little bit late, but from there on it went totally nominally.

BRAND Also, I think, we have to mention that we were a little late by a minute or 2 to begin with simply because we flew on the Soyuz attitude to begin with instead of the P20 attitudes. Later we decided to go over to P20.

STAFFORD We weren't sure of what their attitude really was.

SLAYTON Okay. There again, we got the doors open and got the data, I guess, within 30 seconds of the time we started the sweep and had it all the way through and our cal had been good. No problems at all. I think we got them all the data. We terminated that sweep and, of course, since we started late, we were well into daylight on that one. We then came back on into stationkeeping and were in good shape. From there on, we were supposed to do the pitcharound maneuver and then the 1000 meter. And that was another surprise. We kept calling and saying, "Okay, are you ready for us to do to our photography,

because we're ready to do it?" And they kept saying yeah. We're about ready to start pitching there, and suddenly here they are yawing. They went through 180-degree yaw maneuver. I still don't know what was going on there.

STAFFORD That wasn't in the flight plan.

BRAND I think they called us at some point and said, "Are you ready for our maneuver?"

SLAYTON Yes. But I thought they were talking about a little roll maneuver, you know, that was going to put them into a good position to look out through the window. But they went through 480 degrees of yaw. Anyway, they finally got through that and we did our 2 seconds of Z and then we went through the 360 pitch, but by then we were getting into sunset again. That was another case wherein we were ready to do our sep burn and we did it and zap, there they were between us and the sun again. Normally we would have been well on the way out before we hit Sunset. I hope, we got some good PR pictures of them there on the horizon. But the problem we had there was we were still in daylight and the Earth gone dark, and the sun was shining right on the frame of the rendezvous window. There was no way once we went into darkness that I could see those guys. I'd been tracking them in MIN IMPULSE pitch, but all of a sudden they weren't there any more, and I didn't know what direction

to go to find them. Finally we got the light off the window after what seemed like a long time, but it was only a couple or 3 minutes, but then, we didn't have Soyuz anymore. As it turned out, I had pitched too much and I had to go way back down and pick them up again. That didn't harm anything, but it did cost some attitude fuel. Once we got into the data-taking position, we were about where we belonged on the trajectory, but there was no way on Earth we were ever going to see that reflector in flight. They did keep their orientation lights on and the ground kept telling us they were getting good data. And I was holding in a position where I knew their reflector was supposed to be, and it must have been working. At least they claimed they got data on the air-to-ground. So, if they got good 1000-meter data, I'm surprised. That was the end there. We did two P49 sweeps there, one with the covers open and one with the covers closed. At this time, I was surprised to suddenly discover that I was supposed to dash up on the docking module and go to work on those science demonstrations.

STAFFORD It seems like it was busy and I went up there to help you on it a couple of times.

SLAYTON You're right. It was busy.

BRAND The thing that surprised me was that the whole UVA thing was a pretty long day.

SLAYTON Tom helped me get some stuff out and stowed there. That was like everything else. The first time we tried it, it went slow, trying to find all the bits and pieces and set up cameras and making sure the TV was on and that the VTR was running and all that stuff. I think we lost a couple of pieces, but finally located them. The demonstrations themselves, we got that on 16-millimeter per the flight plan.

BRAND I think I activated the SIM BAY.

SLAYTON I think that's right. You probably did.

BRAND That's one thing that took a lot of time. Then we had some kind of test for the X-ray. It was a plane test. That was where we had the alinement problem. It was called out in the flight plan that after I activated the SIM BAY before I should take some data in the raster scan, or checked out the thermo-dynamic offset or other for the X-ray I was to do a series of two P52's, the first was an option 3 which was done easily, and the second one was an option 1. But these were done in ORB RATE.

STAFFORD That's right.

BRAND And I forgot why. It must be that you had visual ops pass coming up. Well, the problem was that when you're in ORB RATE and you torque the platform, the computer loses track of where the platform is because it's going ORB RATE for as long as it's torquing, and coarse aligning. This didn't hurt us in option 3, because the torquing system takes a second or 2. But in the option 1, it takes quite a long time to torque the ball around, and by the time it stopped torquing, I looked at the optics and I could see zero. On the sextant there was no star after pointing by auto optics. Due to the fact that the light loss is so bad I could only see one star, in the telescope. So I went with what I had then and said well, I completed the option 1 with the exception that I didn't tweak it up on two stars. The ground said go ahead and do your X-ray scan. We did that. And then when I had plenty of time to dark adapt my eyes on the next rev, I completed the option 1 tweaking. That was a little disconcerting though, as you hate to have the feeling that you don't know if you're within 2 degrees or 20 on your alinement.

STAFFORD Well, that was a mistake not to do the whole thing in fixed attitude and then go to ORB RATE.

BRAND That's right. I think it's acceptable in option 3 to do it in ORB RATE, but not in option 1.

STAFFORD Well, it's easier on the Moon, because you're only torquing 3 deg/min around the moon, there you've got 4 degrees around the Earth.

BRAND As it turned out, I finally got the thing squared away, and my error had only been about 2 or 3 degrees.

4.4 Apollo Solo Activities

SLAYTON On the science demo, all I can say is that, the wicking thing went faster than hell; I don't think anybody expected that stuff to wick as fast as it did, but it was one big mess.

STAFFORD Deke had blue hands for the rest of the mission.

SLAYTON I had blue and red hands for the whole mission, from then on. That oil and stuff would come floating out of there in blobs. No way to prevent it. But it was interesting and I hope - they have it on film and of use somewhere. The foaming stuff worked just like it did in 1-g and interesting. The other one was the oil and water in the boxes and creeping up the walls. That was interesting only because oil acts like water and vice versa. You get so much surface tension on the water, it acts exactly like oil. Just a big old blob, and the oil will float right off from it.

SLAYTON The next things were the EUV the X-ray, and the helium glow. I think you guys did all of that.

STAFFORD It was a very busy period.

SLAYTON The furnace study all went normal; I guess I put in most of the first samples, and there's nothing to that. You put them in, turn on the right switches, wait it out, and take them out. The only problem we had with the furnace was a shroud door, which is supposed to be closed; they just put too much insulation on it. Vance got it closed once, when I couldn't close it, and I got it closed a couple times, but most of the time I just couldn't get that closed. I guess they just decided it didn't make all that much difference if it was open or closed. It might have been the low pressure on the insulation that expanded it. I feel that I could have taken a knife and gone in there and trimmed that insulation, and solved the problem but I didn't want to do that in zero g. We didn't get one sample done. I don't remember what happened. We were suppose to put one in on day 2, but we were not getting a good bleed down on that one sample, we put it in on schedule and they elected to leave that in. We never got the symbolic sample in there. I was concerned about setting up the crystal growth one. But again, no problem. I did grease the plugs once, to make sure they didn't stick. Electrophoresis. There again, the setup on that went per spec. We had some problems getting that cover back on the old greezer which is not unusual. I still think our biggest problem there was due to

to the amount of humidity in the cabin. We pulled the darn thing we got a lot of frost, not only on the styrofoam plug but also down on the samples.

STAFFORD It made it hard to pull the samples, too.

SLAYTON It made it hard to pull the samples, made it hard to read them, and eliminated some of our clearance there. I was very concerned about breaking the tubes. I took the cover off, and they were frozen on there solid. We broke those things loose and didn't lose any samples. There was one sample, sample 5, I couldn't get out of the freezer. I finally took a pencil and pried it out and left the tab in there. Sample number 7 we put in there and turned it on and I went up to the DM to do something. Then Tom took a look at it.

STAFFORD Yes, I looked down and saw something weird, there was a big blob about an inch and a half in diameter on the right side. A huge glob of water.

SLAYTON Anyway - per flight plan if we every had a leaky sample all it said was throw it away and go to the next one and forget it. However, somehow we couldn't get them to make that decision down there very quickly. We decided that was the very thing to do but they sure did a lot of muddling around before it happened. We finally took it out. Then they wanted to save

that sample, which we did. The next sample was a dry sample which was an isotac. So, we just went ahead and put that in, and pressed on. From then on everything was normal. So that's the only nominally I know of with the furnace.

STAFFORD Looked like it was leaking around the right-hand fittings.

SLAYTON I think it was coming out from the end of the tube there. There were some bubbles and I think we got that recorded. Anyway, on two or three samples, there again, they showed us how to get rid of the bubbles and I drove them out to the far end and we didn't have any more bubbles. What can you say about ZFF?

BRAND The only thing I can say is that near the end of the mission and saw a few more rings. And the photos will clear that out. I think it went nominal; only exceptions were that we were 20 or 30 minutes early or late sometimes, or exactly on the flight plan but always very close.

SLAYTON We had a plus or minus 3-hour tolerance in the data take.

BRAND Once at the first of the mission, I called the ground because the covers on 22 had been open awhile, but I think in general after that we always maintained the covers closed pretty well.

SLAYTON On the Russian sample, when we got it we didn't have any Velcro. We stashed that down there in bungee bag for a day or so and

finally got around to putting some Velcro on that and stuck it up there.

Crystal growth, same thing. We just went strictly by the flight plan, activated it per schedule and took the photos every 12 hours per schedule; at the same time we took for ZFF's. We saw some big bubbles in there which we referred to the ground. We never saw any evidence of crystal growth anywhere. Then, the biostack. What would you like to say about the biostack?

STAFFOD Check whether it was on or off and what time it was.

SLAYTON We did leg measurements as required.

STAFFORD We tried to get a few the first and second night, as extras; it was called for in the flight plan, but we ran late into the presleep period and sleep period and didn't get things started so we didn't have time.

SLAYTON We did height measurements per the flight plan.

BRAND Only thing I can think of important to mention there is, that when you measured the relaxed in the relaxed mode, where you would measure from the couch to the eyeball, you went diagonally to the corner of the eyeball, rather than going parallel to the couch, simply because it was more accurate.

SLAYTON The mechanics of taking the measurements weren't any big deal. The first experiment, was activated. We got the right pictures on day 2. I moved them up the DM on day 6. We documented it again per checklist; it's all there. We gave the ground a few reports on activities; the only thing I didn't notice on the last day, we had three or four fish iced with three of them in the black package. We had about dozen 10 or 12 hatchlings and the eggs. I don't know what happened to him, but we found our mosquito in there launch night and I saw him again the next day. I never saw him after that.

BRAND I never did either.

SLAYTON We talked about feeding him to the fish, but never saw him again. Don't know what happened to him. He was just flying around. He didn't know whether it was zero g or not.

BRAND 5PSI, no sweat.

