Scott

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GEMINI XI

TECHNICAL DEBRIEFING

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MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

[redacted]

PREFACE

This preliminary transcript was made from voice tape recordings of the Gemini XI Flight Crew debriefing conducted September 16, 17 and 18, 1966 at the Crew Quarters, Cape Kennedy, Florida.

Although all the material contained in this transcript has been rough edited, the urgent need for preliminary transcript by mission analysis personnel precluded a final edit prior to its publication.

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1.0 COUNTDOWN

1.1 Crew Insertion

Conrad It went very smoothly on the morning we launched. We were on time and got right into the spacecraft.

Gordon Insertion was normal.

1.2 Communications

Conrad Communications were good and especially working on Press-to-Talk. We could hear everybody and I'm sure that with out noise they could hear better. Our recommendation is to stick with the 3 minutes and come on at T-3 with PTT.

Gordon Continuous interphone.

Conrad Have the Houston Cap Com check during the built-in hold and right when they pick up the count, we go to recorder continuous and Continuous Interphone PTT.

1.3 ECS

Conrad This was where we encountered our problem at crew insertion. When we closed the left and right hand hatches and started the cabin purge, we detected a leak around the left hatch. We went ahead and opened it and closed it again. We seem to have lost a little time there for some reason.

Gordon I was listening there you were not on the net.

Conrad No, I was not on the net.

Gordon There seemed to be some confusion as to what they had done and where they were going and therefore, the countdown was held

but all it really took was recycling the left hand hatch and things went along normally. There was some confusion as to what they had and whether it was still leaking after the second hatch closure. But it was not and we pressed on from there.

1.4 Crew station controls and displays

Gordon I noticed nothing abnormal about the switch settings.

Conrad The backup crew had it ready to go and we picked up with the Post-Insertion checklist and went right on with the count winding up with everything on as it should be. I didn't have any problems whatsoever.

1.5 Launch azimuth update

Gordon Launch azimuth update was on time, no abnormalities at all. T-3 update was on time and good.

Conrad Yes, T-3 went in, which is what you are worried about. But it went in and everything worked fine.

2.0 POWERED FLIGHT

2.1 Lift-off

Gordon No doubt in your mind, is there?

Conrad No doubt. The engine ignition is much quieter than you expect it to be. I picked up the count with Stony at 3, 2, 1--counted through zero and had myself calibrated to count up through 4 and right after I left 3, the bolts blew and we got lift-off, Clocks started, Comp light came on, and we were on our way.

2.2 Roll program

Conrad Roll program came in at 8.4 seconds just like it was supposed to. I might point out that our event timer is good enough if you go through it enough times and you're really watching for a roll program. You know exactly when it comes and there was a discrepancy. Houston gave us 9 seconds for roll program TC gave us 8.4, and I think TC was right.

Gordon Yes, I have 9 seconds from Houston and it was critical.

2.3 Pitch program

Conrad Pitch program came in just like it was supposed to and away we went.

2.4 ECS

Conrad The cabin sealed off right when it was supposed to. No problem. Little high--5.8. Suits were good--never collapsed around us or anything and we did go, of course, with Recirc open.

2.5 DCS updates

Gordon They were on time and called out on time.

2.6 Engine 1 operation

Conrad Engine 1 operation was perfect.

2.7 Engine 2 operation

Conrad Engine 2 operation was just like it was supposed to be--lights, and so forth.

2.8 BECO

Conrad We had BECO at 2:34 and I'll say this for it, it seemed that the whole staging sequence of the Engine 1 lights coming on, the fuel and oxidizer needles pegging to the top, and Stage 2 lights going out, all happened much faster than I've seen it in a simulation. The thing that impressed me the most was the Fuel and Oxidizer gages pegging to the top. Man, they took off like they had twice the spring force on them that they have in the simulator. Maybe it was just that I was spring-loaded to them.

2.9 Staging

Gordon The only thing that I noticed as far as staging is concerned was that it's quite an explosive change and I did see an orange flash. There wasn't any ball or anything, just an orange flash out the right-hand window.

Conrad Yeah, I saw it out the corner of my eye, but I was pretty well locked on the gages.

2.10 Engine 2 ignition

Conrad Engine 2 ignition was smooth. I also had the feeling that the acceleration on the g meter was just a little lower than you see in the simulator.

2.11 RGS initiate

Gordon I'd called out IGS initiate about 18 seconds after staging, which was nominal, and I recall you didn't get RGS until about 52 seconds.

Conrad Yes, I called it out either over the air or to Dick that we didn't get guidance at 2:48 and I expected to see it at 2:52. It came in at 2:52 and steered very smoothly.

2.12 Steering

Gordon The steering on the IGS needles was good all the way once it brought it in from staging. It took out the pitch and yaw right away and for the rest of the boosted flight there was no more than half to one degree variance all the way to the top.

2.13 Go/No Go

Conrad The Go/No Go came out of Houston a little early, which was fine, and we were GO, which was fine, and systems were fine.

2.14 Systems status

Gordon We had a number one section Delta P during the boosted flight. Two sections did not have a Delta P at all. As soon as we were inserted it steadied down and there was no light.

2.15 SECO

Conrad I thought SECO was about 1 second late. We were expecting it about 39 and I saw it about 40 or 41.

Gordon The only thing I noticed about SECO was the great amount of junk that came floating by the spacecraft.

Conrad I stayed on the gages; I never even looked out.

Gordon I just happened to notice it.

2.16 Communications

Conrad Communications were good all the way. You could hear Houston loud and clear. I had the impression by the way they were talking to us, that they were getting us loud and clear all the way through powered flight.

3.0 INSERTION

3.1 Post SECO

Conrad We'd really trained hard on this and I was in the process of doing my one potato, two potato. I came right on with the OAMS Control Power and I was looking at that. I came on with OAMS Control Power, went from RATE COMMAND to DIRECT, unstowed the Maneuver Controller, turned it on and about that time, as I was changing my attitude and needles to RATE, Dick called out the fact that we were pitching up slightly. This was in yaw. The booster left us with a slight pitchup, which actually turned out very well.

Gordon I read address 72 at insertion at 25649, which was a little bit below the nominal. We were expecting a nominal of 25745. When I read address 95, it came up 41 feet per second forward which agreed right with the IVI readings. We were on our way right there.

3.2 SECO plus 30 seconds

Conrad Okay, spacecraft separation and thrusting--I took a look at the IVI's. I don't remember the up-down or left-right, but before separation it was 41 feet per second forward, and I was tickled to death to see it.

Gordon The IVI readings after sep--you called out 39 forward and 1 left.

Conrad We had planned to separate at 6 minutes, right on the money, and I had trained to do it myself so Dick could be reading computer. I normally led with the Maneuver Controller and then hit the Sep Spacecraft Button. I think that I was about 1 second behind. I think I hit the the Maneuver Controller about 6:01 and Spacecraft Sep right afterwards. There was the big bang at separation and I noticed the debris, and we were on our way. There was no doubt about it. We got a green Sep Spacecraft Light. I only put 2 feet on and I started rolling right away using the needles to zero yaw and the proper pitch down on the FDI needle, and it worked perfectly. Those needles were steady as a rock. We rolled right upright and there were the beautiful IVI readings--39 forward and 1 left, and, boy, we were on our way. I started firing right away and attitude rates and damping is no problem at all. It's really beautiful. I burned out the forward but I just didn't even bother with the 1 foot. I was going to pick it up right at the end. Before I finished burning, Dick came up with 15 seconds down.

Gordon Now, let me go back to address 85. I normally read that at 6:10, but I missed it and picked it up at 6:20. Address 85 read 11.63 and the nominal 85 reading was 11.76 which meant that we were not quite as far downrange as we should have been. I went into the Insertion Correction charts right away and with that, coupled with the address 94, I calculated an Ñ

desired of -5. Our $\dot{R}$ actual out of 94 was zero. These two corrections gave us a -5 feet down that we needed, so we applied a down thrust for 15 seconds.

Conrad Well, let's see. We did notice the debris at separation. I got a loud and clear GO for M=1. No strain. We were burning when we got it. We expected to be burning when we got it, and I didn't expect to hear anything else after having looked at the IVI's. I knew we were on the money.

Gordon From the Rendezvous charts my $\dot{R}_D$ was -5 and with the correction for time to relative apogee with an $\dot{R}_D$ for zero downrange error, it gave me a -15, which converted to a +53 seconds added to the normal apogee time, which we got from the ground before lift-off. 5206 gave us a relative time to apogee of 52-59. As we've already mentioned, the radial velocity correction was a 15 second down burn. Out-of-plane, address 69, came up and was positive 89, which converted to the second Delta Z correction and GET of burn. From the onboard computations, the out-of-plane burn was 29+40 and it calculated out to be 3 feet to the left. This is the one we went with. The ground was unable to give us an out-of-plane correction at that time. Pete, I have nothing on communications. It was good throughout.

Conrad Yes, I remember CAP COM called up the $\dot{R}$ a couple of times, didn't he? I guess we didn't answer him right away. He

wanted to know for sure if we got that. We got it. I don't remember whether we answered or not, but it was close enough, so we could press on.

Gordon Module III loading after the insertion corrections was on time. It was the first thing I did after we completed the insertion corrections. Module III went in automatically without verification. We used the Address 01 and it went in with no problem.

3.3 Insertion checklist

Conrad This is again another one potato, two potato routine that we had just practiced over and over and over again suited in the simulator and it really paid. As soon as the burn was completed I went into my routine on my side and Dick went into his. The first thing I did was switch my FDM from COMPUTER PLAT, and the needles were in PLAT/ATT. I right away centered the yaw, centered the roll, took the pitch to what I knew it should be for about 8 minutes, and that's right where we were. We were right on schedule. At about $8\frac{1}{2}$ minutes we were through burning. At that time I reached up, jettisoned the fairings and came right back down again. As soon as I saw I had a scanner lock, I switched the platform from FREE to SEF, pulsed it just a little bit to see that everything was going all right, flipped it into RATE Mode, and it pitched up just about 11 degrees or so and started torquing the platform right back in pitch. We were in the SEF/PLAT Mode, so that we were aligning

right away. In the meantime, Dick had already gotten the computer program and I was beginning to see the IVI's count up. Module III was going right in there. Then we had a regular Insertion checklist which I worked on my own and Dick worked on his. Then we read them back to each other. After I got into PLAT/ATT I was right back on at Boost Insert-SAFE, four Retro Rocket Squibs-SAFE, Maneuver Controller-OFF and stowed--and we got the D-ring stowed and we went right into the checklist. Dick read it to me and we did it. We got it all done and it was done on time. We started at 10 minutes and we started right into our unstowage.

Gordon One thing I would like to add to the insertion--I did get from the ground that we were late on lift-off by one half a second. This would normally mean a correction, a radial burn down of 3 feet, but I got the callout that we had a late lift-off of about a half a second after all the burns were done, and consequently we didn't apply this small correction at all.

Conrad It may have accounted for the fact that we were behind a little bit.

Gordon It could have.

Conrad We were behind just a tad at relative apogee. Really, it was immaterial at that point.

4.0 ORBITAL OPERATIONS

Conrad There was no out-of-plane maneuver update. The ground could not give us one and we called back and told them we were going on our own, which was 3 feet out-of-plane to the left, at 29:40. At 25 minutes I had one little funny there. I came on with the radar and I got a Lock light for a little while, long enough to make me think I had it, and then it broke. I went back to standby and started doing something else. I came on with the radar again as I pitched up and then I had solid lock. I never lost it again until later on, which we'll get into.

Gordon As far as Agena Acq time is concerned -- when Pete called out that he had it, I hit Address 36 and I got 61.45 out of that. I may have been a little bit late.

Conrad That's visual.

Gordon I had him earlier than that visually and Dick didn't get to it right away.

Gordon But I did read out 61.45 miles

Conrad That's after 29 minutes.

Gordon We've already talked about that 29 minute out-of-plane correction.

Conrad We burned the 3 feet. Attitudes and rates were fine.

Gordon Addresses 23, 24 and 92 were all verified. No problem. Set up and verified well ahead of schedule.

Conrad Okay, we got our TPI backup. It came through loud and clear at Tananarive.

Gordon The TPI backup from the ground -- GET of burn was 49 + 43. Address 25 was 01396, Address 26 was 00170, Address 27 was 90066, X_{RA} was 18.9, Y_{RA} was -8.6, range at 45 was 22.7 miles and $\dot{R}$ at 45 was 107.

Conrad They were all good. Okay, it's a good thing John called out Radiator to FLOW and Evap to NORMAL because we were hustling and that's why we had him call it out. By golly, he called them and we had not switched it and, boy, we put them in right there and got that out of the way.

Gordon Start Comp was on time at 45:30, or on our clock 20:30 after a new clock start time. I might mention what that was at this point.

Conrad Yes, because of the late clock-start time we got into rendezvous at about three minutes elapsed time our time.

Gordon Start clock time for our computations at TPI was 27 + 29 after lift-off.

Conrad Okay, now let me just say something right there. We had the Agena visually in the daylight. We picked up the flashing lights when we went into the darkness. I had the reticle up and on and they were within a half a degree of radar boresight. I was really impressed. We had solid radar needles. There was no doubt about it. I could track either on radar needles or

optically, and radar needles were solid. I will say that I had training to use optical tracking and everytime Dick wanted a reading, because the optical and the radar agreed so well, I went ahead and tracked optically. It was a good thing as I will get to later that we had trained to do this too.

Gordon Okay, let's go into the TPI burn. We have already covered the backup TPI from the ground at Tananarive. After all was said and done, it came out this way: Ground was 139.6 forward, 17 down, and 6.6 left. The closed loop solution was 140 forward, 27 down, and 5 left. Onboard backup was 140 forward, 22 down, and 4 left.

Conrad We were the happiest guys in the whole world.

Gordon We were shaking hands at that point because we felt at that time that we could have burned any one of them and it would have done the job.

Conrad So, obviously, we went closed loop.

Gordon The start time for this calculation, when it was all applied in a single vector, was calculated to be 142 feet forward at -8 degrees on the ball. We started on time at 22:24 on our clock restart. The length of burn was nominal. We quit at 25:36. I was impressed with this fact that the backup times were the same as the computer times, within a second of each other.

Conrad Yes, hit it right on the money.

Conrad We burned in Rate Command on the computer Attitude Mode and it was just no strain at all. We just burned it out in a single burn with the aft firing thrusters like Gang Busters.

Gordon After TPI PQI onboard was 70 percent. Pete called it out. I made a mental note of it. I didn't write it down anywhere but --

Conrad I thought it was a little low considering that we were as nominal as were, compared to what we had seen in the simulator. When we were nominal like that in the simulator, even with a little Delta V for out-of-plane thrown in, usually we were around 78 or 80 percent. I was a little surprised to see it about 10 percent down, but I wasn't worried.

Gordon Okay, the 49:49, 16-1, was received at Carnarvon and all we did was acknowledge.

Conrad Right. We told them we had a good TPI burn closed loop. We passed them all the solutions, as a matter of fact, to keep everybody happy.

Let me say one thing here. I did use my red lines on my little M=1 Checklist. They hit the really critical items. I made sure Dick had Orb Rate compensate in at 45 minutes. I made sure that Dick had 20 00100 in when we switched to rendezvous. And I made sure that it came out after TPI. All I did was ask Dick. He hit them all but we were double checking each other all the way through.

Gordon At our clock time of 32 minutes, which was a total elapsed time of approximately 57, Address 96 was 34.7 degrees.

Conrad And that was done with optical track.

Gordon Okay, at the next check point, or the first correction, the first vernier, Address 96 was 37.6. Address 36, which is range, was 11.79, and range rate, Address 35 was 87. At the next one Address 96 was 41.3. That was all we needed for computed backup first Midcourse correction. I got 3 aft and 6 up on that correction. The closed loop correction was 1 forward, 4 up, and 4 right. We burned the closed loop. The Delta V of the burn was as I just mentioned. The GET of the burn was right after that calculation, at about 36 minutes on our clock restart.

Conrad That was done on the green Comp Light green which is 36 minutes. It was right on schedule.

Gordon Okay, the second correction - we're probably going to talk about that one at great length, because this is where we started getting into trouble. Pete, do you have to go ahead with the radar bit on this one?

Conrad I was watching the time pretty close and we were coming up at about 41 or 42 minutes, I'm not exactly sure what the time correlation is. Maybe you remember, Dick, but I was looking for 40 and Comp Light to go from green to out, indicating that we were going to grab the seven radar data points.

I had about 2 minutes to go when the light went off and I was switching my scan from tracking out the window to make sure the radar needles stayed centered, and I noticed the radar needles started to move off fairly rapidly. It pitched up in elevation and moved right in azimuth indicating that the target was moving up and to the right. I instinctively started to pulse to the radar needles, but I put my scan right back to the sight and I was tracking off. Right then and there I thought something was funny, so I went back and centered it optically and the radar needles continued off to where they indicated about 3 degrees pitch up and 3 degrees yaw right and I said something to you right away, and you said, "Did you forget to switch the antennas?"

Gordon I think I had switched them, but I sent 260 again because I knew we should have been on the spiral. I can't remember whether I sent it earlier. We were keyed to send it at 30 degrees elevation. Now, I know I didn't send it for the first correction. But at that time I reached down and I sent 260 which is the spiral antenna and got no MAP.

Conrad That was the second glitch, in that we had a little quick discussion and Dick sent it a couple times and I asked him to send dipole to see if he got a MAP. The thing that was funny here was the radar lock on was solid the whole time; the lockon light stayed on. We should have gotten a MAP indicating

that we had switched from dipole to spiral. Now we'll talk more about their lack of MAP light. This particular problem plagued us throughout the flight on the Agena. The next sort of funny, though was the azimuth came back in and the yaw came back in and tracked through and went out yaw 3 degrees left. The elevation came in and the azimuth came back to the center and tracked 3 degrees to the left. Now at that point, I said the closed loop is going to be wrong; we've missed the radar data points. They're not good because the Comp Light had gone out and I knew that it had data points that were at least 3 degrees off in both azimuth and elevation. I just said, "I'm tracking them optically and you go ahead. I'm going to burn your closed loop solution. We had to make a decision right there. We had it wired. I really wasn't too concerned if we didn't burn anything. I figured we'd get him.