SLAYTON The SAM thing is the only other one I've got written down here in day 6. We got the instrumentation set up and we did everything right, except for one problem. I had that 250 lens and was supposed to be taking data. The first one was a Sunset and I clicked the camera away the first click and I could feel it clicking and I thought we were in great shape and we got the end of the pass and took a look and hadn't fired a frame. We

quickly checked the camera and what had happened, I didn't have the lens cranked all the way on. It needed one last click so we blew the photography on that one. And, the next one was a sunrise pass. And, I think that went all right as I recollect. That was a short one, except they said to use up all the film. So we went ahead and we were supposed to get 30 seconds worth and we really shot 3 minutes worth. There was something on the intervalometer that didn't work just right at the end of that. I think what happened there was I had it in my hand and might have easily moved it from whatever position it was supposed to have been in. Because we suddenly became aware that thing hadn't clicked when it was supposed to. The next one was another sunset. And, that was the one where they had all the ground truth set up to support it. I think that one went fine. I don't remember any anomalies with that at all. I put a new magazine of film in. Then we came to the next sunrise and I screwed up again. There's something about that SAM I didn't like. I forgot to pull the slider on the magazine. We're coming in, we're all set up fat and happy, ready to go, check the magazines, check the setting and everything and suddenly it's time to shoot and I pull the trigger and nothing happens. When I check, the slider's still in. Anyway, - I guess we got them one fully good daylight and one full good sunset and partials on the others.

BRAND Whenever we could and as soon as we could.

STAFFORD After the last transfer, Deke tied it down for final sep and left it there. He had to turn it around 180 degrees.

BRAND The height measurement people were worried a little bit about it being in the way and I didn't feel it was in the way at all.

BRAND I can't remember any anomaly, hardware wise, with the EUV or the helium glow. It worked great. The X-ray, everyone knows what a lot of work we had to do with that because of the sensor problem. That was off nominal. I hope it all worked out all right.

STAFFORD It was obvious that the way we had to use the exerciser you had to be restrained. It was a great exercise. You really work your legs, back, everything. But you had to be restrained. The only way you could restrain yourself was between the two handrails that went right across the bio belt. We put tremendous force on the exerciser, which was rubbing and knocking the bio belt. It put a lot of strain on the wiring internal to the belt, and it was shorting out. So I tried to isolate it. First I changed out leads, then I changed over to Deke's bio belt, and had the same problem. Later we changed sensors. We fooled around for about an hour or so on that thing, trying to help them.

On the first exercise that I did, because of the goof on the ground, they lost the data. That was a real booboo. There's just no compatible way with that bioinstrumentation to do exercise.

STAFFORD I thought we were going to be bombarded by all those flashes. I was amazed on how few there were. How about you, Vance?

BRAND Exact same comment, Tom. I was a little disappointed, I thought we'd get more action in those.

STAFFORD We had two incidents at one time when we both got a comet in our right eye at the same time. We both got it at the same time, in the same eye, at the same place.

SLAYTON You guys ever see any light flashes other than when you did the experiment?

STAFFORD A couple of times. I usually was so bushed I went to sleep right away. But, a couple of times when I did avoid going to sleep, on two or three nights I saw a couple of flashes.

BRAND That's about the same with me. I can't say that I saw more than three or four events total, because I fell asleep so quickly.

STAFFORD That's what happened to me. Maybe one or two a night for only two or three nights. Four to six maximum during the whole flight.

SLAYTON Same here. One night that I slept in the CSM, and I wasn't sleeping well, I was just kind of awake with my eyes closed, and the other night in the DM when I was cold. The only thing I thought was weird, I never saw them anyplace except my right eye. (Laughter)

SLAYTON Press conference. We all got up and got ready for it. We all had time that morning to get up a little early so we could shave and shower and get out some clean clothes.

BRAND It went okay.

SLAYTON DM to CM equipment transfer. That went smoothly, by checklist. We'd already moved up in there a bunch of equipment that we knew was going to get there eventually anyway. We had two trashbags already in there. If we'd have gone by the flight plan, we'd never have made it.

STAFFORD Never made it.

SLAYTON We had a lot of stuff in there beforehand. We started at least an hour early on that exercise, and we didn't beat it by much before we got to where we were supposed to be at

the end point, closing out. I had to unstow that probe and turn it around, and that took a little time. We had two big bags of garbage instead of one.

STAFFORD We had two huge bags.

BRAND We took one of our suit bags to use as a trash bag. I might add that our trash scheme of more or less filling that TSV on a daily basis and emptying it into a trash bag in the DM went quite well. Surprising how nice it is just to get all that trash on a daily basis out of the CM and off into a place where it never bothers you. I never noticed that it was stinking or giving us any particular problem.

SLAYTON It worked like a charm. As far as securing those bags in there, I'd like to comment on that. It was a little off nominal. The plan was to stow it on top of the furnace and tie it down. We had two big bags instead of one, and I personally debated if I should be tying one bag on the other side or not. I tied them together on that side. I guess it worked all right because when we jettisoned, the DM went exactly as planned and everything was all right.

SLAYTON Loading and securing A-2 container. We did that per preflight plan, guided it down, no problem. Probe stowage per checklist. I didn't get that stuff tied as tight as I'd like to have. It

just seemed almost impossible to get it really solid, but I guess, it wasn't going anywhere.

DM closeout went per flight plan. We cleaned everything out of there per checklist. We transferred it back into the CSM.

BRAND We were all conscious of how much we'd been living with hatch 1. We didn't want to bang it around too much. We were careful to check the seals before we put it in. I'd sure recommend that as a procedural step in the future, because you're betting everything on that hatch working good.

SLAYTON True. It sure got a lot of rough treatment down there, moving it around perpetually.

BRAND That's correct. Every time you had to get into a locker, you moved that hatch, it seemed like. And the suit bags, too.

SLAYTON You know, in retrospect I'd have felt warm if we'd have had some kind of protector around that seal. I thought about that a couple of times.

STAFFORD Like Apollo hatch bags.

SLAYTON Right. Either that or some sort of a band to go around the seal.

BRAND A piece of tape or something.

SLAYTON Tape or something. God, we gave that rough treatment. We had to. We couldn't get into the lockers any other way.

BRAND It's a rugged hatch and seal.

SLAYTON Seals are good.

SLAYTON Hatch 1 pressure integrity check was normal.

BRAND Completely. It took a fairly long time to complete, which surprised me, but then I knew it was supposed to take that long. It just never did, in simulations. Went completely nominal.

BRAND Donning PGA's wasn't difficult.

SLAYTON We helped each other, and it worked out pretty good.

SLAYTON Suit integrity check was certainly normal.

BRAND I started off donning PGA's, and it took me about 20 or 25 minutes, mainly because I put on a UCTA. I was sort of getting started off. But after that, I think each of you put yours on in 15 or 20 minutes. We were through in 50 minutes, as I recall.

STAFFORD It really helps if somebody helps you down the back.

SLAYTON Right. Tom helped me and I helped him, and it worked pretty fast.

SLAYTON DM jett. Pretty baby, went nominal.

BRAND It went nominal. I was pleased to see the rotation that the DM had afterwards. I didn't really need the COAS reticle. After I jettisoned the DM and I tried to track it, I couldn't put it into the COAS. Well, I couldn't see the reticle when I was pointed down at the sea, if there were any clouds on the sea at all. The only concern that it gave me was that I didn't know if the camera in your window was pointing right. The other thing was that the procedure to jettison the DM involved jettisoning it, and then continuing the 5-degree second pitch rate for 15 seconds, and then going to attitude hold.

STAFFORD I wonder why we did that. That was way too much.

BRAND The idea was that if you did it that way, when you went to attitude hold, you could look out the window and you'd see the DM right in front of you. It didn't turn out that way. The DM was off to our left and appeared to be down a little bit. Everybody went to the windows and searched around for it. We finally found it, and I maneuvered and got locked on to it, and we got the photography. But, that was a slight surprise.

SLAYTON I think you've got a perfect rate going on it. I timed that thing a couple of revs with a stop watch, and it was running like 5 to 6 degrees.

SLAYTON Cabin pressure verification, normal. SPS burn post sep was nominal.

SLAYTON Doffing PGAs, same thing.

STAFFORD DM 2 maneuver, nominal.

STAFFORD Preentry cleanup and stowage. We worked like hell to make sure everything was lashed down good.

BRAND Our main concern was some tools that we had been using. They were rather blunt, heavy objects, and we wanted to make sure that they were all put away. We checked the cabin real well to make sure they were. We tied the suit bags down snugly with entry rope. I think it was tied down well.

SLAYTON The only conflict we had there was we were trying to do some Earth obs right to the last minute and we kept that stuff out. But, no problem. We got it all stashed.

BRAND Also, I had to get to panel 382 and couldn't tie down a suit bag as well as I wanted to.

SLAYTON Donning OBS for entry. That was nothing unusual.

5.0 ENTRY

SLAYTON CM/RCS activation, normal.

STAFFORD Separation checklist, normal.

STAFFORD Burn attitude, normal.

STAFFORD Sextant star check, normal.

STAFFORD Deorbit burn, normal.

STAFFORD Entry parameters.

BRAND It was almost perfect on the CMC for perigee as I recall. We trimmed out to less than 0.2 on all three axes.

STAFFORD Zero, minus one, and zero.

BRAND RCS sounds, just normal. RCS was easy enough to hear during the minimum-impulse check on the CM rings. We could determine that it was firing; I think it was through feel and hearing both.

SLAYTON We could also see them.

BRAND Yes.

BRAND I saw flashes.

SLAYTON Right. We got some pictures of them.

BRAND Comm blackout. We were hardly aware of it.

BRAND Ionization - beautiful.

SLAYTON We got lots of pictures there.

BRAND Control modes on entry, normal.

BRAND Until we get to the end, where we'll have special comments.

STAFFORD Visual sightings and oscillations, nothing new. Normal.

BRAND We were chatting a lot about it simply because it was such a
 tremendous thing to watch.

SLAYTON Interesting.

BRAND We departed from the nominal below 50K.

STAFFORD I picked one thing up on comm at this point. It occurred at
 65 thousand feet. When the display came up, it showed 0.9 mile
 miss distance. I hit verb and ... it went down to 0.7. I hit
 verb again, reported back, and got a "Roger" back. I heard
 a reply back and, as far as I'm concerned, that was the last
 communications we had with the outside world for the flight.
 We never got acknowledgment to a direct transmission after
 that. We were trying to transmit repeatedly. This is when
 the noise started to pick up; a squeal occurred sometime after
 that. When, I don't know.

SLAYTON That was my impression too. We never got any comm after that.

STAFFORD After 65 thousand feet, we had no comm with the rest of the world, ever.

BRAND Somewhere around 59 down, I think it must have been comm noise and aerodynamic noise. I think we were beginning to pick up some aerodynamic noise at that time too. It got pretty darn noisy from then on down.

BRAND I don't recall us having too much trouble communicating until somewhere between 50 and 45K when we were to talk about going to the BOOST/ENTRY position and arming the pyros. I remember at that time that there was noise. I did not believe that I heard anything definite. I couldn't understand what was said. I threw those two functions, and then I said something about it hoping that someone could hear me.

STAFFORD ECS. Entry was really warmer because our main water boiler was out on us. We had just a nominal temperature going into entry, when normally it should be cooled to where you're cool. We didn't have that. So, by the time we finally hit sea level and got down, we were sweating pretty good.

SLAYTON We were warm.

BRAND

Left seat, is where I was sitting, Tom Stafford in the center seat, and Deke in the right seat. Everything was quite normal down to 50K. I remember passing 50K, noting it on the altimeter, and mentioning it, and also mentioning something about BOOST/ENTRY position and PYRO ARM. After say it I put the PRESSURE RELIEF to BOOST ENTRY, PYRO ARM switches to on. There's quite a bit of noise from RCS thrusting, and probably from aerodynamics, through that region. At 30K, normally we arm the ELS AUTO, ELS LOGIC, that didn't get done. Probably due to a combination of circumstances. I didn't hear it called out, maybe it wasn't called out. Any case - from 30K to - 24K we passed through that regime very quickly. I looked at the altimeter at 24K, and didn't see the expected apex cover come off. Didn't see the drogues come out. So, I think at about 23K, I hit the two manual switches. One for apex cover and also, the one for drogues. They came out. That same instant the cabin seemed to flood with a noxious gas, very high concentration it seemed to us. Tom said he could see it. I don't remember for sure now, if I was seeing it, but I certainly knew it was there. I was feeling it and smelling it. It irritated the skin a little bit, and the eyes a little bit, and, of course, you could smell it. We started coughing. About that time, we armed the automatic system, the ELS AUTO on, and the ELS LOGIC to LOGIC.

Continued down through 10,000 feet, expected to see the mains come out. They didn't come out, so, at 9,000 feet roughly, I hit the buttons for mains. They did come out. We had a hard time talking to the ground, partly because we were having a hard time talking. We were coughing so much it was hard to talk with that gas in the cabin. We did get the important things on the checklist - strut locks, etc. I think at roughly around 3K I put the PRESSURE RELIEF valve to OPEN, somewhere in that region anyway. I think somebody tried to call the ship. I'm not quite sure about that. We certainly had the impression we weren't getting through, which was substantiated later, when we got on the water, when we couldn't call them. We could hear them, though. After 800 feet, I closed the pressure relief valves. Deke took power off the main bus. Splash was fairly hard, and in one motion we went to stable II. Quickly Tom got the chutes off. There we were hanging in our straps, stable II. About that time, Tom released himself, got down, got the oxygen masks out. We all took oxygen masks and held them to our face and Tom turned the O₂ on and that helped quite a bit. I remember being concerned that we were in stable II, more or less trapped with that atmosphere. We very quickly got the uprighting system going, and in there somewhere I passed out. Tom said, for about 40 or 50 seconds. I knew that I was going to pass out. I could feel the - just feeling badly. I could feel either the anoxia or the toxicity of the gas was getting to me. After I

passed out, Tom put the mask to my face, and I came to again. After that we just went through steps of trying to clear out the cabin the best we could. Eventually, we got the hatch open, closed it again, got up on the ship, and you know the rest.

6.0 LANDING AND RECOVERY

STAFFORD Touchdown, impact. Wow!

BRAND It was a hard impact.

STAFFORD It was a slapper, I'll tell you.

SLAYTON I remember I was sitting there with my fingers on those breakers, waiting for impact. I must have gotten one of them in before my hand came off. I went back and got the other one. We hit pretty damn hard, it seemed like.

STAFFORD It was bang, bang; a big positive pulse, and a huge negative pulse, and there we were.

SLAYTON We just flipped, I guess from hitting the water.

STAFFORD Sequence and procedure for main chute release - we got it off.

BRAND It went very quickly considering the accelerations.

SLAYTON Postlanding checklist. Well, the first thing we did there, we were in Stable II, and Tom was scrambling to get back and get some oxygen masks. I was scrambling to get the breakers in and get the bags pumping, and Vance was getting the switches going over there.

STAFFORD The bags started to inflate right away. You guys did good.

BRAND As soon as we were upside down, it occurred to me that we had a bad atmosphere in there. We were upside down, and that was sort of a bad situation. I put in the breakers and started the uprighting pumps. Something was said about oxygen, and Tom very quickly went down and got us masks, which was great. I remember from that point on having a little bit of trouble talking and keeping the mask on at the same time. That's partly because the boom mikes on your headset interfere and make holes through the mask. You can't see through the mask too well.

SLAYTON They were all fogged over.

STAFFORD Also, we had that damn squeal in there too. It was squealing like a son of a bitch.

BRAND I was holding the mask to my face with my left hand, but having to take it off quite a bit.

SLAYTON Yeah. Same way.

BRAND Finally, I guess I left it off too long or something. We were hanging in our straps at that point, and I knew that I wasn't feeling good. I could see that you were not feeling good, Deke.

SLAYTON I was pretty nauseated at that point.

BRAND I suddenly knew that I was going to pass out. I put the mask to my face, and Tom tells me that I passed out. I guess, for less than a minute. I don't know.

STAFFORD You were just hanging there, glassy eyed like you were hit in the jaw. You were hanging there kind of still. I didn't recognize it for I don't know how long, it was a period of seconds. I said, "Vance, you okay?" And I tapped you and no motion. So I rushed over and put the mask to you - hit the button. I got a high flow, and you came around in about 10 to 15 seconds. You started flailing your arms, clobbered me, knocked the mask off again, and passed back out. I went back this time and got a better hold of him. When you came back, there wasn't flailing arms. You were back with us then in good shape.

BRAND Once I came back to, I felt relatively good. I didn't have any problem after that.

SLAYTON This is a good point to put to bed on that stuff that's been coming out of Houston about orthostatic hypertension. If you're going to have a problem, it should have been when we were up at three g's, not at minus one g. That would be helping, not hurting.

BRAND You can tell when a gas is getting to you. I don't know if it was from lack of oxygen or from a poisoning effect from the gas, but it was the gas that was getting us.

STAFFORD I was having a hard time following the checklist; I couldn't concentrate on it.

SLAYTON That was my problem. You were calling, and I wasn't sure I was doing the right thing.

STAFFORD I would check something off and then I'd say "Did I really get that?"

SLAYTON I think we were all a little befuddled.

BRAND I remember being concerned about what it was going to do to all of us, and then turning on the DIRECT O₂. As a result of that, I think we ran out of oxygen a little faster when we were Stable I, but we were trying to purge the atmosphere.

SLAYTON Temperature and humidity were both higher than the devil in there.

STAFFORD High and hot.

SLAYTON PLV wasn't bringing much of anything in it. There wasn't any obvious flow of air at all.

STAFFORD Obviously, it was below sea level because the whole atmosphere fogged on us. Vance had the ventilation fan on; it just whined, hardly flowing, flowing zilch.

BRAND When we opened the vent valve itself, we felt some improvement. But when we turned on the fan, we could hear the flow and observe no flow.

STAFFORD I wet my finger and put it up there, and you could just barely feel a little bit. It was negligible.

SLAYTON Communications. We just didn't have any.

STAFFORD No communication, but lots of noise.

SLAYTON Battery power. That all looked normal. Seasickness. No problem. It was nice and smooth, and nobody had any problem.

BRAND Nobody had taken any scop/Dex or anything either.

STAFFORD No. Right.

SLAYTON We went Stable II. Couch position: Tom had to get unstrapped first and scramble back up there and get those masks.

STAFFORD I was trying to watch out from falling down in that tunnel. But my eyes were watering so much, I misjudged my footing or something and I went crashing with my checklist down in the tunnel.

SLAYTON That was a good job. Spacecraft powerdown procedures. We lost the checklist page while we were scrambling around after we got back to Stable I. We tried to find the right page and reconfirm we had done everything. I think in process of milling around, we just tore that out of the book. I'm not sure we cared how we ended up leaving that spacecraft configuration at that point. We knew we were in good shape. We opened the hatch, once we knew the collar was around. I might have made a small mistake there. They were around by my window looking in, and I gave them a thumbs up because I figured we were in good shape then. I didn't want anyone to think we were in a panic mode. There wasn't any hurry out there. They were muddling around. We could have got that hatch opened quicker probably. But if, on the other hand, if we had given them a thumbs down, I was afraid everybody would go into a panic mode out there. I didn't want that to happen. So, it was a little longer getting to where we felt safe opening that hatch. I knew Tom wanted to get that hatch opened quick.

STAFFORD You remember Gus Grissom, during Mercury 4.

SLAYTON I wasn't at all eager about getting that hatch opened too quick.

BRAND When we finally did open it, we did it the right way. We took the nitrogen pressure off of it and opened it slowly with their

help. I was concerned mainly we'd compound the thing by breaking a swimmer's leg or something if we opened it up too fast.

STAFFORD I did that one time on Gemini 9. The pressure built up and I didn't know it. I opened the hatch and bang, it went flying through the air. I felt bad about it.

SLAYTON We could have probably opened it up a little quicker there if we pressed the system, but we didn't want to push it.

BRAND The atmosphere was cleaning up slowly, it seemed like.

SLAYTON We got the PLV opened up, and it was getting some fresh air.

STAFFORD We also opened the side valve.

BRAND It sure felt good to get that hatch opened though.

SLAYTON Then, the pickup. We went ahead and closed the hatch up again, and they hoisted us onboard. We all went back and kind of strapped in.

STAFFORD We all got some water - had a drink of water. Had a little bit of flow left. We strapped in the seatbelts. That was all, I think.

7.0 COMMAND-SERVICE MODULE SYSTEMS OPERATIONS

7.1 Guidance and Navigation

BRAND G&N, superb. Superb system. The ISS was beautiful. Optical subsystem. I've heard it in previous debriefings, but I was really surprised by the light loss in the telescope. On one occasion, that gave us a minor problem. I found that, to use the telescope effectively, I had to dark adapt probably for at least 10 or 15 minutes. And even then, it was marginal. If you did not dark adapt, the probability was that you would see one or two stars in the telescope, and that was all. Auto optics always worked well. The sextant, therefore, would always point to a star without any big need for identifying stars in the telescope.

The computer seemed to work great. The ORDEAL cramped out on us partially near the end.

STAFFORD It was sometime after the rendezvous. It was when we were doing the helium glow. I wanted to set one ball in orb rate and the other to inertial. I noticed I kept having funnies on ball 1, but I was punching the DSKY, so I just went to ball 2 and just kept ball 1 to see how the angles measured up to what we had on the DSKY. I tried to troubleshoot it, and it seemed like it would give me an offset where it wouldn't even work at all. I discussed it with Vance, and then later Vance tried it.