Gordon Here's what it came up for this one 96 was 64.6 this was the optical tracking now 64.6 degrees elevation. The next data point -- Address 96 was 69.3, the range was 3.63, and the range rate was 49 feet per second. The other angle, Address 96, was 74.3. I got a backup solution of 2 feet forward and 1 up.

Conrad At this point my range - analog range - was very steady. My analog range rate was oscillating about the proper range rate in the order of 15 to 20 feet plus or minus. Now, apparently the

computer range rate was good because Dick read the $\dot{R}$ that he read out of the computer and if it hadn't been good $\dot{R}$ information we'd have gotten outgarbage.. We believed it and made that back up calculation on it. Well, as far as the closed loop solution is concerned here, it came up with 1 foot forward and 3 up and those two points agreed exactly with the backup, as far a as 2 feet forward and 1 up. This is excellent correlation between the two. The only anomaly in this correction was that the closed loop came up with 11 feet to the right. Now we knew this was wrong because of the way the needles were looking. You could tell we didn't have any out-of-plane. We were sitting on the very edge of the bellyband, and I knew that we might have just a tad in there, but there wasn't any 11 feet right and I wasn't about to burn it.

Gordon So, consequently, we burned the backup solution of 2 feet forward and 1 up.

Conrad And, boy, right after that things really started to happen.

Gordon Delta V of the burn was about 2 feet forward and 1 up and this was applied at 48 minutes on the clock start and as far as the attitude rates during burn, the control mode was the same as before. The computer was switched to NAV Mode right after the burn was completed. Addresses 25, 26, and 27 were zeroed, and we pushed Start Comp. We went inertial needles one time for the rest of the braking maneuver.

Conrad Things started happening. We were about 90 degrees. We were directly underneath him and he burned into daylight.

Gordon That was a surprise, the brilliance of this target. We were both scrambling for sunglasses.

Conrad I never got mine on. I never got mine on, and I wish I had, because it did cause me a bit of confusion because I could hardly see my FDI. When I looked back in I couldn't see the attitude indicator. I was really hanging on those inertial needles. But I had enough track on the inertial needles to know that the line of sight rates were practically nothing.

Gordon So, consequently, we didn't follow any certain braking maneuver. Pete was surprised that he could see the running lights on the Agena, and just by visual observation we thought we were a lot closer than we were. I was reading Addresses 36 and 55 to him all the time.

Conrad I saw the running lights just before he broke into daylight, but I could see the flashing light obviously much closer, and I could see the two belly running lights very clearly, and then he burned into daylight. Now let me go back to the analog range. The analog range was oscillating and so was the range rate, but they were apparently oscillating approximately around the right magnitude. At this point we were right around 50 feet per second. I told Dick I was going to pull off some, and I did, and I think I pulled it off to about 40 feet per second.

And then the braking just went smoothly. I was a little bit concerned with our closing rate so when I picked up a little out-of-plane on him, I just let it drift a little out-of-plane and then held him off in the sight because I thought if I whifferdill I don't want to hit him. But the braking worked out real good. We just really slid in there.

Gordon While Pete was maintaining visual track, I was reading Addresses 36 and 35, and I felt they were good down to, probably 500 feet, when they also quit at this time. I had nothing in between that, so the last portion of the braking was really all done visually. The last bit of information I remember having was Address 36 for something like 180 feet. Then the last thing I saw on the ball was, we were sliding through 105 degrees just a little bit out in front of him, just where we wanted to be. I let us drift a little bit to the right so that we came up on the right side of him and we did a three dimensional where we slid up the right side, stopped level with him, rolled the spacecraft up and did, around in front of him, a 180 to where we wound up sitting right up in front of the docking cone. Station keeping was a piece of cake. We drove right up to the docking cone and we stayed in Rate Command most of the time. I found that if I just kept my hand off it and bleeped the thrusters that things were going good, and I may even have switched to Pulse a time or two. I don't remember now; that will be on the tapes. But

anyway, we just slid up in front of the docking cone, we were reading the lights, and we were having a discussion with Hawaii. We picked up Houston and we got a GO for docking. The Agena was in FC-1; we drove it right in there. There's nothing to it. And I think the biggest surprise was the latch engagement; we drove right in there and it grabbed us in and rigidized. Agena status display was normal. Dick went through as far as the Agena command went. Check the Arm-Stop light. The Agena never moved as far as I could tell even in FC-1. We were wandering a little bit because I thing we showed about 8 degrees or something like that off of the pole, and I noticed that it wandered a little bit. I think I asked you the question, "Are we in FC-1?" Now, let me stop right there. When I opened my left stowage box back at the beginning of insertion, I planned to take out an extra voice tape, and I planned to take out the Pentax light meter. I also planned to turn on the 16 millimeter camera at the end of the third correction, but due to radar funny at the third correction I completely forgot to turn on the camera. But I got it later on sometime - I think I was pretty close to him, probably 3 or 4 thousand feet before I turned the camera on. I finally remembered it. I never did get that light meter out nor did I get the extra voice tape out because there was a towel in front of the light meter, and I couldn't find it right away and I didn't want to get wrapped around the axle.

I figured we had good camera settings. The other anomaly was that at one hour into the rendezvous we never did get the tape running light, so we have only the first hour of the rendezvous on a tape.

Conrad If I remember right we were very close to being right on time.

Gordon I think it was 1:34 that we docked. And as far as D-3 is concerned, that burn was made at 1 + 55 + 10. Prop quantity was 55 percent. O_2 and H_2 were off scale high. We burned for a Delta T of 25 seconds. Pushed Start Comp at 18 seconds.

Gordon Address 80, at the end of 25, was minus 0029. Propellant quantity at the end of this burn was 53 percent. Water gun reading was 450. As an added highlight I read 81 and 82. 81 was 00001. 82 was 00005. That takes care of D-5. The undocking was nominally done with the flight plan. I think we were on time with that one.

Conrad The undock was phenomenal too.

Gordon We used command 220 for this one. When the docking cone is unrigidized and extended the latch is released. The reaction of the docking cone unrigidizing just pushed the spacecraft free, and we didn't have to touch a thing.

Conrad We drifted out at about a quarter or a half a foot per second. I never touched the controls or anything. It pushed us right straight out from the Agena. It was smooth and unbelievable. We zapped at 2:10 right into the S-26. We had the black and white film loaded in the camera. I double checked the proper camera settings, and we did Mode B, Sequence 01 out-of-plane in 10 minutes, so I had Dick turn the Agena tape recorder off, and I said we'd press right into it. We went right back in to the second sequence and finished it all in 20 minutes of tape and dumped at Hawaii, didn't we? We asked them if we could do it and it worked out fine.

Gordon We did them both, and I think the tape was dumped at Carnarvon. Right.

Conrad Okay, we dumped both of them at Carnarvon. That was it.

Gordon And after that dump we went right in and did Mode B, Sequence 03 on time. And we had that done before Hawaii.

Conrad That Mode B, Sequence 03 included the nuzzle and, boy, we stuck the nose right in there within, I'd estimate 18 inches, of the sensor. And I was sitting with my eyeballs right next to the docking cone.

Gordon Let's see, the next docking at 3:25, was done by the pilot. It looked just like the first one. FC-1 again. No problem maintaining position. It was in RATE COMMAND for the final docking and the contact velocity was, probably, three quarters of a foot per second. The undocking--here's where we had a little anomaly. We didn't notice this till later, however. But we used the hardline connection for this undocking. Used the unrigidize switch and went to the UNRIGIDIZE position. It did undock and it just pushed us out like it did before. We'll come back to this one. The reason it's kind of a funny is that when we came back to dock after the S-26 Mode A, the linear one, which was also done on time--when we came back to dock in darkness, for the third docking, we did not have a dock light. We looked the cone over and it appeared to us that the latches were not all the way extended. So I sent 220 and the docking---

Conrad And you didn't get a MAP.

Gordon We didn't get a MAP. That's correct.

Conrad But the dock light went to dock.

Gordon That's right.

Conrad Neither the dock nor the rigidized lights were on. When we sent the signal we didn't get a MAP, and we didn't see the cone move, but apparently the latches extended and the dock light came green.

Gordon So, we docked.

Conrad Yes. We went ahead and docked.

Gordon And we didn't use the hardline connection any more after that. We always used Command 220 to undock.

Conrad Everytime we docked after we went through an automatic docking sequence, you always hit the rigid/dock switch.

Gordon That's correct. Okay, for the first thrill of a lifetime this was the out-of-plane PPS calibration burn. Let me just look at that for the updates. This was a plane change. GET of 4 plus 28 plus 52, Delta V of 104.4, duration 1 plus 28. Address 27 was -- I got it smeared in my notes here but I think it was 0104.4 - and we got that in on time. We went through the procedures book for our PPS translation out-of-plane. Times and procedures went as expected, and then the surprise of your life was when that PPS engine ignited.

Conrad Well, let's add something there. There were a couple of little things that we hadn't expected to see. At 1 minute and

22 seconds there's some sequence in there--I guess, the bi-propellant valve or something gets pressurized, and there's a little rumble that goes on in the Agena, and it spits out something, out the left side.

Gordon I agree. It was very noticeable, before the PPS burn.

Conrad It happens 1 minute and 22 seconds and then you go through 1:24 and nothing happens and, boy, at 1:25, kapowee! It really lit up.

Gordon Okay, it burned on time and it had a VM shutdown. The Engine Arm/Stop switch was recycled on time to STOP position and then all of the post-burn commands were sent.

Conrad Let's mention the next thing. I had my rate needles on RATE, and all I saw was about 2 degrees per second, but I noticed that the ball wandered out pretty good in attitude, in yaw.

Gordon I didn't notice this on the needles for that particular burn. Maybe I didn't even see the needles this time, for this short duration burn, because this thing no more ignited than it was shut off. I still had my hand on the Engine Stop Switch. It was definitely a VM shutdown. Pete called to me and I flipped the Engine Switch to the STOP position.

Conrad Okay, 05:05:00. S-29 experiment. Right on schedule.

Gordon We didn't have S-29, remember?

Conrad Yes, but we substituted a couple of other things for it. Gegenschein and two comet photographs rather than the libration point.

Gordon Yes.

Conrad Which required a little extra maneuvering, but, we did it just as we planned to do S-29. We pointed at the Gegenschein, went inertial on the Agena, and took the photographs as advertised in the back of our book. I think they were 1 minute, weren't they?

Gordon They were 1 minute for the Gegenschein and a 5 second photo for the comet, which we used the pointing commands for the change. Pointing commands for the comet nothing more than yaw 145 degrees and pitch up 16 degrees. And the Gegen-schein photographs were done at a plus 17 degree pitchup at sunset, and this was done on the S-26 magazine, picture numbers 47, 46, 45 and 44; and the comet was 43 to 39. S-29 was not done - that was to photograph the libration points - due to the delay in launch from Friday to Monday. They were in the Milky Way so that experiment was scrubbed.

Conrad At 06:40 we gave a crew status report. That's written down in the flight plan.

Gordon It wasn't done until later. But there was one. Crew status

Gordon reports were changed, and it was given at that time.

Conrad Well, let me just say something right there. We used this little summary flight plan in which we had written some of our own cues, and it really paid. We had our little unstowage cues and everything else. We had practiced enough of this in the simulator, suited with the equipment, that we went right by the numbers. We stayed right on it and it was tough. We had to keep going, going, going. As long as we hustled and stuck with our flight plan, it came out like it was supposed to.

Gordon PLA updates and fuel cell purges. Really nothing to say. They were nominal in all respects.

Conrad We wanted to really start conserving fuel, so at 06:45:00 when Dick did his night docking, that's all we did.

Gordon We each did a daylight docking and a night docking. All four were accomplished with the Agena in FC-1.

Conrad Right. We didn't want to waste attitude gas going to FC-6. We knew we could dock okay in FC-6 so we used FC-1, the cheap mode.

Gordon Sleep periods and eat periods. What can you say about those? We ate when we felt like we needed it. We slept as much as we could, and when we woke up we ate as much as we felt we needed again.

Conrad Yes, we drank all the time, too.

Gordon We drank water whenever we could.

Conrad Crew status reports are down here somewhere.

Gordon We had one at 7:40; then there was a big long sleep period, and we picked it up at breakfast. We might add, for the first sleep period, we slept on the Agena - the Agena in FC-1, TDA forward, or spacecraft BEF. Now, I guess we go right into the next one. Platform alignment - we always went to FC-2, and caged the platform on the Agena. And that was all there was

Conrad Well, let's say one thing, you really did have to let it gyrocompass a little bit in FC-2 because it wandered around about 10 degrees, not so much in pitch. It held pitch real good, but it seemed to wander in yaw. It wasn't too much in roll, but it would roll al the time. It was about 2 or 3 degrees.

Conrad In FC-1.

Gordon Yes, the biggest, the most noticeable one was yaw, in FC-1.

Conrad But as soon as you went to FC-2 the Agena stabilized right down, and it was solid as a rock and caged the platform S-11 experiment was the next thing on the list. We did North/South airglow, Sequence 02 with no particular problem. The S-11 bracket for this flight was a new one in which some of the old pitch and yaw was taken out, and as for the head position for the Pilot in sighting on the horizon, it was confortable. There was no problem in controlling the Agena/ spacecraft combination on the horizon for those pictures. It was really a simple operation to do.

Conrad Yes, it depended on how we wanted to arc around. We used Pulse or Direct. The Spacecraft/Agena combination flew beautifully in Direct. If you wanted to get somewhere and crank it up to a degree or a degree and a half or 2 degrees per second to get there, well, give her a shot in Direct and away you would go. There is one thing we forgot to mention when we were talking about this, and that was my up/down thruster braking. It was a little soft.

Somewhere in there we picked up a number eight where did we pick that up?

Gordon I think that was while we were docked. When we went to yaw we would get a roll right out of it.

Conrad Yes, I wrote that down somewhere. It was before EVA because I lost the card I wrote it down on on the EVA.

Gordon Well, let's see, Apollo sump tank photographs. The Apollo sump tank photographs were all done as per the procedure book. Exactly as written, and there was no particular problem in doing these maneuvers on the Agena and it went according to the procedure book. We did Mode A which was the high/low energy slosh test. We did Mode B which was side tank slosh test, and I might add Mode C was done in a minimum impulse burn and Mode B on the first docking. So those are all taken care of.

Conrad PLA updates always came in on time when scheduled, and we

copied them, and if somebody wants to check them, they are all in the book.

Gordon EVA sunset. I don't recall that. We used sunrise plus 10 minutes.

Conrad Yes, we went through a little ditty on that. What we were looking for was EVA sunrise time plus 10 minutes, and then we went through a couple of lightning-like computations, and had the ground correct them, so that we could roll the Agena to the right inertial attitude and all that stuff.

Gordon We did do a fuel cell purge while we were waiting to go EVA after some of the prep was done.

Conrad We skipped the one that was scheduled there, and just decided that we would do it as late as possible in the EVA prep.

Gordon 30-1 GO/NO/GO was received, and I guess we want to talk about the EVA prep a little bit.

Conrad Yes, Okay, we are off and running. We started our EVA prep right on schedule, and this is probably our first mistake, because we had practiced that EVA prep so many times that we had all the gear out and running not more than 45 or 50 minutes after we started this long 3-hour EVA prep period. We got the ELSS out, hooked it up, and started running a flow check and everything, then started dumping the cabin. The only way we could keep Dick cool was by running the ELSS, and then

we got into this ditty of running the heater for a long time. The ELSS was dumping oxygen so fast and we were dumping it out of the cabin so fast that the manual heater couldn't keep up with it. We had to do something, so we reconnected him to the suit loop and shut off the ELSS and got our oxygen quantity straightened out again.

Gordon I concur on this EVA prep. We were allowing ourselves 4 hours and all that did was get us in trouble.

Conrad Yes, it sure did, because we were ready to go so far before the EVA prep. Actually, we discussed asking them to go a rev early. We weren't all the way through it at that point where we could make a decision. I kind of wish now that we had made the decision to ask to go a rev early, because we were really ready to go. Then we just had to sit there with all this junk on.

Gordon Well, I think as far as the EVA prep was concerned, where I ran into trouble on the umbilical EVA was getting that EVA visor on.

Conrad Boy, I'll say.

Gordon I just worked my tail off getting that darn EVA visor on with the suit fully pressurized. I simply couldn't do it.

Conrad You have got to realize that I am strapped in with a suit integrity check pulled, all buttoned up, with gloves on, and when he closes his visor and locks it and pressurizes there

is no way he can do it. And I got it connected on the left side of the helmet, but I couldn't reach him to get it on the right side and boy, oh, boy, in zero-g he was up against the ceiling in a pressurized suit, and he worked and worked some 35 minutes on and off after he had sat there with all this gear on for an hour and a half. He got all ready to go, and he couldn't get it. I kept saying, maybe he ought to go with it half undone and over his face, and that really wasn't a good idea, and so finally after he rested, he gave it his all but maximum effort as we were coming up on the time right at the end, and it took him about 5 minutes, and he got it. But he was already winded. He was already hot.

Gordon Yes, I was fairly saturated with sweat because the spacecraft was not depressurized, and I wasn't getting any cooling out the ELSS. It was really a bad situation. I don't think it was the inability to put that on. I had trouble with that EVA visor later on even in a soft suit. The thing just would not fit right and kept getting inside the fail bar and was terrible. I even had my helmet off one time and tried to put it on and the fittings were so tight that I could hardly get it on without any gloves on - with my bare hands.