I think during the DM jet period. So, we had a funny as far as orb rate and ball 1 that was intermittent in the latter part of the flight.

BRAND When I checked it out, ORDEAL worked perfectly if you used FDAI 2.

STAFFORD Yes.

BRAND If you used FDAI 1, one of two things could happen. Either you would have a bias in pitch or else - well - I had a couple of different biases. That was it.

STAFFORD On the rendezvous, it worked beautiful. It was only during the latter part of the mission that I noticed any funnies.

BRAND What we ended up doing was we just didn't use it on ball 1. We decided to do that on our own. Later, the ground advised us that was the thing to do.

The EMS generally checked out and worked out just great. But, Deke, I believe you had one problem with it, didn't you?

SLAYTON Yes. I was getting the bias in it there on that solar eclipse where we backed out there for a total of 4 minutes and then thrust back in. I'd have to go back to look at the Flight Plan to remember the exact numbers, but I was closing on the exact

number I was supposed to have on the EMS. Everything was looking great, and all of a sudden I looked down, and I'd gained a tenth of a foot. I checked it a few seconds later, and I gained another tenth and it was incrementing on up on me. I didn't realize that's what had happened instantaneously. I therefore thought I might have inadvertently put in a little plus X, which made me nervous, so I backed off a little. It turned out that that really wasn't the right thing to do, because I kept incrementing plus X. I ended up closing too slow. That cost us a little fuel to get the rate of closure going again right.

BRAND We don't understand that. I'd like to emphasize that that was not in the VHF RANGING mode, but that was in the delta-V mode.

SLAYTON Exactly.

BRAND I thought the procedures people did a great job, in general. That certainly includes the G&N area.

BRAND SPS TVC. Perfectly nominal.

7.2 Stabilization and Control System

BRAND Thrust vector control. All good. Displays and control functions. This blends in with our previous discussion on G&N.

7.3 Service Propulsion System

STAFFORD Delta-V thrust switches were good.

BRAND Thrust vector alinement - superb.

BRAND Delta-V remaining counter and rocker switch - good.

STAFFORD No problems.

BRAND We never used the DIRECT ON switch. The DIRECT ULLAGE button, we never used. The THRUST ON button, we never used. The Pc indicator worked normally. I don't recall any bias. PUGS was not used.

7.4 Reaction Control System

BRAND I would say throughout the mission that the SM/RCS worked very well. We had one anomaly - procedural anomaly, during the period before launch when we wetted the RCS. The procedure, I believe, in recalling back, was to wet the auxiliary system before the quad system. It was done in reverse order. That was my mistake. It was a coordination misunderstanding. Looking back at that, all I would say is that that's something we never did simulate. At CDDT, we bypassed that. If we ever had another mission, they should really simulate that, because it seems logical to do it the other way around.

STAFFORD That's right. If I had been in your seat, I'd probably have done exactly the same thing.

BRAND Fortunately, it had no big impact on the mission.

7.5 Electrical Power System

SLAYTON Fuel cells, normal; batteries normal, with one exception that we'll hit later. BAT CHARGER normal. DC group and AC INVERTER all perfect. NONESSENTIAL BUS, G&N power, cryo system, we already talked about. The only problem there was the O₂ tank transducer going to zero. Other than that, I think everything was totally nominal.

SLAYTON Cabin lighting and controls. No problem.

SLAYTON The only thing I saw was after sep we were getting a constant oscillation around zero of plus or minus 4 to 5 amps. This didn't seem normal, but, on the other hand, the voltages were looking stable so we quit worrying about it. We called it out to the ground. Other than that, everything in the electrical system worked perfectly.

7.6 Environmental Control System

SLAYTON Oxygen system, cabin pressure. That was all normal. We were getting high flows on the O₂ the entire mission.

BRAND That was because of the cryo freezer. The ground kept wanting to purge oxygen into the DM or the CM. That gave us continual MASTER ALARMS. My only comment on that is that, if you cry wolf too many times, everyone starts to ignore the cry. We finally got to the place where we had so many MASTER ALARMS that we would push them out without thinking about them.

SLAYTON That worried me because we'd be sitting there with the panel covered with food trays, and all I could see was that MASTER ALARM. I'd just reach over and punch it out, and then I'd say was that really on O₂ HIGH, or wasn't it? You're right. That's a dangerous - potentially dangerous situation.

SLAYTON Cabin atmosphere. It was hot most of the time. We figured a lot of it was due to the VTR cranking out a hell of a lot of heat. Plus the problem we had with the PRIMARY EVAP. Water supply. We didn't dump wastewater very often.

STAFFORD I think we had two the whole flight, two or three.

SLAYTON Yes.

BRAND I spilled a little chlorine on one of the chlorination procedures one evening. I think it was mainly because I got the chlorinator screwed together and there was a little bit of galling. The next night Tom did it. He did it just right. After that, we were always very careful with it. I always had the feeling that I could have messed up that chlorinator by forcing it in anyway, because it was easy to get into a mode where it seemed to gall.

SLAYTON The water. To me, it always tasted good. The cold water was nice and cool and the hot water was hot.

STAFFORD The hot water. Sometimes there'd be no bubbles, and on occasion it'd be full of bubbles.

SLAYTON That's true.

BRAND We never understood that.

STAFFORD But I never had a feeling of a lot of chlorine in it, did you?

BRAND Only immediately after chlorination, which is expected. And I don't think the hydrogen bothered us too much, really.

SLAYTON We just passed it off.

STAFFORD Passed her off.

SLAYTON Water glycol system. Nothing there. Suit circuit. Anything there?

STAFFORD The main water boiler started blowing water out of the inlet hose.

SLAYTON We got a lot of humidity in the cockpit.

SLAYTON Gobs of water out of the outlet hoses there. I backed up against it a couple of times and would get totally saturated with water leaking off on you.

SLAYTON Gaging system. That didn't work so great for the whole flight. That's one that we didn't mention before. It was no

big deal. We had that constant oscillation. It never did read right. We weren't sure what was right.

SLAYTON Waste management system. Urine and fecal disposal. Initially, we were concerned that our urine system wasn't working. It seemed to not be able to handle the flow.

BRAND We simply determined to get an adequate flow you had to have the BATTERY VENT, CLOSED and all the other vents down there closed.

STAFFORD You need all the suction you can get to operate that.

BRAND After that, we didn't have too much trouble. You could overpower the system. You could give it too much flow, so you had to be careful.

SLAYTON That worked fine. The days we had to use the bags, that wasn't any problem. We got the bags out, used them, stowed them, and dumped them per checklist.

BRAND They worked well.

SLAYTON Fecal disposal. We didn't even attack that problem until the end of day 4. We all escaped it. Then we all used the old DM as an outhouse and solved the problem up there. I think everybody can speak for themselves there. I guess on that first

try I was pleasantly surprised how well it worked out. I was expecting one hell of a mess up there.

STAFFORD It takes a lot of tissue.

SLAYTON I got by with one tissue.

STAFFORD Did you? Oh, I'm sorry. (Laughter) The end of my feces was just a gooey mess. It started out hard enough. I filled the whole bag full.

SLAYTON I got overconfident. I screwed up the next time.

BRAND I thought it worked out better than I expected it to. You've got to allot a lot of time to it. We didn't have any time allotted in the Flight Plan for it. We did feel that we had to wait 4 days. You can say that we didn't, but there was so much to do that first 4 days. It was too bad that we got into that mode in a way, but we did.

STAFFORD Well, there was no time allocated for personal hygiene. Also, the planned time for personal hygiene may not occur with the urge. So we just could not box in this one. If you had a bathroom thing, it would be much better. I still think that with a mildly low-residue diet and that enema, you can go 2 or 3 days and not have to worry about it. There's no problem.

SLAYTON That might still be the solution for the crew on a 2- or 3-day Shuttle mission.

BRAND I think beyond about 3 days then it gets to be an individual sort of thing. How much can a guy tolerate waiting.

SLAYTON We were fortunate in this respect to have the DM for use. That way one guy could get off line and the rest of the system. We didn't end up messing up the CM. We left the stuff up in the DM full time. What I'm saying is that you ought to have a separate bathroom somewhere. That surely ought to be the case in the Shuttle - build an off-line system that is totally unassociated with the rest of the vehicle for handling waste problems. Have it properly vented, if nothing else.

CO₂ absorbers. I guess there wasn't anything there.

BRAND Only one thing I'm curious about. The absorbers in the DM locker, I think it was DM-4, were superwrapped. It was hard to get the wrapping off, as a matter of fact. It took a little bit of time. I thought, well, it's just the way it has to be. Then we got down to our latter canisters, which I believe were in B-6, and they weren't wrapped at all. That was very convenient. At that point, I didn't understand the logic of why some were and some weren't. The whole point comes out simply because it was hard to unwrap those in D-4. I would have liked to have had them all unwrapped, if that was possible.

7.7 Telecommunications

STAFFORD The first thing that was a problem was once we got locked on there would be an echo on the voice from Houston, four or five echoes. That made it damn near unreadable. This occurred both on ATS and the regular ground stations. Once we identified it we could get it under configuration and got it worked out.

The other thing was the interference with all the ground controls, the towers, approach controls on various circuitry throughout the world. This is the first time I've ever heard that, but, like Deke, one time I turned off VHF/AM and VHF/FM, and, man, it was still coming through.

SLAYTON This would bug us at night. We had to have the squawk box on, and then we would be up there in the DM and all of a sudden I would hear somebody talking in a control tower somewhere.

STAFFORD One time when we went over LA, we were cleared to runway 24 left.

STAFFORD Over Africa there'd be some Frenchman talking on the tower. We had German, and English, and Russian weather reports.

BRAND I think that the ground tried to contact us a couple of nights, and they couldn't. I don't recall what, precisely, our comm

configuration was. I think that if they couldn't, it was probably a result of us trying to configure so that towers didn't bother us.

SLAYTON Individual audio centers. I think those all worked. I don't know of any failures in any of them.

BRAND No.

SLAYTON VHF. I think we talked about that earlier. The AM comm checks with Soyuz were made outside of spec range, the FM checks were a little inside, and they weren't too good there.

BRAND The only comment on VHF I can think of is during the UVA you had a 0.02 mile bias in the ranging.

SLAYTON I'm thinking it was more like a 0.05 there sometimes. I didn't have a hell of a lot of confidence at all in that ranging data for the UVA. In terms of absolute numbers, I figured we were close to 150 meters. We never did show past 100 meters on that thing.

BRAND Fortunately, the bias was on the safe side. It read that you were close when you actually weren't. That's a good side to have the error on. We figured out preflight, when you added up all the errors, they were more than our total range on the 150 meters. So, other than sending out trend information, it wasn't too useful.

SLAYTON Operation of the high-gain antenna. I was frankly surprised how well that went through the whole flight. We didn't have any trouble with it at all, hardly.

BRAND I would have judged from the sims that we would have had more trouble with full high-gain operation. Other than the echo configuration problem, I thought it was just superb.

SLAYTON It didn't do a lot of mucking around getting lock ons. When we had the right angles in there, things seemed to lock right up most of the time. There were a couple of times when we were reading about 50 percent signal strength and just couldn't seem to get it pumped up. But in most of those cases it was because we were in an off-nominal attitude from what was predicted. Once we got the exact angles in, that thing just seemed to home right in there. I thought that worked superbly, personally, considering all of the flap we went around in in training.

SLAYTON Tape recorders. We don't know. I assumed that they all worked - from our end. Vox circuitry. The few times we used that it worked. USB emergency, we didn't use. DSE. I guess it worked, as far as we could tell. ATS-6. We just got through talking about it. Thought that worked great.

7.8 Mechanical

BRAND Tunnel. It all worked good. The latches worked great. Tom's docking was good. I noticed that the tunnel indicator was right on zero right after he docked with the docking module. The connectors that are right around the latches were just the way I expected them, slightly hard to reach but acceptable. They all connected well.

BRAND Before going to bed, we had a procedure which involved putting the cryo freezer in tunnel 1, so we could isolate any nitrogen leakage from it and not be bothered by it. The first step was to take the probe out to make room for the cryo freezer. I went up there and went through the removal steps. Everything went nominal until I came to the step which said insert tool - I forget what it is - L or something like that. Anyway, "insert tool, rotate it 180 degrees to release the capture latches." At that point, I found out that I could not insert the tool in the back end of the probe, in the base of it, mainly, because there are four pyro connectors back there for firing the nitrogen bottles, which were in the way. The wiring and the elbow of one connector were in the way in particular. After trying to move the offending wiring connector out of the way, I found out I couldn't. I told the ground about it. They said let's sleep on it. The next day the

ground advised, "take off the pyro cover, remove the connector and get it out of the way, and go through the operation." That was done probably within an hour, by coordinating with CAP COMM Dick Truly. He really did a great job in talking us through that. He apparently had a probe on the desk in front of him and our communication was very good. We disconnected the connector and never reconnected it, got the probe out, and everything proceeded on normally. The only thing that surprises me - I think the wire to the connector was possibly too short. Looking back on it, I don't know how the probe could have worked for this step. For probes in the future, if we do, make sure that a check is made on the probe to make sure that the tool can be inserted and the wiring can't get in the way.

SLAYTON Side and forward hatches. They worked well.

8.0 DOCKING MODULE SYSTEMS OPERATIONS

8.1 Environmental Control System

SLAYTON Odors? The first time we opened up, we had that kind of an acrid smell in there. Pyro smell. The second time, we had kind of a glue smell in there. I got kind of lightheaded in there. We think that was most probably a nitrogen pocket. The smell stayed there for quite awhile, and it finally dissipated. Temperature, I thought, was pretty good most of the time. I slept in there most of the nights. One night I got pretty cold in there. I think that was the second night. Once we docked with the Soyuz, it begin to warm up. It warmed up through the rest of the mission as I recollect. That thin hatch down there in the bulkhead, particularly after we got back from the Soyuz - for a day or so it cooled down there with an awful lot of water on it. And by the end of the mission it was warm down there too.

BRAND In general, the atmosphere was pretty clean. The LiOH canister change schedule is extremely conservative. Readings were always real low.

SLAYTON Pressure changes in the DM? That was all nominal, up and down. Operations were normal. All the valves worked per schedule. I don't know of a thing in the DM that didn't work as scheduled.

8.2 Telecommunications

SLAYTON Telecomm? Anybody have any comm problems in the DM?

BRAND No.

STAFFORD The old squawk box kind of squealed. I would get some squeal on that when you had it on with the comm carrier.

BRAND That was predicted. By and large, I considered that squawk box in the DM to be unusable. I considered it an emergency squawk box.

SLAYTON I used it a few times when I was up there by myself.

STAFFORD One time I was up there defacating, and someone called, and I used it. You could listen, but the transmission was terrible.

SLAYTON The old DM was a good old machine, in my opinion, all the way through. Worked like a charm.

BRAND I'd like to say that the DM and CM were just unbelievably clean. I think it's a real tribute to the people who tested it and put it together.

STAFFORD Just great; couldn't have been better.

SLAYTON That whole stack, right from one end of the booster to the escape tower, that whole stack was just as clean as a whistle.

Everything in there - other than that one probe problem - was
a super bunch of hardware.

9.0 EXPERIMENTS

9.1 Flight Experiments

STAFFORD Microbial Exchange. We did it per Flight Plan. In the SAM Experiment, we were off nominal in a couple of cases there.

SLAYTON In the case of the furnace, the only thing we missed was the symbolic sample. We missed that because we couldn't get a good vent on the furnace. They wanted to keep the one in there for a longer period of time to outgas. Other than that, the whole furnace thing went normal.

SLAYTON Electrophoresis Technology. Sample 7 screwed up. We had a leaky sample. We had bubbles in two or three samples before we started them. We took the bubbles out the end, and I think we brought that sample back. We brought two dry samples back. No we didn't either, we brought sample 8; I don't think we brought sample 4. The German one was normal. Crystal Growth. No crystal growth.

STAFFORD Soft X-ray. It's on the onboard tape - all the problems we had with it, all the problems we had with the instruments. We just coordinated back and forth with the ground.

BRAND We did a lot of purges and shutdowns. We just tried to do what the ground said. You know the rest of the story.

SLAYTON UV Absorption. The COAS alinement was super. Spacecraft control was very good, much better than simulation. I got into a couple of small problems there in configuration. Other than that, there was no big deal. It sounded like they were getting good data, and we were approximately where we should be. That is great. We could see light in their window. We got them to turn the beacon off so that we could get good data. But it sounded like they filtered out the data in spite of that, fortunately. Extreme UV survey worked like a charm.

SLAYTON Helium Glow worked like a charm.

STAFFORD Doppler Tracking. I activated it on time in the command module for the WARMUP and the same way for the docking module. One time later, when Deke and I were trying to close out the thing, I think you hit one switch from WARMUP to OFF. We lost just a little bit of time on it, which shouldn't amount to anything.

SLAYTON That's when we were trying to get the lights off up in the DM for some reason, and I went back to turn the lights on and I hit the wrong switch there.

STAFFORD When I turned the power ON to check the reels, it was obvious. Reels C and D didn't move. And in fact, A and B did not move at first. None of the four reels were moving. The ground

gave me a procedure to go to OPERATE, and back to standby, and to OPERATE. When I did that, reels A and B moved during the rest of the data take. They continued to move, whereas reel C and D never moved.

SLAYTON Light Flash. We have already talked about that. Biostack, Geodynamics.

9.2 Preflight and Postflight Experiments

No comment on this.

9.3 Earth Observations (MA136)

SLAYTON First thing is cameras. And we had three cameras that we used for Earth obs. Let's talk about them independently. We had the silver camera, 70 millimeter.

BRAND It was the 50-millimeter lens that was great. With the 250, we had light loss that gave you problems.

STAFFORD Yeah. There's a lot of selective targets we wanted, and we could see them with our eye but, when we looked through the reflex, the light loss was so much that you couldn't even get on target. Also, we had to take the pictures too far back from the window. It would have been simpler if we had just a regular 50-millimeter lens with a ring site.

SLAYTON Yeah, the reflex thing most of the time didn't do much for me at all.

BRAND I liked the reflex if I had the 50 lens on. It's with that 250 lens on that gives the problem that you are talking about.

SLAYTON Well, the other problem I had with it, too, is with the orange filter on it. I had the same problem with that; I couldn't get the resolution through it. And I know I screwed up one pass because I thought it was the orange filter that was giving me distortion and I was really out of focus on it. You still have to play the mechanical game just like you do with the black camera. I just think that you can't depend on what you are seeing through there. A lot of things that you can see with your eyeballs, you just couldn't see through that reflex.

BRAND I still think that a reflex, if it is done right, gives you something in addition. It lets you frame the picture that you are taking and really see it.

SLAYTON When you are moving as fast as we are moving, you didn't have that option too many times anyway. You are looking through the window and all of a sudden here comes something and you got to get it. All you are going to do is hold the camera up there and point at it and time it out for your 5 seconds, approximately, and shoot.

BRAND So for the Shuttle, I guess a lot would depend on cabin geometry.

SLAYTON We used up all the film we had available using that camera.

SLAYTON I screwed up that camera once for the SAM experiment, where I didn't get the 250 lens on all the way. I thought the camera was firing and it wasn't. Now then, the 70-millimeter black camera is a mapping camera. Every time I used that, it worked perfectly. I stuck it in the window and set it fine, and then all I had to do is turn it on and let it run. And it did great. We used that for a lot of miscellaneous out-the-window stuff too.

BRAND In the end, we had film left and decided to use it in the silver camera.

SLAYTON Yeah. And I think we used up all the film we had left for that camera. I guess I got some questions whether we are using the setting on that camera one of the times during the latter part. We couldn't find that cue card once in a while, and I think we thought we could use the same settings we used on the silver one. I am not sure if that is really right. Well, hopefully they weren't too far off anyway. The 35 was not designed to use for Earth obs. And we shot one hell of a lot of Earth obs with that thing using the light meter, at least I did. I think we made one mistake there. We called the

ground and talked to them about using it, and they recommended going to the 300 lens. And I put the 300 lens on there for one pass, and that was useless in my opinion, totally useless. Your field of view is so small. The relative rate of motion over the Earth is so fast that you're trying to get rid of the motion in that thing - I think is almost impossible. And you couldn't tell what you are shooting. It was just a blind-type operation. I think we took that off after - that really torqued me, that one good pass right through the middle of Wisconsin. And when I had that lens on, I don't think I got anything.

BRAID I think that whoever gave us that advice was thinking in terms of purely Earth obs objectives. And what we were wanting was a general purpose out-the-window.

SLAYTON I think the lens we had on here was pretty good for that. Might have been a little bit too - too broad a lens. It might have been better if we had a tighter lens with that much.

BRAID It is a very convenient camera. If there is a difference out the window, such as you can't use the light meter, it would have been nice to have had a bias or something.

SLAYTON It would be interesting to compare some of the film we get with that, because you and I ran one strip along the Inacollian fault. You were using the black camera and I was using that one. I kept changing settings in accordance with the light meter. I think you were running with a canned setting.

BRAND I was changing as we approached the terminator.