Conrad It is amazing that he got it on pressurized. It was a supreme effort, and that is the trouble. It was a supreme effort and you were tired before you ever started. But we got the EVA and

depressurized right on schedule. We had the Agena inertial at the right attitude, and the hatch popped open, and then the fun began.

Gordon Well, the thing we noticed right off the bat was that I had a tendency to float up and out of the cockpit, and Pete had to continually pull me down.

Conrad Yes, that is something we hadn't planned on. I had to hold him all the time.

Gordon I think this is caused by the flow out the pressure valve at the bottom of the ELSS. There is enough outflow of gas out that valve that you actually develop a Delta V in a zero-g environment. This problem was not too bad once I stood in the seat. Extending the handrail was no problem. I retrieved the S-9 package. I released the handle, put on the tether, and I had a little trouble pulling it out of the box, but when I got the handle all the way over, it did come out of the box without any trouble, and I handed it in to Pete. Okay, the next thing to do is install the EVA camera.

Conrad Well, wait a minute, let's carry it all the way through. You handed the S-9 in to me and I ththered it as planned and shoved it down between my legs. You went back to installing the camera.

Gordon Yes, and this is where I had a little trouble. The washer was on the camera, and I could not readily install the camera in

the receptacle. I had to let Pete let me go up real high so I got my body above the camera and had to push down on it quite hard to get the camera in the receptacle. It did go in and it did lock in place. But I did notice on that receptacle, once the camera was installed and pointing forward, that later on when I came back and changed it to D-16 position, I couldn't rotate it at all. I had to take the camera completely out of the bracket and reinstall it in the D-16 position.

Conrad That is where we got another anomaly also. Because while he was doing this, he apparently hit the strike stop button on the camera and it ran for a while. I finally noticed that the run light was on inside and knew I hadn't pushed the button and I couldn't figure out how the camera got on. We had a little discussion about that while he was outside.

Gordon Okay, as far as the umbilical EVA is concerned, other than the work in the hatch, when I first attempted to go up to the Agena spacecraft tether, I tried to push off of the hatch and the hatch holding device, and using the technique that Gene Cernan had suggested, I tried to grab hold of the RCS thrusters as a mid-point before I got to the docking bar. Well, the whole crux of this problem was when I pushed off the thruster, I floated up above the TDA and went above it and missed completely, and Pete hauled me back in with the umbilical. I tried it again and did manage to grab the TDA and the handholds.

Conrad Well, it was by the skin of your little finger you got it though, because you were arcing up as you went by.

Gordon Well, we did get it, and I tried to get myself in position on the spacecraft, as I had done before. I wanted to use my legs inside the docking cone to help wedge myself in there so that I could have both hands free. But, unfortunately, this was not the case. It didn't happen this way. I had to use my left hand and hang on to the handhold on the left side and do all the work and attaching this tether with my right hand. And this was a monumental task as far as I was concerned.

Conrad Yes, now let's stop right there. I had watched you do this very task in the zero-g airplane. You could get in that zero-g airplane and whistle up to that thing and get yourself parked where you were completely astride it and pull yourself down, but you never could do that up there. You were off the thing, and you never got your legs as far forward in the TDA as you did in the zero-g airplane. It just wasn't quite the same. And there you were. I kept seeing you working away, having to hang on with your left hand.

Gordon Tethering was difficult; it was so hard to maintain my position and work on this thing, that I let my feet float up and out of there and use one of the handholds and one hand on the clamp. I had an awful lot of trouble screwing this clamp down. Every time I tried to turn it, it would swivel on the docking bar.

Conrad Several times before you let go, it did this. It was getting obvious that you were running out of steam and I think that I asked you to rest a couple times, and you did. In 2 or 3 minute periods, you sat there and blurped. But it was an effort to stay where you were with your feet in there, and then you'd float up and give a twist, and the darn thing would spin around and you would hang on for dear life with one hand.

Gordon Anyhow , I finally got the clamp on to my satisfaction. The tether was in place. There was one test remaining to do up there, and that was to install the mirror. I took one tug at the cover that was over that mirror, and it didn't give an inch. I just gave it up and said forget it. I came back to the hatch.

Conrad That was quite a job getting you back to the hatch. You asked me to do something a couple of times. I gave you a very light tug and you started to take off up and away from the hatch.

Gordon Well, we did get back to the hatch, and by this time I was pretty exhausted. We stood there for a long time trying to

catch up with everything, and the only thing that was really wrong was that I was having trouble with my right eye. This was merely a matter of sweat in my eye, and I was having trouble seeing out of it. It was actual sweat, and it was stinging my eye. I was completely exhausted at the time. I wanted to get back to that adapter very badly for the nightside pass, but we talked about this and made the decision to ingress rather than leave me out there for the nightside pass.

Conrad This was the problem. It was obvious that Dick had expended a great deal of energy, and I wasn't sure how much more he could expend. I was afraid that if it was as difficult for him to get to the front as it was to get into the back, he was going to be completely exhausted again, and he'd ride the nightside pass out. We had agreed that he wasn't going to waste his energy getting the D-16 because he'd never get into the back. So here was a question of getting to the back and riding out the nightside pass there. I was afraid that he would get tired getting back there and get tired a third time trying to get those cameras out of there and everything and get back to the spacecraft. We had gone through the film change and everything and we tried to rest. At this point, we had been about 35 - 40 minutes into the EVA and this problem with his eye was that there was no evaporation of water or sweat.

Gordon As far as the ELSS operation was concerned, as far as cooling

down the body temperature, it was probably satisfactory. I did go to high flow and it seemed to be working properly but, as a matter of fact I really put out a lot of energy and was really beat at this time. I could see with no problem. It was just a matter of irritation in one eye, it had to get better, but the decision was made to ingress. In retrospect after we had done this and talked about it, I think there was only one thing we could have more seriously discussed. That was to leave me standing in the hatch for that nightside pass and let me take a look at ourselves the next daybreak and then go back to the adapter. I really hated to give up that adapter work. I felt that probably the most important part of the umbilical EVA was to get back in the adapter and get that equipment out and evaluate those foot restraints. I personally feel very badly about not being able to do this.

Conrad However, we had a decision to make - either to get back in or stay out there. I was concerned because he couldn't see out of one eye, and it had not improved in the 5 or 6 or 7 minutes that he had rested, and he was still breathing pretty darn hard.

Gordon Yes, no doubt about it, I was tired.

Conrad I was happy with the decision, I still stick with it. I think that if we went back to do that whole EVA operation over again, we could probably get it all done, with what we know now. We

had practiced this, and we just didn't have trouble with the gear. It is just that we did four times the amount of work to do the same task that you had done many times before in both the zero-g airplane and in practice at one g.

Gordon Gene Cernan warned me about this and I took it to heart. I knew it was going to be harder, but I had no idea of the magnitude. The task itself was a relatively simple task to do, but as it turned out, it was monumental. I think the results of the tether evaluation bear some fruit that would be as good as umbilical EVA.

Conrad We handled a tremendous amount of clap trap in the cockpit; John mentioned it. We were a little better off with the amount of tether, but otherwise, we had the same amount of gear. We took a fair amount of time in the ingress operation. We went slowly and surely on it, and it worked out fine. We got the hatch closed and started to repress before we went into darkness. And that's why I wanted to make sure that we did the ingress in the daytime with all the bits and pieces and tethers we had floating around. We should have film of all our work on the flight, both from the outside camera and the inside camera.

Gordon The ingress was no problem. I would venture to say the ingress was the least amount of work that I did.

Conrad Seems to me I took a couple of Hasselblad shots of you standing

in the hatch with all the clap trap floating around.

Gordon The ingress itself was the easiest task of all the umbilical EVA. I got down in the seat and the hatch came closed. I pulled it down myself...

Conrad Banged the old hatch right down to the first latch on the ratchet and dogged it in.

Gordon The Post Ingress procedure was no problem. We just sat there and rested and collected all this stuff and a little while later we-

Conrad We practiced this enough times so that we knew exactly how to handle it and what went where. We had the things marked correctly and it went very well.

Gordon During the equipment jettison and the opening of the hatch, I was strapped in the seat. I went back on the ship's ECS system to get another suit integrity check, opened the hatch, and by being in the seat, I was able to get rid of the ELSS and the great huge duffle bag that we had full of clap trap that we could get rid of. The equipment jettison was no problem at all, and I was able to pull the hatch down while strapped in the seat.

Conrad We jettisoned it out of plane retrograde, slightly up.

Gordon All the fuel cell purges went very nominally. During fuel cell purges at the end of the mission, we did get a Hydrogen Delta P light. Power down was according to the

procedure, no anomalies.

Conrad We unstowed the dosimeter, we kept very close track of how our stowage went, kept it in hand at all times. We were always in the proper configuration. 28:37 crew status report; I know we passed them whenever we were asked for them. We tried to be ready for them in advance. The dosimeter readings were 9 events and just a smidgen over .1 Rad. I'm not sure whether that was zero at the start of the scale. I'm not sure whether we were getting that much or not.

Conrad We took a good rest after the EVA and went back on the flight plan at 28 hours.

Gordon The rest of the day's activities as far as the eat period and the S-11 dock, sequence zero one was done, sunset 29 + 20 into the mission. Sleep period was nominal; we probably both got the best sleep that night than we did during the rest of the flight.

Conrad We slept 5 or 6 hours-solid.

Gordon S-4 Neurospora activation was no problem. I understood it, activated it, and stowed it in the spacecraft. I think it ended up in an overhead pouch on my side for most of the flight.

Conrad That time is wrong on the de-briefing, we did it on time somewhere around 30:15 over Hawaii.

Gordon It was done real time, however.

Conrad We went into the alined platform to the sleep period.

Gordon The third day was one of our biggest and longest days. I guess things started out with a fuel cell purge and a crew status report right after breakfast. We had received a 45-1 GO, and this will only give the PPS posigrade burn for the high altitude. Pete, you want to talk about the whole high altitude bit?

Conrad We did it just as we planned to do it. We had our update; we had Velocity Meter load in and verified the night before. I'm sure they looked at the Agena all night and determined it was GO, and that's where we ran into our little anomaly again; it started to get worse. Coming up to within an hour of the burn, we were sending thrust commands to the Agena, and then you sent a command and didn't get it back. We sent the same command again, and you got it back. We discussed this - we passed it to Houston, and they looked at the data and determined that everytime we sent something, even though we weren't getting MAPS, it was going into spacecraft. We kicked it around and everybody decided that everything was GO. I have to admit I was a little worried there. It was a heck of a time to have a little glitch like that show up, especially where we planned to power the Agena down after the burn. So, we had a checkoff list written out and I got the GET of the burn at 40 29 59. I set it up on the checklist at 3 minutes from it, 40 26 59,

to start our event timer down at 57, and we counted the Agena down again just like we have it written in the book. We went exactly by the numbers. We were in Orb Rate of the platform; we burned, and we got an entirely different burn. We were in different lighting conditions with respect with what we saw. We did get a large attitude excursion. I guess it at about 8 degrees.

Gordon When the PPS engine ignited, it started yawing, and the needle I was looking at, went to the right very slowly; there wasn't anything fast about it, but it did go to about 8 degrees right and, at the same rate, came right back to zero. I would guess that the needles were null after about 10 seconds of burn time. The needles were back in null and the thing progressed right on through to a VM shutdown. The Engine Stop switch was put to STOP. Addresses 80, 81, 82, were read out and passed to ground. I didn't record these at this time. We were too busy with other things but they were passed to the ground.

Conrad We had preped to do this burn in reentry configuration fully suited, face plate closed, proper stowage. We had organized our cameras and everything. We had talked about it the night before - we talked about it many times before but we went over it again that night before we went to sleep. We were really organized, but when we shut down we did one thing off the schedule. I was just a smidgen late getting the platform into

FREE. We passed that information to the ground and told them that might happen. We knew we were going to get a big surprise out of that burn, and I'll tell you that was the biggest thrill of my life - that long burn on the PPS.

Gordon It was really something to look at the accelerometer afterwards. It was -1.1G, and you're hanging on those straps the whole time until that thing shuts off and it releases you right back to zero G.

Conrad 26 seconds is a long time on this thing. This big orange plume effect - we photographed all three of them...My window was so dirty, I don't know how good the photographing is going to be. We photographed them at the right setting. F-2 and 1/200 will wash out everything else but the plume. You get a little plume at light up, and I guess on those short burns, you'd think that's plume all the time, but the plume disappears once that engine gets up to full thrust. There was some light from the engine, not of the orangey nature, while it was making the long burn, but just as it shut down, you got this plume effect again. You get this big orange plume, and when it vents, it vents all kinds of stuff.

Gordon I might add that the biggest thing I monitored during these burns was the attitude excursions. I seriously doubt if you really notice the Status Display Panel or main engine red at that time. Maybe you would if it came on.

Conrad Well, on the last burn, when you couldn't see the panel, we made two burns, and we were getting in the swing of it, and I was doing pretty good. I was following the main red, the rate needles, and the event time.

Gordon You were watching that one, because the sun position was so bad, that I couldn't see at all.

Conrad It's a coordinated job, and we practiced enough in the simulator so that we knew what we were doing, and as we made each burn, we noticed more and did better. We learned from experience.

Gordon Okay, this high altitude stuff, in a word, was phenomenal; it was almost unbelievable. We took photographs out of both windows with wide angle 5 millimeter lenses on the Hasselblad and the Maurer camera and the 18 millimeter lenses on the other motion picture camera. We did S-5 and S-6 on the way up to apogee, and we got apogee over Australia. We did the S-11 photographs on the night side on the way back down, with no problems encountered doing these things at all. In the second orbit, S-5 and S-6 photographs were also taken. All these things were done on time, and, hopefully, some of these photographs will be as spectacular as the real sight.

Conrad We could see Africa, India, and Australia all at the same time. It was a sight beyond description.

Gordon As far as coming back down for the PPS retrograde burn, we did exactly as planned.

Conrad We did this 360 at the top, first apogee, for the S-26, and we didn't have the Agena recorder on. I was hoping that they got it in real time at Carnarvon since we were high enough and everything. Even though we were in acquisition range, our antenna pattern or something must have been such that they were having telemetry troubles. I hope they got that data because it was not on the Agena tape dump.

Gordon I think the reason it wasn't was because the recorder wasn't turned off soon enough. It ran more than 20 minutes.

Conrad When we came up to 2rd apogee we rolled her up to the ball angle. Actually, it wasn't too bad in the real world. In the simulator, for some reason, I lose track of which way is what, and in the real world, being able to look out the windows, we stayed fairly well organized on that, and ball angle didn't mean that much to us. I should add, that we did most of the photographs out of Dick's window, because mine was so bad. I have reasonable assurance that they are good. We set the Agena up in PGP in the right attitude, and we just let her gyro compass half way around the world. We were satisfied that at about 30 degrees on our inertial ball that the Agena wasn't back gyro compassing. Attitudes were good, and we went ahead and caged our ball at that time. We freed it up just as we had written in our procedures to free up the orb-rate to monitor our retrograde burns. That was when a whole different set of lighting

conditions began. This time we saw a lot of things on the Agena that we didn't see before. We had the sun behind the Agena shining up into the tail pipe, and just at the burn time the sun was in Dick's window, but it wasn't in mine. I had a good look at the status display panel. I could also see the flame from the 16 lb. thrusters, which I hadn't seen before, and this time with the sun shining up the Agena engine, I never saw the plume, and I never saw any flame from the engine at all. I was looking into black sky with the sun behind the Agena.

Gordon I didn't monitor anything on this retrograde burn except the attitudes. The sun was in my window and I just couldn't see anything out of the window at all so I just buried my head in the cockpit. This time, however, there was a yaw excursion in the opposite direction, the needle deflected to the left and it slowly went out to a maximum of about 7 degrees. It slowly came right back in to the null and once again we recorded 80 81 82, rather we didn't record them, but passed them on to the ground and they have all these recorded.

Conrad We apparently got beautiful cutoffs up and down and we came right back down again where we were supposed to and in the same orbit.

Gordon I guess the next big item was the EVA prep for the standup EVA. By this time the cockpit was very well cleaned out of all the

garbage and there was no problem here and we took our time this time in EVA prep.

Conrad We told them we were running late, and we weren't going to worry about it. We ate a meal, that was the big thing. We needed food so we ate a meal. We took our time. We knew where the gear was and again we practiced EVA prep so much that we didn't need anywhere near the 2 hours. It came out just right. As a matter of fact, we had about 15, no, we had 20 minutes to go to EVA and I had to urinate. So I even undid my suit, took out the urine device which we had stowed, hooked it up, unhooked, hooked up the suit and did another suit integrity check and we hit it right on time.

Gordon This time the EVA was nothing abnormal at all, in fact, it was as far as I am concerned, the most enjoyable. We did the S-13 pictures with the Agena in inertial control mode...in the star field. Pete was satisfied that the star field was right. I could reach down while standing in the open hatch. I reached down and commanded 401 so the Agena would be inertial and we had no trouble at all, taking the S-13 pictures. Pete timed all the exposures; he gave me a mark at the beginning and the end of each one. They were all done and we got three constellations. There are a series of photographs associated with each one and we had a nice long rest period while EVA during that dayside pass where we had excellent opportunity

to get some Hasselblad pictures while standing in the hatch with the Agena inertially controlled rolled over 80 degrees to the left. I was looking straight down on the Gulf Coast as we went across.

Conrad We got our fingers crossed on those photos though because we had the right camera settings in there, but unfortunately we didn't tape the camera. They may have moved off a couple of.. but we think what happened was that we moved the next setting which would have had to take the pictures that F-8 at 1/125, rather than at F-11 at 1/250, which was the same combination. We may have a little jiggle in it but he steaded it on the spacecraft structure. I got my fingers crossed that these came out.

Gordon I do too. That's exactly how it went.

Conrad Again, things went smoother than we expected in steering the Agena around. I used Rate Command and that did cost us a fair amount of fuel, but we saw that we were getting things done well. We didn't really think we had a chance to get all six series on the two night passes, but by golly, we got all of them with time to spare at the end. We shot a bucket of fuel on it, but it wasn't that much that I was worried. I knew that we were going to have enough fuel by keeping on the schedule.

Gordon I think that this was the correct way to get those pictures. I

don't know how they came out, but using the Agena to control the attitudes and the inertial modes by having the ACS on was, you might say, the "tiki boo" in taking those pictures.

Conrad We'd still be up there arcing around in PULSE trying to do it in a hard suit, but RATE COMMAND just took all the sweat off it.

Gordon So that old standup EVA with the S-13 was a real pleasant experience and we didn't find anything that went wrong in any of that. It was right on time and it was a real simple thing to do.

Conrad Dick, things went so well there on the first night pass, that I thought that rather than get tired or something like that, I made the suggestion that we pop back in and close the hatch and repress if we had enough oxygen. Dick wiasn't tired and I thought I'd just make sure that we stayed less tired, because popping in and out without that ELSS and all that stuff turned out to be just easy. Houston cleared us back that everything was cleared for picture taking. We figured we'd do it as planned then, and that was the best decision. I was wrong in trying to think that we should pop back in and close the hatch and repress and rest after a few minutes.

Gordon Even after that was all over, the ingress itself was no problem. In fact, I almost just sat in the seat and pulled the hatch down and closed it right on my head. There was no problem here at all.

Conrad Actually, you did that and I reached over and closed it to the last ratchet.

Gordon There are no particular problems in fuel cell purges and platform aligns. Those are always done on schedule in real time when we are over a station or on the flight plan or at other

times.

Conrad Well, we started out on the tether evaluation right out of procedures. I guess that I don't realize how sensitive the slightest forces are even to a large vehicle up there. So, when we undocked, it didn't break the tether free from the velcro and I had to apply a fairly hefty shot aft, I though, to jerk it free and start it out. Well, then it started out real good but it left it with a right lateral translation. I jockeyed around as we were backing up and I stayed over on the right side of him. Then, we got to about 50 feet and I guess it hung up in that little loop in the box in the other section. I had to go into it and back out and jerk it. I could notice that when I did this, it would upset the Agena a little bit but of course the Agena was running inertially stabilized then in FC-2 and then we backed all the way out, we saw the flag come out and before I could get it stopped, I hit the end of the tether, but the tether was hung behind the right handle.

Gordon Pete, I'd like to make a comment on that. I don't think it was hung on the handle because that tether was pushed down with an extra amount velcro on the bottom portion of that strap because the spacecraft's end of the strap was laying on top of it and we wanted to be sure that that came out first. I really do think that it was still the velcro holding that on.

Conrad It may have been. Whatever it was, it took us quite a bit of jockeying to get up above and sort of co-op at an angle up, and this ran us out of our 7½ minutes, and past the local vertical. I wasn't ready for it or anything, and I just shot the 7½ minutes. I figured we will see what we can do here, and then we ran into the next phenomena of the spinning tether. Then that tether started spinning around and was rotating in a counterclockwise direction like a skip rope. Everytime I get the back half of the Agena end upset and forced into me and I jockeyed around there about ten minutes. I finally got out there to a slack, straight, tether. I don't know how we got the spin out of it, but we finally did, and then I got lined out right. It took me a little while to get all back in front and lined up on the Agena and roll 180 still and everything. We finally got set up.

Gordon I finally turned the ACS off.

Conrad Yes, we turned the ACS off and I fired aft and down for 10 10 seconds and turned it loose and boy that's when we got our next surprise, because I backed into that tether very gently, and we honestly stretched it as we were firing. We stretched it enough so that when we let go of it, we didn't have a little bit of slack in it - we had a great big loop. It looked like we were heading back into the Agena. I was really tempted to do something, but everybody said the best thing you can do, is just

leave it alone; so we really gritted our teeth. I wanted to do something but I knew I shouldn't so I let it go. Sure enough the the slack pulled out and it stayed tight the rest of the time. Well, it had a little slack in it because the operations were pretty good.

Gordon The tether by and large was snug and had a sine wave up and down occasionally but that was all.

Conrad I think you can see all this very well in the movies that we got if the film came out. We took a lot of movies of it.

Gordon The surprising thing of all is we continued on into the night side pass realizing that the thing was moving out there, in front of us, but it was getting smaller and we only lost sight of it once.

Conrad Yes, we lost sight of it the very first time when we had the large slack, and we never lost sight of it again. It stayed up and in front of us and it wandered in yaw. The Gemini yaw was as much as 45 degrees from the tether. When we came out of the first night side pass, the tether was all rolled. We had obviously rolled you know, 30 times or so, with respect to the Agena. It kept rolling, but it never seemed to me that it rolled in the reverse direction.

Gordon It never did. It always rolled in the same direction.

Conrad The oscillations got down very low and the tether got very taut, but there was no cause for alarm. It would come up a couple of

times and then it would stop. And then you guys tried to talk us into spinning up faster, and I wanted to leave well enough alone, for awhile. It took us a while to psych out which way we were going so that when we did spin up, we'd add velocity and do everything in the right direction. And we applied it right, and then it took off again. We got this big sling shot effect, and the Gemini really went wild on that one. We got up to a 60 degree yaw for the tether and I couldn't stand that, so I fired her up in pulse and I just killed the yaw and pitch rate and boy it just started like that was it. It was stable after that and it was just beautiful.

Gordon We went through another night side and a portion of the day side pass at a higher rotation rate which we reported to the ground as best as we could, and we could get it off the Agena attitude. But the thing was nose to nose and was like a rock the whole time.

Conrad Yes, and we even got to eat. I think we were doing several other things. We got to where we didn't even worry about it. Then we talked about de-spinning and how we were going to do this. We decided we'd catch it on the horizon and be lined up in the right direction, and when we were all set to do it, I was going to fire in, Dick was going to turn the Agena on inertial, and as soon as I saw slack I was going to jettison the bar and be in Rate Command and just stop everything to it. We went

through the elaborate procedure of turning off all the circuit breakers long before that. We were all set up to jettison at any time. I hit the jettison switch and little old pieces of debris shot out of it, but the bar didn't move. I had a slight sinking spell and I hit the switch the second time and the bar took off the second time. The tether snapped out and the Agena control system came on and we fired up in Rate Command and thrusted just a little bit and we were station keeping.

Gordon Everything stopped within 30 seconds - everything. Steady as a rock.

Conrad Sixty times easier than doing it in simulation.

Gordon That was it as far as the tether operation was concerned.

Conrad I feel if we had to do it over again, we could probably get this combination stable in the gravity gradient. It may take a little fooling around but I think you could do it. If the Agena had the ability to point straight down in orb-rate it would have been a piece of cake, I think.

Gordon I think we both had the feeling that this gravity gradient would work, if we could have stabilized ourselves to begin with that the combination wouldn't even have moved. It was phenomenal the way it actually stabilized out and we just had rotation of the tight tether all the time.

Conrad These are couple of corrections we picked up from listening to the tape before. On boosted flight at SECO we had green man

again, John had it on 1C, and we had two decided big burps right after SECO prior to spacecraft separation. I would say they occurred not more than five seconds after SECO and it was burp and maybe a two second delay and then another one. It was pretty rapid bang bang.

Gordon Very destinctive, there was no doubt about what was going on.

Conrad We did have a couple of inadvertant circuit breaker operations. One of them was the electric timer which fouled up the TRS and they had to re-sync the clocks in the spacecraft. I hit that when I was turned around doing some stowing. The other circuit breaker that I remember is on the standup EVA. Dick knocked off the #1 Suit Fan circuit breaker and we had a slight moment of panic, thinking the O_2 High rate had come on and one of us had a leak. We discovered that very rapidly and got it back on. Another thing on this stand up EVA I should mention was that things were going so well out over the Atlantic after the day-side pictures were taken, that we both fell asleep with him outside and me inside.

Gordon I wanted to make a correction to the TPI on the initial rendezvous. In reviewing the flight plan, I just wanted to correct the numbers. We said that the ground solution was exactly as the directions as onboard, but in reviewing the addresses they read up. The out-of-plane burn was in the opposite direction of

what the onboard and computer calculations turned out to be. I checked the addresses, and it was such that their out-of-plane was 6.6 to the right, where the closed loop was 5 left and the backup was 4 feft. And the other corrections I wanted to make is this. I actually read down 22 as the up down correction and in reviewing the charts again, I had made a mistake and looking at the numbers it should have been 27 down. And this correlates exactly with the closed loop as far as 4 aft up and down is concerned. There was a one foot difference in the out-of-plane to the left. I actually made an error in reading it. I had recorded 22 during the flight which didn't really make any difference. We were close enough that the decision was made to go at the closed loop, and it's still valid, but I wanted to point out that the backup chart accuracy was such that they agreed exactly with the closed loop solution. It was just my mistake in reading it. Pete, I think to continue the flight plan, the next thing after the tether evaluation was the separation burn from the Agena. This was the ground computed burn for the next morning.

Conrad Yes, at fifty-three hours we alined the platform flying SEF, station keeping behind the Agena in Plat Mode was no strain. We had a good fifteen minute alinement on it. Obviously from the re-rendezvous it must have been a good alinement because we had essentially no out-of-plane to the Agena afterwards. After

the SEP burn and when we rendezvoused it was less than a foot per second out-of-plane.

Gordon I'll just go over that burn. The seperation burn from the Agena was at 53:24:56. Delta V was 8.8, Address 25 was 00 051, Address 26 was 90071, Address 27 was all zip. We used a forward firing thruster, the maneuver was posigrade and up. We used Address 55 all 9's to have the FDI needles in the correct mode for using the forward firing thruster.

Conrad Okay, and I have a comment on that. That's a bad way for the ground to handle the burn. That particular burn using the forward firing thruster, even though we put in the logic, 55, all 9's, which is the logic for forward firing thrusters. It requires you to roll the spacecraft upside down if you are going to use the generated plane commands out of the computer. And that was to me a peculiar way to continue station keeping and make the forward firing thruster burn away from the Agena. I would have perferred, and it's so easy station keeping, that we could have station kept with the Agena out my left window and made that burn with the aft firing thrusters which is the normal way to burn and to me is the most accurate way to burn. I wound up making this burn in two components, aft and up, staying zero, zero, zero on the ball. I had no pointing needles to do it on, and we just lucked out in killing out the residuals. It just turned out that the burn worked pretty good. But I thought

that was an awful awkward way to burn.

Gordon They were actually zero, the address 80, 81, 82 were zero. And we were fortunate to get them to zero. Okay, I think the next thing that appears in the flight plan was another burn which was a trade off burn, and it was also a calibration burn for D-3. Now the way this burn was done was so that we could get the D-3 quantities and record them in the procedure book. The ground updated us for this burn to be at 54:37:27. Delta V of 8.9 feet. Duration of 0 + 11, yaw 180 degrees, pitch 56 degrees up. Address 25 was 90050, 26 was 90074, 27 was all zips. We use the aft firing thrusters. It was retrograde and up. Now to be able to get the information for D-3, we burned exactly for eleven seconds, stopped theburn then I recorded Address 80, 81 and 82. At the end of the eleven seconds Address 80 was minus 0029, Address 81 was 00001, Address 82 00005. Now that was all the information that was needed for the D-3 other than the weights and the quantities. Let me correct that. Those residuals I read were for the first burn. At the end of the eleven second burn Address 80 read 8.9 at the start and at the end of the burn it read minus .9. Those are the correct numbers for the D-3. After the D-3 portion was completed we did continue to burn out the residuals. This, of course, didn't take part in the D-3 experiment, so the residuals were null for that burn. Then there was a little experiment with the hydrogen

tank. We blew the squib on the vacuum seal, pumped up the pressure to 670 PSI. I guess 660 was as high as we got and this was the first time we discovered that the Manual Heater position on the hydrogen is to be held. It won't stay in place.

Conrad I knew it was a spring loaded switch, but this is the kind of thing they sneak in on you at the last minute. What we didn't know was the fact that it was going to take 30 minutes holding that darn switch to pump that hydrogen pressure from 450 to 670. It's not a fast heat heater like the O_2 Manual Heater which really throws the blocks to it.

Gordon This was very disconcerting. I took my survival knife and wedged it in there so that the dog-gone switch would stay on so we didn't have to hold it for 30 minutes. The forces on that switch are pretty high and it's right next to the guard. It was nothing more than a pain-in-the-neck to have to hold that switch. We got it up there then we turned the heater off and left it that way over night.

Conrad Then we had a momentary panic because somewhere along the line we switched over to the O_2 position while Dick had his knife wedged in the heater. We looked over and saw 680 on the gauge and we figured we had been dumping hydrogen overboard and it scared the heck out of us. We suddenly realized we had not done this and that we were in the oxygen position. We went back to

the hydrogen position and sure enough we hadn't done anything to the pressure. We were still at about 620.

Cordon For the rest of the days activities we had an eat period right after that and then we went into D-15 for two night passes. There was no problem with the operation of D-15 as far as turning it on and warming it up was concerned. The monitor fit into the bracket okay, with no problem with it. I will mention that the picture.....

Conrad Something was wrong with the alinement.

Gordon It was skewed 45 degrees on the monitor so that instead of the scenery below flowing from the top of the monitor directly to the bottom, it started in the upper right hand corner and moved to the lower left hand corner. This was a little disconcerting at first. I took the TV monitor and held it in my knees and rotated it 45 degrees so we could correlate with what was going on below us, or what was underneath with what was being viewed in the monitor.

Gordon I will say there apparently is a lot of light from the night air glow that the D-15 equipment is capable of picking up. Consequently, for a large portion of the passes we looked at an awful lot of clouds. The clouds stood out on the D-15 just like it was a natural photograph. You could actually see the cumulus build ups, the lightning flashes would appear on the scope. Attitude thrusters would be picked up and you could readily see

all of these things on the D-15 equipment. I was able to call out the coast line on the first pass across the coast of Chili in South America. I told Pete that I could see the coast line on the monitor. He could not pick it up. I'm not sure you ever saw it as we went across it. Fortunately the cloud cover ended a few miles off the coast line so that there was a distinct break between the clouds and the land mass of South America. It was readily apparent that the coast line was easily picked up.

Conrad In all fairness to the Mark I eyeballs, the TV tubes put a lot of bright light into the cockpit. We were flying sort of on instruments to a point and everything, so I had the red lights on my side up pretty bright and my window was terribly dirty. It was dirty enough to hide second and third magnitude stars wh when I tried to look through the center. So I didn't really try and look that hard for the experiment because what I could see at night was not a fair evaluation on my part. If I really tried to see at night I think I would have seen a coast line.

Gordon As we came across that first night, if you'll remember, it was dusk and it was daylight. Once we got in closer, got vertically underneath this thing, you could actually pick it up because the clouds were kind of blocking it off from way out there.

Conrad You're talking about the D-15?

Gordon Yes.

Conrad The first comments I was making were about my eyes.

Gordon The first time we came across the coast of South America, on the monitor you could pick out the mountains, there were a couple of dry lake beds that you could see and correlate with what we saw out the window. Now, by and large any large light source will wash out that monitor and as we came across South America there were a lot of thunderstorms and a lot of lightning on the ground. We could readily see this on the monitor. As we came across, destinctive features were mainly cloud coverage. You could see fires on the ground quite readily. You could pick out cities only because of the light that happened to be there. There weren't any features that we could indentify, but these gross features were readily apparent just by looking at the monitor. As we came across the eastern coast of South America we picked up an awful lot of cloud coverage during the pass across the Atlantic on the way into Africa. Essentially all we saw there was cloud coverage and lightning on the monitor. Once again as we came across Africa and up to the northeast we picked up the same features. I picked up the coast line. I was not able to pick up any rivers but the coast line, fires on the ground, lightning and clouds were readily apparent. We came across the lower half of the Red Sea directly into the Indian Ocean. The eastern coast line of Africa was readily apparent on the monitor. We went along the edge of it for a while and made

appropriate comments into the onboard tape. We came across India in the scanning mode and once again the same features were readily apparent. We were able to observe the Delta around Calcutta but were not able to pick out the river or the water in the Delta. It was all massed into a general coast line. The D-15 was disrupted after one hour and 30 minutes. We then went into an eat period for the pass across the Pacific. Picking up D-15 again, for the second night beginning at South America. We did run into the night phase a little bit earlier this time, but throughout the same comments are as valid for the second orbit as they were for the first. We came up across the Red Sea and Saudia Arabia. We followed that coast line all the way down and did a couple of tracking tasks on prominent coastal features. As we got to West Pakistan, the area in the vicinity of Karacki was the last place we tried to track the coast line for 30 seconds, and that was the end of D-15. More information on D-15 as far as its performance will be found on the onboard tapes. There was approximately 12 minutes of camera exposures taken at that time, with the remaining film being used for the S-30 experiment the following morning.

FCSD Rep Was there anything on D-15 you could see using the monitor scope that you couldn't see outside the window?

Gordon I think so. Only in the fact that it would actually pick up smaller light sources than would readily be apparent with the

naked eye. I would say, by the magnitude of fires in the area, that I would have a lot more on the scope than Pete could see out the window. His view out the window was degraded for two reasons, the window itself plus the fact that the TV monitor put out an awful lot of light inside. He had his lights up full bright and red. He was definitely not night adapted. I don't think we have the ability to make a good comparision between what you can see with the naked eye and the monitor scope.

Conrad The EVA bug eye was perfect.

Gordon That is all the comments I have on the D-15, other than to make a comment about the stowage for reentry. It was easier than I anticipated, but it was still a pretty difficult task to stow that thing in that bracket down there. But once I did git it stowed I assured myself that it was never going to come out during reentry. The next sequence in the flight plan was fuel cell purge and pumping up the hydrogen to high pressure again. We left the heater off during the night. We ate another meal and gave a crew status report. We slept for the first time without our friend, the Agena, and had our first experience with drifting flight.