SLAYTON That was the advantage I could see to the 35, assuming that the light meter is working about right. Seems like you ought to have a lot better chance of having the right exposure with it. It might be worth looking at for other cameras in the future. Postflight evaluation will tell.

BRAND The flash operation of that camera was nominal. It is a convenient camera to have onboard.

SLAYTON Okay. Then we used the 16 for one strip of Earth obs. You just held it and turned it on and let it run. The intervalometer worked every time we used it, I think. Cables and mounts, those all worked fine. Tape recorders, handheld. I think that's a good little tape recorder.

STAFFORD One night we forgot the switch and the batteries ran down.

BRAND We needed every battery that we had onboard. We were always conservative. We didn't want to have the thing running out of

battery power in midtask. When we thought the battery was getting a little weak, we changed it out; I think we used more there.

SLAYTON We have to be careful about rewinding. In fact, I think you should kind of have the kind that you don't rewind. We tried it a couple of times and we always ended up with a scrambled reel in there. Those little things are not really designed to rewind in zero g. So we should program so you don't ever do that, I think.

STAFFORD Let's see, the Earth obs logs. Sometimes we are so damn busy we didn't get a chance to log what we were doing. But we always put it on the tape. The logs were great; we just didn't have enough time to do them all the time.

SLAYTON The other thing is we didn't use the same mags in the period they had us programed for anyway, so the log didn't even fit. We got it on tape and that is the important thing. They'll find the right frames to go with the right pass on the right magazines.

BRAND That's all we attempted to do, but we attempted to do that. I would log them on pages 4 and 5 but I think I missed one or two.

STAFFORD Yeah. I know I missed a bunch of them.

SLAYTON The Earth Observations Book. I only have one recommendation, and that is we need something different to write in it with. The pages were glossy, and every time I wanted to make a note in it somewhere, like time of acquisition of a site or whatever, I had to go find a felt-tip pen. And even that I could hardly read.

STAFFORD Yeah. Yeah. Yeah, a regular ballpoint wouldn't write on it.

SLAYTON You need some kind of pages that you can write on and make notes.

BRAND Well, in one or two cases, you need sort of little drawings where you can fill in with pencil. Now I will give you an example. I came up on Puget Sound and I was supposed to make comments on the currents and gyres I saw. I saw some. And I saw pollution and everything. You know, that is something that is hard to describe verbally. It is just almost impossible, in a way, because you have to reference it to a certain point. Puget Sound is not a square tank, it is rather a complex sort of thing. And I wanted to draw a picture of what I saw. So I took a pen and, as Deke said, I couldn't draw on the picture, and it was too dark anyway. And I feel that I lost some data there. And after it was all over I cussed myself because I even tried to describe it. I should have just tried to take a picture.

SLAYTON That is what I kind of concluded, in general, if given a choice. The best thing is to try to get some good pictures and then, if we have time later, to put it on tape. Like Tom says, most of the time when you got through the pass you were in the middle of something else. And you even have time to backtrack to pick that up. Early in the mission, things were happening too fast. We got very little good data out of it. I know I didn't, anyway.

BRAND Yeah. I remember exactly thinking what you are talking about. I think, well I'll have time right after this task to quickly get it on tape. And then, I didn't. The next site would come up and you would get five or six sites stacked up, and then it was all over. And then you would say that I'll debrief the whole thing. By that time, you have forgotten some pertinent parts, and then there wasn't time often to debrief the whole thing.

SLAYTON We were always against the time constraint too.

BRAND We had only the photo cue cards, and I used them a little. We needed Nikon film on it, but that was our fault. We should have asked for it ahead of the mission. We sort of had that camera ruled out for out-the-window.

SLAYTON Okay, the map pack. We used the one map that they had in there. And I thought that was pretty good. There were lots of times we pulled that out to navigate with.

BRAND But I tell you, I needed the map pack two or three times, and I wanted it but I couldn't get to it. There were three or four places where I wanted to get it, and it was so inaccessible that I didn't bother. I didn't have time to get it. I recommend against using a color wheel on any future missions.

SLAYTON There's got to be some better device.

BRAND It has the same problems that we talked about before it was ever built.

SLAYTON But it worked pretty good in the airplane where you get lighting behind it which corresponds with the lighting you're seeing on the ground. And in the spacecraft, you're always in the shade with the color wheel, but what you are looking at in the sunshine and trying to compare the two is like comparing apples with oranges. And the only way I could come up with anything even close, I'd look out the window and then I'd come back in the cockpit and get the color wheel in the light, and look at that and say, I think that was close to what I was looking at.

BRAND My technique was to hold the color wheel sideways in the window and hope some light would shine on it.

SLAYTON But then you would get a totally different color appearance also. So I think that color wheel was a dead loss.

BRAND If you get any results from it, the best results will be from the ocean. Because somehow or another those yellows and reds seem to change an awful lot, depending on how much light was shining on it.

SLAYTON I guess our best chance is going to be to go over it and hope we got some good film, and compare the film against the color in debriefing. And maybe we can, in retrospect, say yeah, we think that was pretty close or it wasn't.

BRAND There should be an attempt made, that if this thing is ever important in the future, to get this device that we have all talked about, some sort of an optical device. Color is always a dead loss.

SLAYTON Film management stowage went pretty well.

STAFFORD Yeah, we spent an awful lot of time on it.

SLAYTON We kept F-1 and F-2 pretty full of film. I think it worked all right, we ended up using different magazines at different times. But that wasn't any big deal.

BRAND We'll find out.

SLAYTON We inventoried there once and we were concerned about running out of film. We were shooting pretty fast at one stage of the game, then we began to worry we weren't going to be able to use it. So we figured out how much you can use it and not overdo it. I think in the end we came out using everything except about three rolls of 35, didn't we?

STAFFORD Yeah, I think everything was shot.

SLAYTON Yeah, and we'd have used a lot more 35 if we had thought about it earlier.

BRAND We had enough film onboard, no doubt about it.

STAFFORD We ran out early on the color exterior 16-mm DAC because I used some extra when Deke was stationkeeping.

SLAYTON That's right, we could have used some more of DAC, couldn't we? In fact, we had to use that color interior for entry. I hope that came out all right.

BRAND You know, in the future, I don't think we should budget film for PAO versus Earth obs as we did on this mission. I think you should have a film cabinet with a certain kind of film and you just start using it. These allocation problems should

be solved on the ground. It may be a hard ground problem, but I think it should still be solved on the ground.

STAFFORD I agree with that.

BRAND You know, we had both onboard and we were mainly using the spotting scope, but we sort of had the binoculars onboard as a passenger to be used for evaluation. I made a comparison looking at the Moon one night with both and I found that both worked pretty well, but I had a steady target. I probably slightly preferred the spotting scope. The thing of looking at the ground was something else. If I had the most perfect pair of binoculars or spotting scope, either one, in that low orbit I wouldn't have used them, because you never had time enough to use them.

STAFFORD You have to preplan one specific point on one rev and look at that only.

BRAND And you lose all the other data around it.

STAFFORD And also, from that low orbit, 20 power is too much.

SLAYTON I would have gone right back to 10 power.

STAFFORD 20 power might have been all right for Skylab, but Skylab is twice as far away.

SLAYTON We were seeing much detail with eyeballs, anyway. For example, at El Paso, I could see the runways, taxiways, and hangars faster with the naked eye.

BRAND Thunderstorms appeared to come a fourth or a fifth of the way up to us.

STAFFORD At least 25 percent of the way. You thought maybe only 200 or 300 thousand.

STAFFORD To me, as I mentioned before and I'll mention again, about my Gemini flights. From about 160 to 170 miles down to 120 and below, there is a noticeable difference in the resolution of the ground, and also a noticeable difference as far as tracking a target.

10.0 TRAINING

SLAYTON The first one is CMS crew station fidelity, availability, visual systems, and software. Anybody want to say anything about that?

BRAND As far as CMS is concerned, the crew station was good. Naturally, in the real vehicle, there are different breakers and things like that, but that's no big deal. I'd say the greatest difference between flight hardware and the simulator is in visual systems. Especially in the telescope, there's a lot of light loss in it.

STAFFORD To me, I thought the visual display of the CMS had degraded over the years compared to when I flew it back on Apollo 10. Also, the docking target wasn't as good as what we used to have for a lunar module. Also, the slop in the system was fantastic compared to the real dynamics of space; the present system jumped around a lot. This came about due to some mods they made for Skylab.

BRAND Fortunately, the degradation in visual systems in most cases is a conservative thing in the simulator. In real flight, the visual presentations you see help you out. You get cues that you wouldn't expect, and the only exception to that is the telescope, which leads you to believe that you'll be able to see better in space than you really can. I can't

say enough for the simulation instructors. I think, in general, our simulators stayed up well and the instructors did great.

SLAYTON Well, I'm of the same opinion. I think the fidelity of it - considering the state of the art and how many systems this particular simulator supported, with us on the tail end of the string - I was amazed that the thing stayed together as well as it did and did a good job. It was a rare occasion when we bombed out and lost the sim. That thing was available when we wanted it and I thought it supported us very, very well.

BRAND It's worth noting that we have an exceptionally good crew of IOS's there, and I would hope that this system works as well in the future with IOS training as it did for us.

SLAYTON One-g trainers. There, again, I think as usual we did all of our mockup-type training, stowage, and experiment and transfers exercises in these simulators. I thought the fidelity was adequate for those things. We certainly didn't need more fidelity than we had, and they supported as required. The guys did a great job of getting that stuff all packed together and playing it together in the sims with the Russians, as a matter of fact.

BRAND I, too, think they did outstandingly well.

SLAYTON Simulations, U.S.A. and U.S.S.R. Got any thing about that?

STAFFORD Well, on the first one we ran, there was some lost motion, but I thought they got better each time and brought out points. The last one really helped us a lot on getting some final things down, even though it was a long drag. I wish the Soviet's prime crew had been with us all the time, but they had the third and fourth crews running most of the time. I remember on our second joint sim there was a lot of lost time, but by and large I guess they were worth it.

BRAND In hindsight, I think it all worked pretty well. The only place it seems to me where we could have used better, more thorough, simulation with the Soviets was in the UVA. Because, as it turned out, there were quite a few surprises, and if we'd had some way to simulate that better with them in a closed loop, I think we might not have had these surprises.

SLAYTON That would have been a difficult thing to do at this point.

BRAND Well, we weren't smart enough to know that we needed a more faithful simulation in that area. Had we known it, I think we could have sat down and devised something.

SLAYTON Egress training, pad, tank, mockups, et cetera.

BRAND All adequate.

SLAYTON Planetarium.

STAFFORD I wished I had had it, but I don't think I missed it.

BRAND As it turned out, I was the one that needed it and I never got in it, which was mainly my own fault. I got bombed out by the weather once and couldn't get in there.

SLAYTON I got some but I didn't need it.

SLAYTON Okay, simulator training plans.

STAFFORD Okay, some of that square filling at the last was not required. Some of the things were not required.

BRAND But we've always had it.

STAFFORD Yes, but if you look into the future, you just can't operate this way.

SLAYTON Well, it's the same old business. You need a general plan to follow and then you need to revise it as you go along, and people need to recognize that there is nothing inviolate about that plan and that it's a living thing that changes as you go. Unfortunately, I think we have some people, not the training guys, outside the training system that got hung up on the numbers and assumed that once something was on paper

it was magic. Guys like Mike fully realized what is "real world" and so did the simulator people.

SLAYTON Systems briefings.

BRAND Well, I think our only problem in that area was a shortage of time. I wanted more systems briefings, but never had time to get them, and that was only because time squeezes in on you at the end. As it turned out, I think we had a pretty good systems training program.

SLAYTON Experiment training. In my opinion, we had adequate training for all the experiments that we flew. For some experiments, we didn't get very much, but we simply followed the checklist and filled in the squares and there wasn't any big deal.

BRAND I know that Bob Nute and his people wanted us to get every bit that we could absorb. I just think that we took as much as time would allow and that it was adequate.

SLAYTON Mockup and stowage training.

STAFFORD That was sure worthwhile, to occasionally go through the sequence of something like launch through TDE and exercise the stowage. We sure needed it for some of that transfer stuff, because of that small space and what we had to do in a series operation.

SLAYTON Well, stowage was a problem throughout the flight. We'd really have been in trouble if we hadn't had the simulations we had in that area. I think the guys that worked out the stowage for launch, in-flight, and entry did an outstanding job. Sorting that all out and giving us a proposed plan on how to handle all that stuff - I think, with a few exceptions, it worked like a charm.

SLAYTON Photography and Camera Training. I think we had probably more than enough in my opinion. The kind of mistakes I made with a camera up there are the same kind I make down here, forgetting to take off the lens caps and simple things like that. There isn't any amount of training that will prevent that.

BRAND I think we should have gotten to camera malfunctions and things like that a lot sooner.

SLAYTON We could have, but that wouldn't have made any difference.

BRAND It seemed like we had a 2-hour briefing regularly on cameras and I'm not sure we needed that much.

SLAYTON Okay. Planning of training and training program. I think Mike did a great job of putting the plan together and implementing it. There's a hell of a lot of competing requirements in the same time frame as usual, and I think he did a great

job of getting it all sorted out and fitting everything in,
and we got it done.

BRAND I agree.

SLAYTON Language training.

STAFFORD Well, I think we needed every bit we got. We didn't come
anywhere near what the Russians put out. If we had not had
that crash program to get those four instructors, we would
have really been behind.

BRAND That was the right approach.

STAFFORD Yes. For the future if you are going to have a mission like
this, you need a longer leadtime, to avoid a crash course
like this. That was the one thing that had to be done and
needed to be done right on the spot.

SLAYTON Well, I don't think we could truly ask for any less than
we got.

STAFFORD No. Listening to the way the Russians talked up there, what
had been done and the progress we made, we started behind
the power curve.

SLAYTON Okay, joint training.

STAFFORD Well, in both cases, there was a little lost motion. I think the number of times at each place was adequate. We didn't need any more.

BRAND In a way, I think we did. I think you had to just touch base every once in a while. If you don't, you get too many misunderstandings. That's why you need to clear the air - to keep your program moving smoothly, in my opinion.

11.0 FLIGHT EQUIPMENT

11.1 Command-Service Module

SLAYTON Okay. Flight equipment, event timers, and controls.

BRAND Thank God the event timers worked.

SLAYTON Crew compartment configuration. As planned, and it worked.

SLAYTON In-flight tool set.

BRAND The best thing we ever did was put in a pair of pliers. We used that to disassemble the backend of the probe when we had the problem. I think, in the future, having a few simple tools like pliers and pin straighteners should be considered.

SLAYTON Clothing.

BRAND Adequate.

SLAYTON Tools: Good old gray tape isn't a tool, but I don't think you could live without it.

BRAND I liked those little Velcro straps. I know you guys didn't use them much, but I used up all of mine before the mission was over.

11.2 Docking Module

SLAYTON Okay. Crew compartment configuration, restraint systems, thermal control, and hatches. We talked about that already.

I think Tom might have mentioned earlier about using the restraint system for exercise. That's the only restraint system used.

BRAND I've got one comment before we leave this section on clothing. We all wore the toes of our shoes out. That's no big deal, but just like in Skylab, those shoes of the future probably ought to have a pretty rugged toe so that they won't wear out right away.

12.0 FLIGHT DATA FILE

12.1 Checklists and Timelines

SLAYTON Okay, launch checklist?

BRAND Excellent.

SLAYTON Rendezvous book?

BRAND Okay.

SLAYTON HP 65? That worked like a charm.

SLAYTON Flight Plans, volumes one and two?

BRAND No problem.

STAFFORD Sometimes they try to get too much on; this results in fine print which makes it difficult with the lighting we have. There is too much in these.

BRAND Another comment is - I'm glad they went to the three column format. If they hadn't done that, I don't know what we would have done. I think we'd have had a lot more problems getting anything done.

SLAYTON Okay. Flight Plan Supplement?

BRAND Served its purpose.

SLAYTON Systems checklist? Worked like a charm as far as I know.

BRAND Yes. That's something that was taken care of by the checklist manager sort of on his own. He didn't have a lot of input from us, but he certainly did a good job.

SLAYTON G&C checklist?

BRAND Fortunately, we didn't have to use it very much except for a star chart once in awhile. It was an excellent reference book, and I'm sure glad we had it onboard.

SLAYTON Joint ops checklist?

BRAND We had it ready a lot. From the docking, I had it ready.

SLAYTON DM checklist? Just like all the rest of them, I thought you guys did a great job of putting it together, and we used it reverently, and everything worked per schedule. Experiments checklist (includes EPE/ETE)? That was a good move - to separate those things out of the basic experiments. That worked fine. All experiments, as far as I know, were in good shape, and we got the right data logged in the book and had the right squares filled.

BRAND That was one of the most used checklists during the orbital portion of the flight. Someone was always looking for it.

SLAYTON Update book?

BRAND Only used it for the block data, and that was a mechanical thing. Fortunately, we didn't need it for much else. It is mainly a contingency sort of reference.

SLAYTON Entry checklist?

BRAND The checklist was correct. Well done. Any entry problems were not the fault of the entry checklist.

SLAYTON Photo ops? I think we got it out once; I got it out to crack our film budget and to try to figure out where we were. I think it was a good thing to have, just for that reason.

BRAND I used it as a guide for knowing what the film was.

SLAYTON Cue cards? As far as I know, they were all in the right place at the right time and adequate.

SLAYTON Star charts?

BRAND Adequate.

SLAYTON Alternate/contingency flight plans?

BRAND We only pulled out one. And that was to look up the UV edge. Fortunately, we didn't need all that backup stuff in the A2. However, it would have paid for itself if we had needed it.

SLAYTON Systems data?

BRAND I looked at a schematic once or twice. It was such a nominal flight, we didn't need it much.

SLAYTON Malfunction procedures? We used a couple of those. The only comment I'd like to make about this general area - that came up in our talk about simulations but which didn't come up in flight, fortunately - but, all those red pages with black ink. I think that in future programs those kinds of procedures should be in some other color, like black on yellow. We did have some like that, as a matter of fact, and they were a lot more readable. I think we would all have trouble reading those kinds of procedures if we ever had to use them.

12.2 Charts and Maps

SLAYTON Okay. Charts and maps? We talked about that earlier.

BRAND Only one thing that might be added. We said the most useful map was that map of Farouk's that showed every orbit and where it went. I would say that, in the future, such a map for a similar mission is a useful thing. But you might add a couple of things. The rev number should be put at the end of the rev as well as at the beginning. You had to trace clear across, and it was hard to trace. Also, it might have been nice to have had a minute scale so that you could more or less see how many minutes it took to go from Hawaii to Seattle, for

example. I know that it wouldn't be something you'd want on each rev, but maybe in a couple of representative places.

12.3 Phototype Shuttle Bookbinder

SLAYTON Okay. Prototype shuttle bookbinder.

BRAND In general, my only comment was that if you're going to have this on the Shuttle, it would be faster and easier to use if it was like the schoolbook binder that you can open and close with a flip of the thumb. I'd suggest going to a college bookstore and looking for something that is light and still has a tab that can be used to flip the book open and closed. Then you might have what you want.



13.0 PREFLIGHT SUPPORT

STAFFORD One thing for Shuttle, if you have all these changes for the Flight Data File coming out in hundreds of pages, you need one person full time to keep our books updated.

SLAYTON As far as the support teams are concerned, those guys did a super job. They were also on top of the hardware and kept us updated on the status.

BRAND Couldn't have asked for a better support crew in my opinion.

14.0 VISUAL SIGHTINGS

BRAND

Nothing unusual.

15.0 PREMISSION PLANNING

BRAND

I think the system did its job. I think there was a heck of a lot of premission plans, especially in the contingency area. I think it was one of the most thoroughly planned missions I've seen.

16.0 MISSION CONTROL

BRAND No comment. They did their work.

SLAYTON We talked about some of our comm problems.

BRAND I would say that having the flight control group in
Moscow gave us a warm feeling. It was nice to know our
people were there if we ever got into a situation where
we needed them. Nothing vital was required.

17.0 HUMAN FACTORS

17.1 Preflight

STAFFORD I question the total value as far as the resources expended as to what we could get for it and it's going to be impossible to do that in the Shuttle. We brought that out as a cost-saving factor which was ignored.

SLAYTON I think it is one of those things that ought to be handled logically and within the operations part of the system. Make sure you got crews ready to fly. That really has nothing to do with the medical world. I don't think we need it. Medical care. Well, we didn't need any medical care and there were plenty of people that were looking after us in case we did need it, so that was well taken care of. Time for exercise, rest, and sleep. Adequate.

STAFFORD Okay, medical briefings, exams, preflight. Most of the exams are data taking, not physical per schedule.

BRAND I have just one comment, there. We did talk a lot about how, even though I guess the medical protocol had been pre-agreed upon, we were surprised at the amount of data taking. Since I was involved in Skylab, too, many things were sort of a continuation. The question is where the old-type data taking ends and the new-type experimental ideas begin. To give an

example, the whirling-chair exercise seemed to me to be sort of useless before our mission because it wasn't really for training and it wasn't for any useful experimental purpose that we could see. And there's a crying need really to get in and come up with a fairly new experiment to solve this problem of sickness in space.