Conrad We got up to 10 degrees per second in drifting flight there over the sleep period. I can't figure out why because we straightened out all the venting problems. We weren't getting any venting that tended to wind you up. I was quite surprised to wake

up in the morning and see us up to 10 degrees.

Gordon I don't think it bothered anything.

Conrad Oh, no, it doesn't bother anything. I was just surprised. During Gemini V we didn't get those kind of rates until we started venting. Once we started venting hydrogen however we really got wild ones of 12 or more degrees per second. I was sort of surprised to see those rates during this flight. When we got up in the morning, the S-4 TEMP OFF came in real time. We didn't have an eat period at the scheduled time because we had gotten into the rendezvous. We took the ground burn and burned it.

Gordon Record that for posterity.

Conrad Give them the ground burn and then we will jump into S-30.

FCSD Rep Did you have enough time to align the platform? That was one of our concerns, to give you plenty of time to get the platform aligned.

Conrad When you called up to wake us up, the platform was powered up, aligned, and we were ready to go. We cut the sleep period a little early.

Gordon We would both wake up and check the time every half hour or so.

Conrad Oh boy. Yes and get another half hour of sleep.

Gordon The burn itself for the intercept: ground TPI/GET to the burn 65:27:21. Duration of burn was 00 + 23, Address 25 was 90087, Address 26 was 00121, thrusters forward. At the same time we

were updated for the S-30 as far as the pointing commands and the times to get Gegenschein pictures the D-15 equipment.

Conrad We had a clock start time of 66:06:49 for the GMT count up of our timer for the fourth correction computation. Nominal TPI being zero. We naturally took great pains when we made this burn to null residuals to zero. This is a funny thing, it must have something to do with computers and platforms. I have heard the other crews complain that they couldn't null residuals out for some reason. They kept flopping around. We hanged those residuals. We only had one burn with residuals in it, we left a tenth of a foot per second in during one burn only because we were hurrying to do something else.

Gordon It was during S-30.

Conrad I guess that was this burn. It was forward and we said that is not going to hurt us and we just left it alone. We burned all residuals to zero and there was no problem. We didn't have to work around with them. We just had to bang them a couple of times.

Gordon It worked out real well. It worked out just like the CMS work.

Conrad We made the burn and then zapped into S-30 and again used the old computer. We picked up 17 degrees on the horizon and when we got sunset we had inertial needles. We took our first Gegenschein photos. We went to DIRECT and yawed around the horizon. I was interested in conserving fuel. We yawed around

the horizon in proper sequence for Gegenschein, and made a 360 degree sweep of the airglow. We just two blocked into our inertial needles again and got 10 seconds of Gegenschein photos. We worked over to the 15 degree area east of Canopus for 30 seconds of photos. We then moved on over to the Magellanic clouds for 15 seconds of photos. We flew back to our enertial needles and photographed Gegenschein again. We didn't have a moon to occult, so we skipped that one. We took another Gegenschein and then we went to the eastern horizon and got the last part of the Zodiacal light 10 minutes before sunrise. That was the end of S-30.

Gordon I would like to make a comment about S-30 and part of the D-15. The night airglow on the monitor was readily apparent.

Conrad It was phenomenal.

Gordon It was just beautiful on the monitor.

Conrad That D-15 experiment equipment picks up eight, nine and ten magnitude stars. We would point it at a black hole in the sky and it was just full of stars. It was unbelievable.

Gordon The film should be quite good if the camera was operating, and if the time was correct. We had 20 minutes of film for D-15. There should have been ample film for S-30 and even some left over.

Conrad We went back and acquired the Agena visually and just started watching it. Dick was reading computer angles and went to the

time of the fourth correction and got that. What was it Dick?

Gordon Let me look this up. The ground passed up a nominal correction of 6 feet forward, zero up and down, and 2.4 right. This was to be applied at 66:30:36. I read out the angles of the computer for Theta of 19 minutes and got 64.3 degrees. I read out the angles for Theta for 22 minutes and I got 74.6 degrees. I went into the fourth correction charts, the coelliptic rendezvous charts used on Gemini X, and with those angles came up with zero up/down correction, which was exactly what the ground gave us. We figured by this time that the ground was correct, so we burned their solution.

Conrad We added the 6 feet and there were no line-of-sight rates. We were right in there. We were ready for the daylight problem. As soon as we started burning into daylight, we both put on our sunglasses and Dick went to inertial needles. I was concerned about hitting the Agena if I ran out of fuel. So, I let her drift a degree off and held track out there a degree off. We just let her come in, brake a little bit and we were station keeping. With the sunglasses on, I could really scan the inertial needles and knew at all times what the line-of-sight rates were. They stayed very low with just very minor corrections going in. Of course our gage was very accurate. I think we did the whole show for 50 pounds or so, maybe 60.

Gordon You are surprised at the brightness of the Agena everytime you see it. You are in total darkness and you have to wear sunglasses to look at it. The magnitude of that thing is phenomenal. It is really bright. And, of course, when you get in closer, this brightness leaves and you can see the features of the Agena itself. We noticed something strange about the shape of it early in the rendezvous. We said it was the shape of a cross. When we finally got up there and could see it, the Agena was oriented TDA north with the lights flashing brightly, and the tether which was still attached was way up in the air.

Conrad It was sticking straight up.

Gordon It wasn't moving at all.

Conrad It was gravity gradient.

Gordon When we finally got there and were station keeping with it, we apparently disturbed it with one of the thrusters and it started moving around very slowly. But when we first approached it was rock solid still. It wasn't moving a breath. Our fly-by consisted of asking permission to dock, looking it over awhile, and getting into position to aline the platform again.

Conrad We were going to retrograde again so we alined SEF very accurately for 10 or so minutes. I wasn't too concerned with the platform alinement to start with. We had a good one before and I figured it would pull it in pitch. We had an extremely accurate platform with respect to gyro drift so I figured all that was

wrong with it was orbit rate. We made the 3 foot per second retrograde burn and left the best friend we ever had.

Gordon We were sorry to see that Agena go. It was very kind to us. It made our flight.

Conrad After that we had all kinds of time. We had 3 revolutions to go to retrofire and nothing to do.

Gordon Nothing but sleep and eat, which we did.

Conrad I figured we were going to run out of fuel sooner or later. I was reading like 3 percent or so I just put her in BEF Plat Mode. We probably had the best alined platform in the whole world for retrofire. We went three rev's in alinement BEF. We took our time and started into the stowage. It was clean by then anyhow. We did not pick up our Preretro checklist until the proper time. We went into Preretro checklist by the numbers. Do you have anything on the Preretro checklist?

Gordon No, nothing.

Conrad We were picking up retro and recovery information around the world as they got it, which was fine. It never bothered us, it came in well.

5.0 RETROFIRE

FCSD Rep Retrofire

Conrad Yes, we were at 256. We got through the preretro, and then it was just right down the checklist.

FCSD Rep MDIU quantities read out.

5.1 T_r-256

Conrad We picked it up at T_r-7 minutes and did everything except punch indicate retro attitude that got our first check on the TRS, and at 256 it turned amber, and we punched it up. We did the checkoff list as we said by the numbers; I wanted Dick to check each item off with the pentel to make sure if we got ahead of something that we went back and picked up everything, and he did it that way.

5.2 T_r-1:00

Conrad We picked up T_r-1 minute at 2 minutes which was, I think, wise we were well up on all emergency procedures, but we went ahead and picked it up at 2 minutes and set OAM sep electric and sep adapt and they were all standard, the bangs, the big bang on the adapter.

5.3 T_r-30 seconds

Conrad We armed the retro squibs.

5.4 T_r-10 seconds

Conrad Dick was standing by at T_r-10 to arm autoretro.

5.5 T_r-0

Conrad We had retrofire right on time. Four retros - this time there were no delays between retros. They came in equally spaced and one, two and three were aligned right on the money and number four was, I'm sure wasn't much, but it was off enough in yaw that we both knew it was off in yaw.

Gordon Without even looking at the rate needles.

Conrad Yes, without even looking at anything, we could just feel it. It was firing off the CG, and it gave us the sensation of going sideways, but it was easy to control, no problem at all, and we were looking for a 305 and 115 on the IVI's and we wound up with 303, one left and 118 down.

Gordon Okay, and jet retro was done on the light, T_r+45, and after you'd jettisoned the retropack, I read out 80,81,82. 80 read 305.1, 81 read 11, and 82 read 118.3.

5.7 Postretro checklist

Conrad Yes, now the Postretro checklist we did by the numbers and picked up one item which we added based on John's problem with the D-ring and we felt that it was more important to get that D-ring unstowed and in the proper place, so we both unstowed and in the proper place, so we both unstowed our D-rings and clipped out PTT cords to them after retrofire and zero g there and our cords were short enough that they layed the D-ring neatly in our laps and they were there all the way

through reentry, no problem, and that's the way we reentered and we stood by for our first computer check which would be 400 K and it came in 6 seconds after the...

Gordon No, allow me to correct you, Pete.

Conrad Okay, that's right there was some discussion on it.

6.0 REENTRY

6.1 Reentry parameter

Gordon 400K retro time, preretro fire was 20+12, two zero + one two, and we never got an update for 400K, but we did get it, and I wrote it down when we got it, we got it at 20+14 and I was going to bug John Llewelyn about being off 2 seconds in his 400K retrotime, so I wrote down that 400K was two zero plus one four and apparently old John in his excitement at retro-fire time, thought I was asking for 400K retrotime and he kept reading back two zero plus one two and it was already 22 minutes. So I just wanted to let him know how accurate it really was.

Conrad Yes, the computed 400K time matched the ground...

Gordon It was within 2 seconds.

Conrad Within 2 seconds and we had held our 10 degree bank angle to get this check which was no strain.

6.2 Attitude

Conrad We were in single ring A pulse, and I flew it that way on down and we began to pick up a little tendency for the space-craft to trim and it was very easy to control and pulse and at that time I pulsed it to 44 degree roll left, which was the backup bank angle and stood by for guidance initiate at 280K.

6.3 Guidance

Conrad It came in the proper amount of time, about 3½ minutes after 400K, and at that time it popped right in at 40 miles and the ground had passed us a nominal 62 miles.

Gordon Sixty-three.

Conrad Sixty-three miles and Dick was watching it, he told me he had 40 miles, 0 was on rate on my needles and at this point, I was in the process of just keeping rate needles 0 because there were some very, very slight occillations and it was just very gentle and in Pulse Mode. I could keep it just fine and we looked at the downrange, it started to build a little bit as it should....

Gordon It went to about 60.

Conrad And at that time, of course, it was commanding a roll angle of full lift and the needle was completely deployed to the right, indicating roll right, which would ask for full lift and I went to Reentry Rate Command and rolled the spacecraft to full lift and matched the needles. At that point, the usually large occillations began to be apparent in the spacecraft, and I think I damped the rates just a little bit and told Dick that I was satisfied with the system and operation.

We switched to the Reentry Mode, and the spacecraft was on its own then, and it asked for full lift. That was almost a nominal reentry, retrofire wise, on the times. We were

just approaching one g as the range pulled into zero range and the automatic system commanded a roll, and, if I remember right, it asked for roll left the first time, didn't it?

Gordon I think so.

Conrad And we were both watching it and my way of following this auto reentry was to move the stick, although I wasn't putting any inputs with the needle, so that I was always with the system, just like I was flying it, and that way I wouldn't get confused at whether we were rolling which way. So I put the stick with it and rolled one time, it seemed to me, and rolled all the way around to lift vector full down, and asked for a roll in the opposite direction. It asked for it of course, going through the 180 point, but it got all the way to lift vector full down, and it hesitated and hung up down there, lift vector full down, and that was giving me a little bit of nervous swivet there. I thought maybe I might pull on it harder except it was firing as much as I could have gotten out of single ring rate command myself. It reversed itself and of course by having hung up down, lift vector down a little bit, it shot back asking for full lift and it rolled back up to full lift, oscillated at full lift a couple of times, and about this time we were beginning to pull out of lift, so it pulled the down range right back in and asked

for another roll. This time, I believe it asked for a roll right. It rolled right and we left out, that the cross range was within a mile all the time. The cross range needle was within 1 mile, or 2 , the whole time, it never got out of center. And this is why it did a lot of oscillating and asking for reverse roll and it did the same thing again and it rolled one more time, rolled to lift vector full down and at this point reverse logic for a center line situation and it slowly pulled the roll, reversed it, went back in the other direction, and wound up lift vector full up and we flew the rest of the reentry lift vector full up through the max g and just as we were coming out of max g, it recognized its 10 mile short undershoot point being washed out by flying full lift and it asked for one more roll, it did, it was just as advertised, a perfect reentry. It asked for one more roll right coming out of max g, it rolled one more time, went to lift vector full up, the altimeter was off the peg and we jumped on the checklist. I called 90,000 feet on the checklist and just prior to this point, it was asking for one more roll. I would guess we were at 125,000 feet going like a bullet, and loud and clear over the radio came "HERE BOSS, GEMINI ELEVEN, GIVE US A SHORT COUNT", and I thought that was a little bit early and Dick started to say something to them

and I said "Shut up, get back on the checklist, we're not through yet."

Gordon Give him a short count, that's what he wanted. He didn't have anything to do.

Shepard You didn't get Johns answer to that, did you?

Gordon No.

Shepard That was a very fine count, Dick.

6.4 Impact targeting confidence

Conrad Things were happening pretty fast at this point, we came through 90,000 and I was satisfied that everything was in good shape. The needles were dead center, and we went back on the checklist and we both said at 90,000, "We're standing by for 70K." and at 70K, we brought on the landing arm and I brought up - oh, at 90K I brought on the other ring in the Re-entry Mode, so it was firing at the four degree per second rate, both rings on. At 70K, I switched out of Auto Reentry and went to Rate Command and both rings came on full blower and we were just oscillating at a very high oscillation, but it was a very narrow excursion and we were in beautiful shape at 50K.

6.5 Drogue chute deployment

Conrad I put the drogue out right at 50K and....

Gordon I was personally surprised. I'm not sure they went to the

magnitude that they could have gone to; I thought the oscillation, the frequency of it was higher, but the excursions in it, I didn't think, were as high as you would expect. Just sitting there watching the rate needles. It didn't look like they were going to the full rates.

Conrad It seems to me that the rate needles, at the frequency of the oscillation, was such that the rate needles weren't indicating accurately by the time the rate command system sensed a four degree per second rate and did something about it. This was a decided impression that I had.

Gordon This may not be the actual case, but that's the impression I had. It looked like the amplitude wasn't being reached, but the frequency was high enough that it kept you within that band quite well. That's the impression that I had.

Conrad Yes, and they were really putting out up there. They were sensing this and the thrusters were firing as you could see. And after that, we got nothing that resembles these other wild ride tales. We didn't have any great oscillations at 60 or 90 degrees. The spacecraft/drogue combination does this high oscillation to itself, you know, between the shrouds and the nose of the spacecraft.

Gordon I was watching that quite intentionally on the way down and I was just noticing that the pivot point was right at the attach point of the spacecraft.

Conrad Yes.

Gordon It oscillated right there and I could tell this quite readily because, every time it rocked up so that I was up, one of the three straps went slack, all the time.

Conrad We don't have any horizon reference, and looking at the ball, it's obvious that the total combination of shoot and spacecraft are doing some excursions like this. But at no time did we have the feeling that these excursions were large in yaw or pitch, and boy, I thought it was a beautiful ride. It was about the same kind of ride as Gordo and I got on Gemini V. And I was aware that the A-ring had run out because when they run out, they tend to burn, the thrusters just tend to have light flames licking out of them. So I was positive that we had no 35,000 checklist because we had our D-rings out. And our 27K checklist was simply to go to recirc half.

Gordon No, we've done that.

Conrad Yes O_2 high rate it was. And Dick went to O_2 high rate and at that point, I elected to shut down the RCS propellant valves. And I'm quite sure we left ring B with fuel in it. Probably a very small amount, but we left some fuel in it, and I should mention the 40K barostat light and the altimeter were exactly together . I went through 40,000 and the 40K

light came on.

Gordon Same at ten six, too.

6.6 Main chute deployment

Conrad We deployed the chute at ten six right on the button, which coincided with the light and the altimeter and we had a good drogue jettison, good main chute deployment here were no rips in the chute,and we got the standard 6 or 8 second dereef time on the chute

Gordon Yes, it seemed like it was longer than 6 to 8 seconds

Conrad Maybe it is supposed to be. I keep getting 6 to 8 seconds.

Gordon I think it is 6 to 8 seconds, but it just seemed longer.

I don't know what it is, but it seemed to me that it stayed reefed for a longer period of time than that. But when it dereefed, it was beautiful.

Conrad The only other thing I can judge it by, is it dereefed at the same time that it does in the simulator in that we were ready to go to two point at approximately 7,000, 7,500 feet, and I called out "Stand by for two point" and we put our arms up and went to two point and got a very easy two point. It was just the old rocking chair kind that we had in Gemini V and at 2K, we did come on with repress.

Gordon Water seal closed.

7.0 LANDING AND RECOVERY

7.1 Impact

Conrad Water seal closed, and stood by to hit the water and we had a very gentle splashdown. There was a good deal of wind, and the chute rolled the spacecraft underwater, I could see the chute go off that way and it took me a second or two to get down there and jettison it. The only other thing was sometime after main chute deployment the R and R can just about hit us. It came that close. I saw it coming down this way and across right alongside us and right by Dick. I'll bet it wasn't twenty feet away.

Gordon Yes, Pete said "Look at the R and R can" and I looked out the window and it was coming right down the right side. I want to add another comment to this 2K checklist. It is true that we closed the water seal. It went to cabin repress open and I had my hand on it and at 500 feet I did turn it off. I I turned the cabin repress off.