STAFFORD Yes, but we didn't have any problems.

BRAND We didn't have any problems but I'm saying that the chair seemed to be sort of a data collection device that had no purpose. And - and if there was to be such a thing, it seems they should get Skylab data and work out a new experiment to try take this experiment a step further.

17.2 Flight

SLAYTON Appetite in flight versus 3 weeks preflight. I didn't see any difference. Some things I didn't eat in flight, not because I wasn't hungry or didn't want to, but because I was having problems getting some stuff reconstituted properly. Some of that I just put in the trash can rather than fuss around with it.

BRAND I was pleased with my in-flight menu. I thought that it was good of the food people to let us take part in it and coming up with as much as they did. But I must admit that, in flight, some of my taste changed. I didn't find food up there as tasty

as it was on the ground. I didn't know what to do about this. I think that it helps if a person participates to a large extent on his own menu preparation.

STAFFORD Yes, but for the Shuttle, it's going to be ridiculous. There are so many flights, and you have to go through all this elaborate effort for every flight.

BRAND The pantry idea is kind of good in that regard, and if you feel like cookies you can pick out cookies or whatever you want.

STAFFORD Yes, the pantry is a great idea.

SLAYTON Let's see - we touched on the next item, changes in crew preference.

SLAYTON The size I thought was adequate.

BRAND I found salty foods tasted the best to me, retained their taste the best. Salmon and tuna, for example, tasted almost as good up there as it did on the ground.

SLAYTON Fruit juices and the fruit always tasted good to me. Of course, it did down here, too. Everything tasted good. I didn't think of anything that didn't taste adequate.

SLAYTON Food preparation and consumption. Problems with dehydration and mixing gas.

STAFFORD Nothing new there.

BRAND Rehydration costs you money. The tasks add up into hours.

SLAYTON There are some foods that just plain don't rehydrate very well in zero g for some reason. The one big problem I had was macaroni and cheese. There seemed to be no way to get the water through that thing. Nothing seems to rehydrate as well up there. It seems to end up with localized dry spots in it.

BRAND I don't know if you guys remember, but I remembered. We'd get our food bundle and if it had a lot of things to hydrate, we'd kind of groan, because we knew it would take a lot of time and we'd have to stand in line to do it. If it had ready foods, things that were easy to open and easy to eat, we were always pleased.

SLAYTON Food temperature, no problem.

BRAND Hot water was hot enough.

STAFFORD Sometimes it had gas, and sometimes it didn't.

SLAYTON The use of spoon bowl packages and the use of spoons. Fine.

BRAND The only place where we got hung up was trying to eat soup with spoons. Soup was too liquid to easily eat with a spoon, although you could if you were very careful. It was too coarse

to suck through the hole in the bag, because it would get clogged. That's the only area where we had a little trouble.

SLAYTON Opening of cans, and consumption from cans.

BRAND The only thing there, you had to always be careful when you opened one and have a wipe of some kind handy so you didn't spray the cockpit.

STAFFORD 15 psi to 5 -

BRAND We knew that would happen, it's just that - once in a while it would surprise us.

BRAND With the cans that have pull-tabs, we had one or two problems. I think that Tom had one that came off.

STAFFORD I pulled and pulled and finally the tab came off. The pre-cut around there just wasn't deep enough.

BRAND All I have to say is that if you have those in the future, you should really look at them to make sure that the pre-cut is good.

SLAYTON Okay, waste food storage.

BRAND I had the feeling that I never did a good enough job in that regard. I never did what was expected of me in the way of properly powering up the pill and mixing it with the food in

the bag and stuff. But, on the other hand I felt that you're wasting time if you spend much time doing that. You're taking away from a valuable experiment or something else.

SLAYTON Yes. That again is a time-consuming operation, and I'm not sure it's really worth it.

BRAND I think that all of our food garbage went into one big bag and we never had any trouble with smell over the 10-day period, it all worked great without too much emphasis of food.

STAFFORD We dumped it all in the DM.

BRAND Fecal bag. There's no great problem, but I don't think any of us ever had a runny sort of situation, and that could have given us a problem.

SLAYTON Evade as long as possible and try to contain it as much as possible.

I think we all drank a fair amount of water during the mission. Nobody was dehydrated. I drank more water there than I do on the ground. I don't hardly ever drink water down here.

SLAYTON Work, rest, sleep.

STAFFORD The only disturbance was that squawk box on C&W and, on occasion, the air to ground air traffic stuff we kept picking

up on the squawk box. And, one time, I had an inner squeal, and I got up at 4 o'clock in the morning and turned it off. We had those three headsets, suit power on, and they were by the squawk box. You got to turn it off. Either that or disconnect it. I turned the suit power off on one and disconnected the other.

SLAYTON I guess, generally, we probably had enough sleep. I guess we would have slept more if we had had time available. I guess that was all said real time anyway, wasn't it?

Programing. Here, again, that was kind of spastic. But that was preflight plan and no big deal. Had to be that way.

BRAND One thing for a flight plan is always to remember in the future that if it says in the flight plan that you're going to get 7-1/2 hours sleep, there's probably no way you're going to get that much. There're certain lead times involved there. I had adequate time, most of the time, for a 10-day mission, although some times it was less than 6.

SLAYTON The only times that I didn't sleep good was if I got cold. I got cold one night in the DM and I got that way one night in the CSM and I didn't sleep good. But other than that, man, it's great sleeping up there.

BRAND We all gravitated toward our own environment for sleep. Tom seemed to like the command module. It's warmer down there.

STAFFORD I like it warm. I had one extra air hose blowing down there just for the fresh air.

BRAND I spent one night next to the VTR, and vowed never to sleep down there again, because it was hot and went up into the cool DM, and I liked it up there.

SLAYTON I slept in the DM through most of the mission.

BRAND The world's softest feather bed, sleeping in space.

SLAYTON Okay, exercise: frequency, duration, quality, and all that good stuff, perspiration.

STAFFORD We didn't have time most of the time to exercise.

BRAND I think we all enjoyed it when we did it.

SLAYTON We said we did. It was all good to me. But I didn't feel that I was getting near enough. I like about four times as much. I really didn't feel like I exercised. We all just plain didn't have time.

BRAND The first-class way is a bicycle or ergometer or something like that that puts a long-term load on you. But not having the room or the facilities for that, I think, we have second best.

STAFFORD For a week or 9-day mission. For a long-duration mission that's different.

SLAYTON I think the exerciser, itself, worked fine as far as I was concerned. The way it does in one g pretty much, I was able to load up my muscles. Not having enough time and the times we got to do it having to be strapped into the biomed stuff, that was constraint.

In-flight oral hygiene: mouth discomfort, brushing, dental floss, toothbrush, and all that good stuff.

BRAND No problems. Brush your teeth and swallow the toothpaste.

SLAYTON Sunglasses or other eye-protecting devices.

BRAND Never wore them.

STAFFORD Never wore them. A couple of times I wish I had, when we were looking at the ground for a long time.

SLAYTON Sure wish we had had some when we came off that 150 UVA. I don't know if those would have helped me as we were right into the Sun. There's not much you could do about it.

Medical kits: Adequate quality, quantity, etc.

STAFFORD All I used was one - and a couple of aspirins.

BRAND The only time I got into the medical kit was to get the stickers for our sensors.

SLAYTON Housekeeping: We talked a lot about housekeeping. It went along, I guess with me it's the stowage area really and they're thinking of it in a narrower sense, here.

BRAND One of the overriding concerns and problems, given the size of the quarters and everything we had packed in there. It's hard pressed for me to say anything about it, except we learned how to live in there and we got along.

SLAYTON Yes, it's one of those things you can't simulate ever. Nobody's ever been able to. It's always one of those things that just eats up a lot more time than you want it to or you expect it to.

BRAND We had certain bottlenecks - or continual logjam things. One was the hatch, always in the way. Another was the suits, always in the way. Another was the water taps. You could only get one guy up there at a time. The other thing was MDC became an all-purpose table. We used to just jam it with things. We had food bags, maps, flight plans, everything on there. Sometimes, it got hard to see the switches and the computer. That only got us into trouble once. After that, we were very careful.

SLAYTON Shaving: We all had different experiences there. In my opinion, if I shaved every day, I could shave with a regular razor and in reasonable good shape. It took longer and I had to use up a couple of blades. If I went beyond that, I had to go to that old windup thing and that's torture too, but it worked.

BRAND It depends a lot on thickness of beard. I have a medium beard, and I found the brushless and the safety razor very adequate and very quick and refreshing. It felt good after a shave every day.

SLAYTON Radiation dosimetry. We gave them the readings every day.

BRAND In general, on personal hygiene, you just have to sort of decide you're on a camping trip and not expect everything to be super. You can't emphasize cleanness quite like you would at home.

SLAYTON We changed underwear, three or four times there. That was one we had to change. Couldn't shower.

BRAND Yes, a change of underwear every 2 or 3 days was about right.

SLAYTON Spacecraft temperature. We talked about that earlier.

STAFFORD Warm most of the time.

SLAYTON Spacecraft noise.

BRAND Acceptable. I expected to be bothered more by the pump noises and so forth. But it seemed to me that once you got used to it you didn't even notice the pumps and things like that being on in there. The biggest thing was that you had to shout at everyone a little bit more in the 5-psi atmosphere to be heard.

18.0 MISCELLANEOUS

SLAYTON Okay, miscellaneous: medical requirements, PAO requirements.

STAFFORD Our medical requirements were explained to us before flight.

SLAYTON Yes. All I would say is that I wasn't very enthused the way the medical requirements were established for the flight. All they did was pull out the Skylab medical requirements document and try to superimpose it on this flight, and that was the wrong thing to do. We just wasted a lot of time muddling around in different levels of meetings getting that thing beat back down to something that was reasonable. And I think that the medics got all that's to be expected from a flight like this. We certainly were in favor of giving them anything we felt was going to be meaningful. And they had some weight things in there, like that muscle tone thing that they thought was a good thing to do at that time. I think the big question is whether a 9-day data point is all that great a medical-data requirement after you've got data for 28-, 56-, and 84-day missions.

SLAYTON Anyway, we did what the plan called for. I guess this is a good point to make, at least as far as I'm concerned. I'm, frankly, pleased with the way they handled everything post-flight. We had our problem and those guys could have - some

of them, I'm sure, would have been charging in there trying to accumulate a bunch of research data, you know. But the guys out on the scene were superb and said let's worry about the crew's health and worry about medical data some other day. And I think that was very good.

BRAND Yes, I think, here, during the postflight problems, Dr. Nicogossian used very good judgment all the way through.

SLAYTON And all the other people involved.

STAFFORD PAO requirement. About the same. We had a plan, it was implemented, and, other than a couple of little flaps there that were off nominal, there were no problems.