Conrad We hadn't gained hardly anything.

Gordon People were concerned about incapacitating a crew and landing and leaving the repress on.

Conrad Okay, there is one other thing too. It's here in these, well I'll get to that after impact.

FCSD Rep Did you have any sign of leaks or fumes?

Conrad Oh yes, we had RCS fumes.

Gordon You had some fumes, but no leaks.

Conrad And I..they're either RCS fumes or heatshield fumes. We had them at 27K because I was having a little trouble with my left ear and right after 27K, when the cabin bottomed out at about 23,000, I popped my face plate open and blew the old nose on the ear and we had fumes at that time in the spacecraft, so I popped the faceplate back, and shut it again.

Gordon I stayed sealed the whole time until after we were in the water and I never did smell any RCS fumes in the suit loop, none at all.

Conrad Yes, but they were already in the spacecraft at 23,000.

Gordon I think after I did open up, that we were on the water 2 or 3 minutes getting warm and then I did open it up and there was a faint smell of RCS fumes, but it didn't bother me. It wasn't irratating or anything. It's just that you could smell that there were some fumes.

7.2 Postlanding checklist

7.3 Communications

Conrad Now we get to 7.2 postlanding checklist and 7.3 communications and this really made me mad. The news media gets a blow by blow description of the recovery, given by the recovery helicopter pilot on 296.8 and the guy was about to blow us out of

the spacecraft with "THE RECOVERY HELICOPTER IS APPROACHING" and I was trying to say to Dick, "TURN OFF THE SO" and he said "WHAT DID YOU SAY?" We couldn't hear ourselves think. I didn't want to shut the UHF off, if they passed the communication to us for something. We wanted to know what was going on and this guy gave this running commentary of the whole operation to the press on 296.8. Now I don't mind them giving them a blow by blow description, but the guy ought to do it on 243.0 or something, not our frequency. It was really bad.

Gordon That was really irritating.

Conrad And finally to get the postlanding checklist done, I shut off the UHF, and we read the darn checklist to one another, and then I turned it back on again because it's the only way we could hear one another even over the intercom. That's really bad, we didn't use any HF.

Gordon I think while we're talking about this particular thing, I think it's their boss; I'm sure he's concerned about where we are, but we do enough talking on UHF that they can get a DF steer with normal conversation. They are not required to have a shortcount at that particular time. They can get it after we are on the water.

Conrad The only calls you should get, is you should get a call from Houston after blackout in one place. It would be easier for us to call 100K, but you don't want somebody calling you. I

can't think of a better way to miss an item on a critical check-list than to have a guy call you right at that time.

Gordon All they have to do is stand by.

Conrad I was concerned. I didn't want Dick to talk to them because I wanted to catch VOX to get the Rate Command on. I wanted to make sure we were in good shape for 50K.

Gordon I think all they have to do is realize that we do read out over the air, address 86 and 87 and there are 7 digits in each address, so that's 14 digits that they can hear being read out over the air and that's good enough for a DF steer.

Shepard Yes, I wrote it down right here, 241829002.

Gordon 2418, that's what I've got. Amazing.

Conrad Okay, now I don't know what this Contacts means, but the swimmers were in the water and plugged in the phone right away and asked us our status and we gave them our status as "Go" and they relayed that and then we got a blow by blow description that we are "REALLY IN GREAT SHAPE" over the UHF from this broadcaster and he was saying "THE SWIMMERS HAVE CONTACTED THE SPACECRAFT ON THE PLUG-IN TELEPHONE" and Dick was trying to tell me to turn off something for the checklist, so it is really bad. The swimmer kept us posted because he is apparently sort of the on-the-scene commander at the space-craft, and he's got signals that he can give to the chopper, and that way he stays in the loop. So that was okay. Now

they had a glitch.

Gordon Why don't you go back; did you say anything about the impact itself?

7.4 Postlanding spacecraft status

Conrad Yes, we said it was a gentle impact. RCS fumes, yes we had them, the main chute was perfect. We could see it two point, I did have the impression that we were rotating slowly all the way down.

Gordon We could tell that, we could see that we were rotating, but we couldn't tell any oscillations at all.

FCSD Rep Could you see the horizon?

Conrad No.

Gordon No, none at all.

Conrad The windows didn't fog until we hit the water. They stayed good until we were on the water and then they really clouded.

Gordon Stuff really did burn off the outside during reentry, on my side of the window.

Conrad There were no leaks.

Gordon It looked like a cellophane burning, you know when you burn a piece of cellophane, how it spreads. Well, this film on the outside of my window started from the outside edges and it burned in towards the center during the reentry phase.

Conrad The electrical power, I looked at your gages and saw no oscillation of the image.

Gordon I did the same thing, and I didn't see any either.

Conrad So we didn't have that glitch on our spacecraft.

Gordon Oxygen and hatches, nothing to say..

Conrad Oxygen, we of course got on the water and after we got squared away, we got the vent open, we got the snorkle open, and brought the two fans back on the line right away to get some cooling. No problem opening the hatches.

Gordon I didn't open mine. I went out yours.

Conrad I was extremely hot by this time.

Gordon You were sweating worse than I was.

7.5 Comfort

Conrad Yes, I was extremely hot this time, moreso than ever before in my life, and I don't know what the reason was. We got the suit fans on; I really think maybe, I was this hot in Gemini V but I stayed in the spacecraft and stayed on the suit fans for almost an hour and didn't do any movement. And this time we were hustling to get done, and I got hot. I was hot when I got out, and as soon as I got out, I had no coolant air in the suit, and it stayed hot. I think that's probably the reason.

Gordon I wasn't bothered by the heat. I was surprised about this, because that suit is pretty hot, and I don't

think I was sweating as profusely as you were.

Conrad No, I really got hot.

Gordon But as far as the hatches, I didn't open the right hatch and when I got out, I just crawled out your hatch. And just left mine closed and used the left hand hatch.

7.6 Recovery team

Conrad Sea conditions were ideal. The recovery team, the flotation collar, they had a failure of one of the collar bottles. That's what took them so long. They couldn't get the left side of the collar inflated, and they finally managed to get a partial load of air in it out of the bottle rather than drop another collar. The collar was sick. It didn't have enough air in it.

Gordon It was soft.

7.7 Crew Egress

Conrad And communications with the swimmers were good through the phone; the crew egress was no problem.

7.8 Survival gear

Conrad We didn't even touch the survival gear.

7.9 Crew pickup

Conrad We jumped into the rafts and got helicopter pickup and away we went.

Gordon End of flight

Conrad End of flight. We'll just stop there for awhile.

8.0 SYSTEMS OPERATIONS

8.1 Platform

Conrad — Platform Alinement. The M=1 alinement, we did as advertised. We never caged, and we just let it pull in in pitch. We aligned for 12½ minutes in Plat Mode and at 22+30, I went out of Plat Mode to the Pulse Mode and did not look at another thing in the spacecraft and kept those needles dead center for 2½ minutes and at 25 minutes I went to Orb Rate. I'm sure the record will show that that platform was not only alined, but it was a good platform all the way. I checked both secondary and primary scanners and I alined several times using both scanners for awhile just to make sure that they were both operating and I was satisfied that they agreed with one another. I have nothing to say about any alinements we got. They worked fine. All the modes worked. We did cage SEF, we caged BEF, we alined SEF, and we alined BEF. We used Orb Rate and we used FREE on the high orbits and FREE on the high orbits at the end of that second orbit was right on the money. The displays: my FDAI worked beautifully (I had no window markings; they had all been covered by Velcro). And what paint lines were on the windows were all obscured anyhow and I didn't use them and I didn't need them. I knew where I wanted to put the spacecraft on the horizon anyhow from Gemini V and I didn't

need window markings. I used the corner of the window and the RCS thrusters. The controls were outstanding in all respects on FDI's and that whole bit. Accelerometer Bias, I don't know what it was but it never bothered us. I'm sure we had very little accelerometer bias because there were many times we ran around with the Start Comp ON and never picked up a number on the IVI's.

Gordon It was a beautiful, beautiful platform. They ought to put that in a gold case somewhere.

8.2 OAMS

Conrad OAMS: operational checks on the pad. That took us two trips around to get a GO and it sounded good and they worked fine in flight except for thruster number 6 and thruster number 8. They were still bi-propellant, but they were a little bit less than 7 and 5. The 6 and 8's were soft and we picked that up, operating with the rate needles ON in the Pulse Mode, that's when we pulsed in these two directions. We picked up a slight roll rate. It was nothing that bothered us because I'd done enough thruster failures and that sort of junk. I'm not sure when I picked them up, but it was just natural to fly them out the way we practiced doing all this stuff. The up thruster, which was the down firing thruster, seemed soft; it didn't seem to put out what the other three lateral thrusters put out and I think that'll be picked up off the accelerometers, that

this thruster was weak.

Gordon It was still bi-propellant; there was no doubt about that.

Conrad Yes, it was still bi-propellant; there's no doubt about that, or we'd have been in serious trouble. But I noticed that it took me longer to kill line-of-sight rates using that thing. I seemed to stand on it more when I had line-of-sight rates, roughly the same as in other axes, and I'd kill them right out right away with the maneuver thruster, but this one, I had to stand on it quite a bit. So, I don't think that was too hot a thruster.

Gordon The little I flew, the two dockings that I did, I didn't notice any of this.

Conrad Well, you wouldn't pick up a soft maneuver thruster pulsing around like we were station keeping. The only time I noticed it was in line-of-sight corrections on both rendezvous. And that's the only time I noticed it. Systems monitoring was fine. Source pressure stayed right on the money. We picked up one glitch in temperature and that temperature was not only source temperature, but it was any time you selected a new temperature, or a new setting on the propellant quantity gaging gage. We'd get a temperature glitch, where the temperature would wander up and down and I'm sure this was in the gage. Regulated pressure stayed right on the money. Actually regulated pressure ran a little high.

Gordon A little above 300.

Conrad Yes, regulated pressure ran around 310 or so. Propellant quantity gaging system worked beautifully.

Gordon We guess it did. It went to zero.

Conrad We burned it from 99 percent at squib fire to where it said nothing and it was still working. I mean we still had propellant and zero calibration was supposed to have been 21 pounds of propellant remaining, so I guess we threw away 21 pounds, which is a shame. We never did get to the reserve OAMS. We never used it.

Gordon We never blew it.

Conrad Never blew it. Our onboard information was prime. I questioned the ground several times about how much propellant they thought we had remaining, and they always gave me numbers that agreed pretty closely with what we had onboard. Okay, selector controls and switches.

Gordon There was nothing on those.

Conrad Nothing. Attitude controller was beautiful. Maneuver controller, both of them were good.

Gordon Yes, mine was outstanding. That's the kind of controller to have, I think.

Conrad We had no inflight malfunctions. The control system, the electronics part of the control system, every mode operated in an outstanding manner and we used every one of them. We

used Rate Command; we used Reentry Rate Command. I used Direct; I used Pulse. Undocked, we arced around in Horizon Scan, and I used Plat Mode. As a matter of fact, the Plat Mode, it seemed to me, kept a tighter deadband than 1.1 degrees and the only time I saw it wander off about one half a degree was in the first alinement when we had water boiler operations and it, as you would expect, pushed it up to the 1.1 degree deadband and it sat there.

FCSD Rep Let me ask you a question. You know just before launch they were having a problem with the hand controller. Did they put a new hand controller on?

Gordon No.

Conrad Just before our launch? They changed the hand controller about three weeks before launch.

FCSD Rep Yes, well.

Conrad That was the spare hand controller.

FCSD Rep It was a spare hand controller?

Conrad Yes, it was not the original Gemini XI hand controller.

Gordon It was the one that the forces were supposed to have been out of spec on and we accepted it. Hell, there's nothing wrong with that hand controller at all. In fact, it felt damn good.

8.3 RCS

Conrad RCS: Operational checks. When we fired the RCS squibs we got a 500 psi pressure drop, which I thought was higher than

normal. We had two 3000 pound rings and they both dropped to 2900 pounds, but if I kind of glitch my memory back to Gemini V, I think we had the same thing in Gemini V and I think the simulator is just a little bit wrong. The simulator shows a 500 pound drop to about 2700 pounds.

Gordon As a matter of fact, it dropped so far that I was saying, "Uh oh."

Conrad Yes, it dropped so far so slowly that Dick thought this ring was going to keep right on going to zero and I'm not sure of the one, that we had it on when we fired the squib. And oh, I know the reason for that. The rings were colder than they are on the ground. That's all. Source temperature and pressure readouts were fine. We never saw the pressure anomaly that we saw on the pad at sim flight. That gage never rocked. If it did, we never saw it.

Gordon I don't think it ever moved. I don't think it ever even glitched.

Conrad All selectors and controls associating with the RCS system worked perfectly; there were no inflight malfunctions.

It was obvious that the Rate Command Mode was a little bit looser than the OAMS Rate Command system, but we know it and it's to be expected and it worked just like it's supposed to. Reentry Rate Command worked beautifully.

I tested them in Direct and otherwise, I never used the Direct

Mode. Only for the RCS ring checks light up of the RCS system. I used Pulse in reentry; it worked fine. Heater operation. We did get a heater light the first 5 or 6 hours into the flight.

Gordon Yes.

Conrad It was ring A. We turned the heaters on and we left them on and you checked them one time and found out that...

Gordon The heater light was still on.

Conrad The heater light was still on and we queried the ground because we couldn't see an amperage change on our ammeters when we turned it on. Now there's one time when those main ammeters would have saved a query. I mean, you could see 45 amps on the main ammeter and you can't on those little bitty boogers. But that's immaterial.

Gordon I checked it a couple of times later on in the flight and I turned the RCS heater off and the light did not come on but since the heaters were already on, I just turned them back on and left them on. I just forgot about them.

Conrad Thruster plume operation: you could see them firing out there and it's a nice conforting feeling. System shutdown: I shut it down while it was still firing by using the propellant valves on reentry and we had a touch of RCS fumes in the cockpit as I mentioned earlier on our reentry.

Gordon There was no residual flame out of those RCS thrusters once

they quit firing. As far as I was concerned that was the end of them.

Conrad Well, there was some residual flame out of ring A while ring B was still firing. It just takes a little while for the residual firing to stop.

Gordon You remember Tom mentioned he hesitated before going to two point until that flame went out.

Conrad Well, we had one on Gemini V that burned for a long way, but it didn't burn down that far.

Gordon There was nothing burning on my side at all. When those things were off they were dead off.

8.4 ECS

Conrad ECS: Suit (command pilot). Mobility was fine; pressure was okay. Temperature, we ran warm the whole time mainly because we were powered up most of the time. No humidity. It was dry in the cockpit; we had one millimeter of mercury on the PCO_2 gage and it never moved. In all, it was comfortable. I could have been cooler and the first night we powered down I got a little cool that night and that's the only time. At the other times, I was warm but not uncomfortably so. The controls worked as advertised and we let the O_2 demand regulator repress the cabin when we got up to 4.5. Suit mobility hampered Dick considerably in the cockpit.

Gordon I think the thing of it is simply that that bunny layer on the

EVA suit prevented me from reaching the same places Pete could. I couldn't reach the....

Conrad In operating the water panel and the camera box. I did all those operations because he just couldn't reach them.

Gordon Well, I eventually could but it would have taken more effort than was really necessary to do so, but it does restrict the mobility in the spacecraft a little bit. Pressure: the thing was fine as far as the EVA was concerned. That suit was the best one I have ever seen and was strictly satisfactory. Temperature: I was kind of surprised. I wasn't as warm as I had anticipated. I was warm but I cannot say that I was hot at any time during the flight in that suit. Now, at no time did I move that suit flow valve off the high position other than to make certain checks. But I left it on all the time and I never did get cold. I must say that I was comfortable for most of the flight. I was surprised. I thought I was going to be a lot hotter than I anticipated. Everybody was talking about how hot it was but even fully powered up, for which we were for a large portion of the time, I was fairly comfortable. We did wear the neck dams and the wrist dams. When the helmet and gloves were off we wore them all the time. Humidity was no particular problem. In fact, I think it was probably just the opposite in that the cabin was so dry that I noticed in talking my voice would change from dryness. I

was always reaching for the drinking nozzle and I was well aware that I was dry the whole time. Not uncomfortably so but noticeably so. CO_2, no problem. Comfort, I think I adequately covered that. Controls, no particular problem with that. They were adequate and easy to reach. The O_2 demand regulator, Pete covered that. Visor fogging, I never had any visor fogging at any time. The 30 foot umbilical, no problem with it. "Y" connectors, no problem. Electrical jumpers, no problem. Standup hoses, no problem. Thermal gloves, no problem, with the exception that I still question the need for all that bulk in a pair of gloves. People are obviously smarter than I am as far as thermo is concerned, but to me to wear gloves that bulky is a genuine hinderance to finger dexterity.

FCSD Rep Did it hinder you when you were connecting up the clamp on the tether?

Gordon No, I can't say that it did. I don't think that particular aspect bothered me at all. They're just bulky and I purposely had those gloves tight because I didn't want to experience this ballooning when pressurized. I may have possibly had them on the tight side. I think if I had to select a pair of gloves for EVA operation again I may have them just a little looser than I asked for them this time. But I asked for them specifically tight unpressurized so that they wouldn't balloon and be bulky in a pressurized condition. But they're so

doggone thick and so padded that finger dexterity is really hampered by this. I think this is an area that really could use some work on. The materials or something that you don't have to contend with this tremendous thickness.

FCSD Rep Did they ever get the seam out of the way that was bothering your thumb?

Gordon Yes, they got the seam out of the way because I didn't use that glove. I took one of the older gloves. The left-hand glove was the old one and I had the brand new right-hand glove. Actually, what happened was, the left glove, the new one, developed a pin hole a couple of days before flight and they just substituted the backup left-hand glove which as far as I was concerned was fine. Interconnects, these I don't like. I wanted to say concerning these interconnects - I wanted to really say that the features that were added after Gemini X (John's so called lock-locks) as far as I'm concerned, are a necessity. If nothing more than for the peace of mind of the guy that has to wear this equipment EVA. Now, those wrist wring locks were really nice. Once I put those on I knew that they were locked and they weren't going to come unlocked. The lock on the neck ring, the pin that goes through there, is a very nice feature. I knew that wasn't about to come undone. The new connections they put on the suit were what was required. I never used any tape on those locks, interconnects or anything

other than these interconnects to plug in the extension hoses. I taped those. I was very concerned about those. The other connections that I was concerned about was the connections on the ELSS. I taped those also. Now, I just don't trust those things and as far as I'm concerned, even if it is just for the pilot's peace of mind, those things should be designed so that they are definitely positively locked so he doesn't have anything to worry about losing pressure when he's EVA. I'm not sure how to do this. I'm not trying to design it, but if we are going to be forced to use this kind of equipment (which I hope we're not), I think you have to have more adequate locks on these things so that you don't concern yourself with them coming undone. Once they're made, they're made and that's it. ELSS restraint, no problem with the ELSS. I slapped that thing on and it stayed in place, and there was no problem with it. The electrical extension was fine and the hatch closing device worked great. The EV visor, I think we have adequately covered this EV visor in the flight planned portion of this debriefing itself. But that is one piece of equipment that I have just got to give a big 'down' to. The thing just simply did not fit my helmet. I had trouble getting it on even with the helmet in my lap. It gave me more problems than any other single piece of gear. I had to use added care to protect the thing during flight and I think we did reasonably well. There was

a couple of scratch marks on that visor when I was all through with it but they got on there after it was used. When I went out EVA the first time with that visor on there wasn't a mark on that thing. I looked at it before I ever tried to put it on the helmet. And I think just a normal amount of care and protection is going to keep that gold on there without any problem. But to put that EV visor on the suit when you're fully pressurized is a kluge and it was a thing that got me behind the 8-ball right away. There's got to be a better way to give you that type of protection even if it's built into the helmet. But we've talked enough about that and as far as I'm concerned the EVA visor is an unsatisfactory piece of equipment. The cabin pressurization: man, after it sealed, it sealed high at 5.8. After that, it bled down to 4.9 and as far as we're concerned it never moved off of 4.9 the rest of the flight. That thing was like a rock and I don't think either one of us was ever concerned about that. Temperature was all right, a little on the high side because of the powered up configuration we were in but it wasn't uncomfortable, I don't think at all. The suit ran between 50, 52, 53 most of the time and I don't even remember what the cabin was. Do you, Pete?

Conrad What, the temperature? Oh yes, it ran around 78 the whole time. It never got above 80 that I ever remember and I never

saw it below 75. Cabin humidity, I still say is too dry for good comfort. It really is. CO_2, no problem. We covered that. Comfort day and night: no real particular problem. Cabin fan: when we were powered up most of the time, we ran on fans 1 and 2. For EVA we did use number 1 fan. For the powered down configuration we were on number 1 fan. There were no abnormalities with that. Cabin pressure relief valve worked as advertised. The cabin pressure regulator was fine. We did notice an awful lot of venting when we put the ELSS on. We were so far ahead of the EVA prep with the ELSS that we did go back to the ship's ECS system so we quit popping that cabin relief valve. That thing was like a flutter valve rather than a relief valve with that outgassing from the ELSS. The ELSS really made that cabin pop. Cabin vent valve, okay. Cabin repressurization valve, no problem. We used the cabin repress when the ELSS wasn't repressurizing the cabin, and it jacked it right up there right away and as soon as we got to the regulated portion of it we turned it off and let the regulator take it the rest of the way. Cabin air inlet valve, okay. Cabin air recirc valve, okay. Primary O_2: System monitoring. I think this probably gave us more concern or more cause for monitoring more than any other system in there. It seemed to me we were always going to that manual heater. Everytime I turned around the cryo O_2 pressure was down. I was

continually turning that thing off and then you were worried about how long it had been on and what the pressure was. You didn't want to vent this stuff so you'd continue to be concerned about looking over there to make sure you weren't building up the pressure too high. And by leaving this thing on for such a long period of time it tends to take away the effect of a warning light. You might as well take the warning light off there because once it's been on for 5 minutes or so you tend to ignore that light. It doesn't serve a function as a warning light anymore. I think the more realistic evaluation of how long you can leave the manual O_2 heater on without worrying about burning it out, this 1/3 duty cycle, is a big pain in the neck. I don't think you should penalize a crew for a system deficiency by making them monitor a system that thoroughly. The quantity measuring system was perfectly adequate. Flow rates were good; pressure and temperature okay. I've already said my little piece about the manual heater. Controls, no particular problem. Secondary O_2, we almost forgot about it. Once we got into flight, and Pete turned off the left secondary O_2 and it was virtually forgotten about the rest of the flight. The pressure stayed right up there. We checked it several times. During the flight we would go through the whole cockpit and check all systems. We never changed configurations except for reentry when they were both open, and that was it as

far as secondary O_2 was concerned. After adapter separation, I never noticed the difference in going from the cryos to the secondary bottles. CO_2 partial pressure, no comment. ELSS: As far as I'm concerned the ELSS controls were adequate. Connections, I've already talked about. The monitoring system is perfectly adequate. Operation was okay. Restraint straps, no particular problem. We have a great big serious question about an ELSS and that just simply is, why do we have to wear it. It's the biggest hindrance you've got to doing any EVA operation. It's in front of you and the only thing that belongs in front of you is your hands and the article you've got to work on. It's just a big hindrance and as far as I'm concerned it's just a piece of claptrap. And I would seriously recommend if we're going to continue this type of an EVA operation, the way we're doing it today, is to investigate the possibility of just extending the ship's ECS hoses and running it right off the ship's system.

Conrad Or if you have to carry a mechanism like the ELSS that jacks up pressure because the suit fans can't hack the Delta P drop with a guy on a short set of hoses and that sort of thing, if you got to carry a kluge like that, carry the kluge in the cockpit and run the umbilical line from the cockpit and plug it into the guy. Don't make him carry all that claptrap with him. I'm convinced we would have batted through that whole

EVA if we didn't have to do two things: screw around with all that claptrap associated with getting hooked up to that EV visor and having all that claptrap in front of you.

Gordon I think we can say this because of the standup EVA. There was a work load in the standup EVA installing the cameras and putting them on the brackets and operating them, reaching down turning the Agena control system off and on; these are work loads and realistic work loads. But at no time during the standup EVA was I ever ever uncomfortable. As far as I'm concerned it's the only way to go.

Conrad He never shoot out of the cock pit. I know that ELSS exaust system was making a racket.

Gordon That's a good point, the strap could be loose and I had no trouble staying in the cock pit. The only time that I asked Pete to tighten it up was when I was standing there so I could apply enough force to pull me down enough to put my feet on the floor so I would be closer to the Agena Encoder. So I didn't have to work to get back in to turn it off and on. I wanted to be close enough to it so I could just kind of lean over and reach it with my hand. But during this time I didn't notice any tendancy to float up and out of the cock-pit. Now, I couldn't see the tether and I'm not sure that it was always tight-

Conrad No it wasn't. There were several times you asked me to short-en it and I shortened it and you got down there but you tended to stay put and you would get a little slack in it again.

Gordon This is an indicator to me that this is probably the cause. Okay, the stowage of the 30 foot umbilical. Those people on out FCSD team did an outstanding job. I'm speaking for Pete right now but the stowage of that thing was magnificent. As far as I'm concerned they're with me all the time because they really did a fine job and the reason I know this is be-cause Pete didn't complain one time about that thing being in that footwell. I tell you that guy really deserves some

credit for the stowage on that umbilical, it was really nice. The only time we'll complain about the umbilical was when it was all undone in the cockpit. As far as we're concerned with all that claptrap out in the cockpit we're in an emergency the whole time that's in there. We didn't feel like we were out of that emergency until we jettisoned all that equipment. Okay, connections were no particular problem. We knew what they were and they were no problem. Dynamics, I really didn't notice any tether dynamics once I was outside. This didn't bother me. I think possibly the reason was because Pete didn't let out any more umbilical than was required for me to go to where I did. And we had already agreed to do this. I didn't want 30 feet of umbilical floating around outside and he'd have to pull all of it in just to get me back to the cabin so we pulled out an adequate length (I would guess something like 15 feet) and this is as much as we ever let out. The rest of it never left the cockpit because this was all I needed. So I can't really comment on the dynamics of the thing. Coolant System: radiator operation and configuration, evaporator operation and configuration, I've already commented on that. We went to the normal inflight configuration over Tananarive when John Young called us and told us the flow was normal and stayed there the rest of the flight. We had no particular problems with the Coolant Loop operation

at all. As far as we're concerned it required no monitoring and worked beautifully the whole time. Water management, the panel accessibility I mentioned. I had trouble getting to it with the EVA suit on; Pete was always able to get to it and he did most all the urine dumps and took care of that since it was easier for him to reach the heater switch and the dump switch. I could have if I had needed to but it was just something I didn't want to expend the extra effort doing. Valve Usage: the only one we used was the dump valve. It's the only time we ever used it. Water Dispenser: I don't think we have any particular comments on the water dispenser, it worked the way it was supposed to during the whole flight. We never had any problems with it. During system assembly and operation it was really nice to have the old type urine dispensing system because it worked great the whole time. Pete and I used the same device all the time and when we used one rubber for about a day, it would start to get a little gummy and not roll out enough so we'd just change them. In fact we had some left over. We didn't use the normal alotted amount of them. We just used them until we felt we might just as well change it because we had an adaquate supply and there was no problems with it at all.

8.5 Communications

Communications: Interphone, operation and quality was

completely satisfactory. No radio problems on the interphone. UHF Performance: Countdown was really nice and I think the recommendation and the way we used the push-to-talk during the countdown was nice. It cut out a lot of extra chatter. We did not go to continuous interphone and push-to-talk until the T-3 hold and then we picked it up. The countdown checks with Capcom, Stoney and tanks should be done during the hold, not done during the count because after T-3 you want to be listening to the T/C. He's got things to tell you about Pre-valve openings and so forth. All those communication checks should be done during the hold. This is the way we did it Al, I'm just saying that this is the way it ought to be done. It's pretty nice the way it was done. UHF performance during orbit for the general part was excellent. We thought we had excellent communications world wide. We didn't have any problem with any station. In fact, Tananarive and the Ascensions as far as we were concerned were great. EV (Extravehicular Activity) - we did start out on VOX - and apparently I had that thing keyed all the time and Houston wasn't getting through so we did go to continuous interphone push-to-talk for that latter portion. Recovery: communications were great. Voice procedures, other than the one we mentioned about Air Boss trying to set a short count, were fine. I think the updates we got from Houston, the short

abbreviated formats, were adequate. We were on our flight plan and things were progressing as we wanted them to and we didn't want any updates. We didn't want to hear from anybody because we were busy. And it just takes time to write down these updates and if they are not required and you're on the flight plan and you know what you are going to have to do, it's not necessary. I thought they were excellent throughout the flight. There wasn't any time when we were rushed to write something down and we always pretty close to being ready to copy what they had. HF Performance; it was never turned on. The antenna was never extended. Voice tape recorder: controls, no particular problem. Cartridge changes: When we first started the flight we went well past one hour and we never did get a end-of-tape light. This was to begin with, so I think we probably lost some of the tape recorder. We were concerned that it wasn't operating during the first part of the flight because the end-of-tape light never came on. We did check the cartridge and it had run out so we just assumed that maybe there was something wrong with the end-of-tape light. So we put the cartridges in as we thought we needed them during the flight. But near the end of the flight the end-of-tape light did start to come on. And we still weren't sure if it was operating properly or not so we kind of played the tape cartridge changes by ear except when the

light did come on to remind us but it did give us some concern at first because we weren't sure whether the recorder was operating or not. But apparently it was and it was just the end-of-tape feature that was not working properly.

Conrad It worked one time on some tape--all of a sudden the light flicker came on about twice. On two tapes we caught it on the light. The tapes are going to be all right because we changed a couple to make sure we had a full tape for an exercise so there will be some half tapes and some full tapes and there will be some tapes that run out in the middle because we thought it was through running.

Gordon The digital command system updates from ground, MDU - these were no anomalies at all during the flight, they were all normal. Real-time transmitter, okay. Delayed time transmitter, okay. Standby transmitter, did we even use that?

Conrad That's another thing. We obviously had no ground problems because we never had any word from the ground on anything about resetting that playback so all that ground function staff on the spacecraft must have worked beautifully.

Gordon Controls and displays, nothing to say. Coordination with the ground: The only thing we even did with the ground was go to real time and Acq with the T/M switch on occasion. That was maybe two or three times during the flight and that was it. Procedures: adequate.

Conrad The communications system worked great. We did have one anomaly that I never did understand and it was associated with the O_2 and H_2 cryo quantities. All of a sudden in the middle of the flight, for no reason we started picking up a very dull low tone. Everytime we went to cryo O_2 or cryo H_2 we picked up this thousand cycle tone steady in the earphones anytime we were in those two positions and it happened about half way through the flight. For the rest of the flight any time we were in the cryo O_2 or H_2 position we heard this little thousand cycle tone. It must be something in the transmitter of the cryo gage. I mentioned it here in communications because we heard it in the comm system. It wasn't there at the beginning of the flight, I'm positive. We just got used to it. Beacon controls, I thought were flight-planned well.

Gordon The antenna selection, sleep configuration, we didn't do anything to change the configuration. During the night tumbling flight without the Agena, we went to the reentry antenna

but that was the only time we were worried about changing it.

Conrad Otherwise, we were plugged into the Agena all the time so we had to be on the adapter selection so we never changed it. Beacon control was run extremely well on the flight. There was very little voice comm about doing anything with the beacons. We did them according to the flight plan, and that's the way it should be.

Gordon T/M controls: Transmitter and antenna, we've already mentioned this, no problem, we never worried about them.

8.6 Electrical

Conrad Electrical System monitoring, that was straight forward.

Gordon No problem there at all. All you have to do is look at the gages. Fuel cell operation: Power down, power up were completely normal. Purging was for the most part normal. We did get hydrogen delta P lights during the purges during the last portion of the flight.

Conrad We had this 2-C stack failure and whatever failed in the stack failed instantaneously. It never got soggy, at least we didn't notice it getting soggy. It was just all of a sudden zero. And there was no voltage so it must have burned out.

Gordon The ground asked me to check it and there was zero amps - and I checked the voltage and it was zero, so nothing else to do; so we turned it off. I dont' know what was the matter. I sure didn't see it fail. We didn't see it do anything but we did

turn it off.

Conrad 1-C was always carrying about 5 amps more than anything else was.

Gordon They were steady the whole time. There wasn't any fluctuation. They weren't straight across the board but any deviation they had remained that way regardless of the power load. The share that they started out with they maintained throughout the flight, with the exception of 2-C and it failed completely. The Main batteries: The only difference I noticed on the main batteries at all, (and I checked them a couple of times during the flight) was that number 3 battery was a hot one and it was a couple volts or a volt-and-a-half hotter than the rest of them. And that's the one we used when we had to supplement the fuel cells when we had the TV monitor on and everything else powered up. We were using the D-15 equipment on S-30 and we also used the number 3 battery. It actually did knock it down a little bit but it never did fall down to the level that others were. Battery tests, they always read 22 volts, with the exception of number 3. The amps were all above 8, I'd say 9-9 1/2 amps on all of them. Squib batteries: I never even looked. I looked at the common control bus but I didn't check out number 3 squib battery. The switches remained on throughout the flight and I did not concern myself with them at all. Monitoring of electrical power remaining.

Conrad We never had a problem. We separated the adapter with 30 something percent H_2 remaining and we could have run powered up for days.

Gordon But, consequently, we didn't concern ourselves with any onboard information about power remaining. We did not plot any "How goes its" or anything else.

Conrad No, it's no problem.

Gordon And we felt that the ground had more than enough information and if they felt that we were running short of electrical power they would have told us about it.

Conrad Yes, we had more important things to do at that point. Don't worry about those things.

8.7 Onboard Computer

Gordon I'll continue with the onboard computer, Man, that thing was like the platform.

Conrad M=1 speaks for that.

Gordon They ought to put that thing in a gold case. The launch trajectory status. There was no doubt about it. I did get IGS guidance on time, 18 seconds after SECO and it was 4 seconds ahead of the RGS guidance. Steering brought it right in and, fortunately, it was within a half to a degree throughout the second stage boost trajectory. And at insertion they were right on the money. IVAR routine was perfectly nominal. I checked the IVAR one time by reading 95 and it had 41 feet in

it and that was what the IVT's had. IVAR was great. No problem with it at all. Orbit determiation, Predict navigation, Rendezvous speaks for itself. No anomalies at all. Retrofire, it did its job beautifully. Reentry speaks for itself. Updates were always good. No particular problem. MDIU quantities were verified and MDU operation was nominal. Computer modes: The ones that we used were nominal all the way through.

Conrad Prelaunch was good. Had a 18 to 19 second self-check routine. We always used that shutting down, or powering up. Ascent was good. Navigation catchup was always good. Rendezvous mode was excellent. Predict Nav we didn't use. Reentry was good. Orbit determination we didn't use. VOX tape memory, beautiful We loaded Module III for the M=1 rendezvous. It went right in. I didn't verify it. We prepositioned the tape so that tape position worked 41 and we started and I no sooner turned it on and away it went. It was loaded well before we even came close to refiring it.

Conrad We only made two loads. We loaded Module III and left it in for the whole flight and for retrofire we loaded Module IV and that was it.

Gordon We did load and verify Module IV.

Conrad We put it in as an 03 and because we had plenty of time, we let it load and verify itself. It operated perfectly.

8.8 Radar

Gordon Pete, the radar is all yours.

Conrad Okay, warmup time, Acq ranges - I had this one little glitch at 25 minutes where I turned it on and I was still pitched down and I got an Acq light and it broke lock and I was still on the horizon and I thought, well, maybe it's against the pegs and it's not going to hold acquisition, so I'll wait until I pitch up. When I pitched up to the proper pointing commands and turned it on, it locked on and stayed on. After that, we played it just like advertised. When we got to TPI and pitched down to burn, I never played with the lock-on. It stayed locked on all the time. I pitched back up again after TPI. (Of course, the rest of the time we were pointed at it.) We never had loss of lock during the rendezvous. We never had false lock and the boresight agreed perfectly with the visual sight. We had them visually and when I aligned the radar needles the visual sight showed a half of a degree of yaw left and a half of a degree of pitch up. That was consistent and we've explained the anomaly that we had with the radar as far as the azimuth and elevation wandering off and we've explained the anomaly we had with getting MAP lights which was, apparently two separate problems. One was a problem with our radar azimuth and elevation apparently, or antenna pattern, or the whole problem lay in the transponder on the Agena. I don't

know which it was. But this has all been well laid out.

8.9 Crew Station

Crew station: We had nothing on controls and displays. The sequential telelights worked as advertised. The event timer worked as advertised. The digital clock stayed in sync the whole time. We had the one anomaly on the digital clock where I inadvertently turned off the electronic timer circuit breaker when I was turned around in the stowage box and caught it right away but the clock had stopped running. In about 5 minutes we caught it. We had to re-sync a few things with the ground and we got the clock running again and we never had another problem with it. It stayed in time all the way. GMT clocks, I never asked for a GMT update because I didn't need it. We had enough GET information available to us and we were happy. We really think so. I never even asked for a GMT update and I don't know how well the clock stayed in. The IVI's worked perfectly. The Flight Director Indicator worked perfectly. Range and range rate indicator worked perfectly till we had our radar glitch and I'm sure that had nothing to do with the indicator. It was something in the radar. GLV fuel and oxidizer pressure gages: They worked perfectly throughout the boosted flight. Just as advertised. The altimeter was very smooth through boosted flight, and wound right on up to 97 000 feet and quit. Actually, it quit

at 94 000 feet and as we flew along in orbital flight, it gradually crawled itself around to 97 000 and stayed there. Rate of descent indicator did the same thing. It indicated a rate of descent of 15 or 20 feet per second, there in orbital flight right after insertion and eventually wound up indicating some rate of climb number above zero and stayed there for the rest of the flight. During reentry, I have to be honest and say that when I saw the main chute deploy with no ribbons in it and we successfully went to two point, I never even bothered to look at it. I didn't feel that I needed it.

Gordon I looked at it just before touchdown because I wanted to get the dang cabin repress valve off so I watched it down to 200 feet and we hadn't hit yet so at 200 feet I just bracked myself and I would guess that when he hit the water it was about zero. I mean it was that type of time duration.

Conrad You're talking about the altimeter.

Gordon Yes.

Conrad I'm talking about the rate of descent indicator.

Gordon Oh, okay.

Conrad I never looked at the rate of descent indicator. Yes, I watched the altimeter but I never looked at the rate of descent indicator. At least, it must have been in the normal position during descent on the chute or I would have noticed that sort of thing. But I was looking mainly at the altimeter. The

accelerometer worked beautifully on boosted flight. It worked beautifully on reentry and it also worked beautifully on the Agena powered flight.

Gordon When we were on the nose with the Agena?

Conrad Yes. Switches, we had no problem with any switches. The only problem we had with any circuit breakers were a couple of inadvertent operations and we mentioned both of them. One was Suit Fan number 1 during EVA and the other one was me knocking off the electronic timer. Did you ever find any other circuit breakers you knocked off?

Gordon No, never found any.

Conrad And I never found any. We never knocked any others off that I know of. Mirrors, fine. Swizzle stick, we didn't need. We stowed it. Umbilical EVA was just the way we planned. We hung it on the cabin vent valve - the tether for it. I stowed it out of the way. And that was it. Lighting is the same as it has always been. It worked fine. We had no lights burn out. We had adequate lighting when we needed it. I'm sure there are better ways to do it these days but this was perfectly satisfactory for our uses. So I have nothing on the lights through left panel, center panel, right panel, pedestal lights, consoles. We could see everything. We always had enough light in the spacecraft when we were using the water management panel, to see what we were doing. We used the

utility lights. Dick used his penlight a little bit. I used my hand glove lights every once in a while when we were gloved for some reason. Onboard data, Flight plan rendezvous, and experiments and systems books.

Gordon They better be all right. We made them.

Conrad Yes. They were all right and they worked perfectly in management and usefulness. We designed special ones for the EVA list. Checklist, rendezvous and miscellaneous cards worked the way we advertised them.

Gordon If they didn't serve the purposes they are our problem.

Conrad Dick wrote clock start time down on the itty bitty card he had up on the timer and I had my little card over there. He had this other card for TAP prime and all that information.

Gordon Oh, I will mention the covering they put on those cards was not very good for Pentel pens. You wrote on it all right but it was almost like writing on glass or something. The covering that they put over the little cards we made for inside was not very good. They shouldn't have used that - I don't know what they put on it - plastic or something.

FCSDREP It was a type of tape and it was put on so you could wipe it off and put another note down.

Gordon Well, I didn't use those cards for that sort of thing; I put a line through it and wrote below it. But I would recommend that they don't use that anymore.

Conrad The Agena command card list Dick had out where it was available and used it all the time. I used the High Orbit Card that I wrote up just the way I was supposed to use it except we never did feel that we needed to compute up times on it. We could have if we needed them. The map worked fine. We could always find out where we were with our nodal update. I've got to say one thing: We never pulled the star charts out. We never used them. And that's simply because we trained on the experiments. We knew the stars and the heavens that we needed to know and when we needed them we didn't need a star chart to find them. You've got to carry it onboard through.

Gordon I think that's the comment I want to make. You've got to carry them onboard in case you get an update or something or a no-platform burn on a star and it's one that you may not readily recognize. This should, obviously, be carried. We carried both types, the polar plot and the Mercator projection. We did carry both, but we never used them.

Conrad The star alignment setups for the S-13 were displayed in the EVA checklist book. The hard suit EVA. And I used that in flight. I had it down on the panel while the hatch was open and I had my red light on and Dick would line me up and then I could tell by looking at the chart what roll orientation I wanted because I couldn't see too well with my bad window. Then we would get it all organized and away we went. So, we

didn't need any of that stuff. Stowage worked beautifully. And again I can only say that the stowage worked well because we worked on the stowage for 6 months and we didn't let anybody change anything and we got rid of the stuff we didn't need. I'll tell you, if I think about it right now, there wasn't anything in that spacecraft stowage that we took that we didn't need and I think of some 57 items I made them delete as handy gadgets to have on the flight and they would not have been handy gadgets for the plain and simple reason that we didn't miss any of them.

Gordon That's right. I think not enough can be said about cutting down on stowage. Some of these things may very well be nice to have but if you don't absolutely need them in flight they are going to plague you. If you don't really absolutely need these items, you should never take them along. Because you just have to pack, unpack and repack. Even as well as this organized for this flight you still have to do that. If you have extra items onboard it's going to cause you no end of problems. There is just not enough room to have the luxury of taking extra equipment. I don't think we can make this point strong enough and when people come along and want to add things to it - you've got to do it. This is the only reason this flight went as well as it did, timeline-wise, was because we worked so hard on this stowage problem.

Conrad Even as hard as we worked on stowage we spent time during our sleep period discussing the next day's operation and thinking again for the 99 000th time about what we needed out and how was the best way to juggle the spacecraft. Let's see, before the standup EVA, after we cleaned up, we knew that we were going to do standup EVA on that third day and the only reason we got everything done right on the third day is because the night before the third day we talked the whole operation over from high orbit stowage for cameras with a PPS burn, standup EVA - those two items required extreme control on stowage and Dick and I restowed the spacecraft that night during our sleep period in a manner that we knew we had using our high altitude orbit checklist and all the rest of the stuff, so we had it just down to a gnat's eyebrow. And we humped the third day anyhow.

Gordon It was a very busy day, that third day. It was rewarding for that reason, though. Belts, no problem. Harness, no problem. Life vest, no problem.

Conrad Got a comment on the life vest. The training life vest that we used were smaller than the flight life vest and this sort of stuff is the place where you get into trouble. And, by golly, they were considerably larger than the stowage life vest and to the point where as much EVA work as we did and M=1 rendezvous work suited, I was really aware of the fact that

these two life vests were bigger.

Gordon I want to make a comment on life vests that I had forgotten. When I had popped or deployed the left life vest after recovery when I was sitting in the raft before helicopter pickup, it didn't get a full charge. It was soft. And I blew it up the rest of the way by mouth. Other than that, as far as that operation was fine. The right one did inflate fully but the left one was soft when I deployed the CO_2 cartridge.

Conrad Yes, why don't you talk to John and let get waste disposal. We, of course, jettisoned every time we had the hatch open - I mean the second time and the third time we opened the hatch we jettisoned. No, I take it back, we jettisoned all three times. We opened the hatch for the umbilical EVA and jettisoned garbage. We jettisoned gear on the second hatch opening. And the third time we jettisoned garbage again, food bags and stuff like that. Color coding, we used the striping on the throwaway bags, the stuff that we wanted to know and that worked perfectly. Boy, after the umbilical EVA we had these bags and gear stowed and thrown away and there was no confusion in the cockpit about what we should keep or where an item was. We threw away all the right things without any trouble at all.

6.10 Spacecraft exterior

Gordon Hatch operation. I think that the first thing that ought to

be said was before lift-off, Pete's hatch didn't seal.

Conrad I don't know what that problem was.

Gordon It had to be cycled one time and sealed and we were on our way. As far as the hatch operation in flight, my side of the EVA hatch operation, I could have sat there and opened and closed that thing all day with no particular concern. It was an easy task to perform. I think one of the easiest tasks was that I didn't have to be concerned about getting down in the footwell to get it closed. Actually, one time I closed it all myself just sitting on the front edge of the seat, right on my head. It didn't get down all the way, but I got it down and engaged a couple of dogs and a sawtooth and Pete reached over and grabbed the hatch closing device and snugged it down to the last one and I reached up and dogged it down. The forces to close it, I don't know what they were. They were awful light. I used one hand and just pulled it down and go all the way. There was no stiffness. If there was 35 pounds on it, I'd be surprised. That's a guess. Handrails and Velcro pads. The Velcro pads I didn't even utilize. The handrails were fully deployed. The manual handrail was deployed. No problem. The handrail in the back I assume was deployed because the umbilical guide was extended. I could see that it was out. Window covers didn't do their job, so they were jettisoned. They didn't do their jobs because the windows were

dirty.

Conrad Yes, I don't understand that. There was stuff on the outside of my window right after I jettisoned the cover. The only other thing I could think of was that there is some cloud, maybe at spacecraft SEP or booster burnout. It would have to be something that's carried right along with the spacecraft, through, so that when you take a window that has gone through the launch environment and may be warm, or something like that, that it collects it. Because of this substance around the spacecraft outgassing from somewhere or something. Because I almost had the impression that the window as clean as a whistle till I popped the window cover. And then it was dirty on the outside. Now, I had another window problem which was dirt on the inside part of the outer pane, some greasy substance. This was what really screwed up my vision.

Gordon Glare shields. I think you made a comment comparing these we had on this flight with the ones you had on V. Remember you were talking about no wonder Jim and Shakey complained about the glare shields?

Conrad Yes, the Polaroid ones we had were completely opaque when you turned the Polaroid filters together to the maximum position and these that we had let light through. Even when they were turned to their maximum darkness and I didn't quite understand this. Because the ones we had on V were much better. Now,

glare shield - we also carried these two sunglass type things. And they were outstanding in the daytime, because we could see in the cockpit and look out and we had good vision out of them and everything. They were outstanding.

Gordon Even with them in there though, the sun during boost phase was bothersome.

Conrad Yes, it was. Even with that sunshade in there, I held my hand up over my head during boosted flight. It's the only way I could see the booster engines.

Gordon And I did too, for the time it was in my window. I couldn't see anything inside so I just used my hand to shade my eyes from the sun. That shield really didn't do the job but for orbital flight it was great. In daylight hours it was really nice to have that on there. We wore sunglasses also quite a bit during the daytime.

Conrad The docking bar worked fine on deployment, fine for its purpose of docking. We had that glitch when we tried to jettison it with the tether on there. Something apparently fired partially on the first time and then the second time I hit it - what may have happened is that it is a spring-loaded switch and I may have hit it up and it only partially started the squib to fire or something.

Gordon How would you do that?

Conrad Darned if I know, but that is the only thing I could think of

because it worked the second time.

Gordon I know it.

Conrad It was really a weirdo because something fired in there but the bar didn't go and then the second time I put the switch back up again, away went the bar.

Gordon Maybe someone can explain that.

Conrad The only thing I can think of is there might be a time delay. And it just happened to go coincident with me putting the switch up the second time.

Gordon It was weird. We both had a moment of doubt about how we would ever get rid of that Agena at the end of that tether.

Conrad You had some comments on-

Gordon EVA camera mount. I do want to mention that. It was hard to install. It did have the rubber gasket on it or the rubber washer. I couldn't push it down standing on the seat because I didn't have any leverage. I had to get up above it and push down on the camera to get it engaged in the adapter. And the other thing, once it was engaged I couldn't swivel it. I couldn't turn it. I put it in a forward position and when I got back to the spacecraft to go to D-16, I installed it that way and tried to swivel it to the D-16 position and it wouldn't work. I couldn't swivel it. I had to pull it out and reinstall it in the D-16 position

9.0 VISUAL SIGHTINGS

9.1 Countdown

Conrad We saw the bumble bees during the countdown after the erector went down.

Gordon I saw the erector going down with the mirror in the window. You could see the road.

Conrad I was on the gages during liftoff and I stayed on the gages at BECO. You said you picked up the flash. It wasn't that we were ingulfed in any flame or anything. It was just an orange flash, that I picked up out the window.

Shepard At staging or --

Conrad At staging. It wasn't spectacular at all, it was just a momentary orange flash and it was gone. There was no debris or anything else out there at all. You picked up the horizon when you expected to pick it up, because I picked it up at about 70 degrees pitch angle, sometime after guidance initiate, and just took a quicky peek at it. At SECO I stayed right on the gages.

Gordon I did look out at SECO.

Conrad You looked out and I chided you.

Gordon I got right back in, but I looked out and was flabbergasted by all the debris that was out in front of us. Man, there was junk all over the sky out there. I don't know what it was. It was

just junk going by the spacecraft. I took a quick peek, got jabbed by the boss, and got back to work. I don't think I looked out again for quite a while. But, I couldn't resist it.

Conrad Fairing jettison was straightforward and there is nothing to compare that to, because we jettisoned our fairings at 3:15 on Gemini V during boosted flight and it blew all to pieces when they came off. These came off real clean.

Gordon I didn't notice the nose fairing go. I saw some shadow out there but I didn't see it as a nose fairing.

Conrad We had the usual visual sightings inside the cockpit after SECO, washers, and tools, etc.

Shepard Did you blow the window covers off at the same time?

Conrad No, the covers were done much later. The windows were dirty. The only thing that I can say about this is that I had the decided impression that the outside film appeared when I jettisoned the window cover.

Gordon Mine did, very definitely.

Conrad I don't know if an outer glass on it was protecting light from scattering on an already dirty pane or whether something was around the spacecraft so that when we jettisoned the window covers, this film appeared. Anyhow, it didn't change for the rest of the flight. Now, I am referring to the film on the outside of the windows, and that film is exactly like we had on Gemini V. I would have considered it a very clean window,

and it would have been the same as Dick's if I didn't have the inside stuff on it. Dick's window was good for photography. It was dirty, but it was --

Gordon Yes, I noticed that film on the outside right away. It was streaked. It looked like the glass had been wiped and you could see the directional flow of smear, but it was almost clear. It looked like somebody took a rag and wiped the window. It left a real thin oily film. I picked this up immediately upon window cover jettison. As soon as we got it loosened and turned that key 90 degrees, the window covers came straight back. Right away you could see the film on the window, but there wasn't any of that visible before the window covers were jettisoned. I looked through the window cover when it was on, and it looked like the window was completely clean. I kept saying to myself that we were in and then when I got the cover off, "smear." It didn't change for the entire flight. It stayed exactly like that for the rest of the mission except it did burn off during reentry. You could see it, it was like somebody set a piece of cellophane on fire, and it crinkled as it burned, but this was from the outside of the edge in. There was an inch strip around this film that was completely clear all around the outside of the window, about an inch wide. There wasn't a speck of anything on that part of the window, but then the smear was on the rest--

Conrad You get the impression that the window sat in the sunshine on the ground prior to launch. The center of it would be warmer than the edges because it might carry off some heat through the structure around the edges. It's that sort of thing. You have a different temperature, and it accumulated this stuff. I couldn't tell that it accumulated during boosted flight. I had the impression that it wasn't there until I jettisoned the window cover, but by the same token that could have made the light reflect on that pane and not the next pane down. So, I don't know.

9.3 Orbital Flight

Conrad We didn't see our own booster on orbital flight at all. We did spot the one satellite, and I thought I saw another one later, but it turned out that it was a large particle outside the spacecraft. But, the satellite we picked up, boy, it was loud and clear. They told me it was 289 miles away. It must have been awfully big. I read that it was Proton III.

Gordon Oh, is that right?

Conrad I assume that this is a booster that they left up there with it. I had the impression, and I told Dick, that it looked like it was a booster. I didn't think it was that far away. It was big, whatever it was. I could tell it was long and cylindrical, and I had the impression that it looked like the second stage of a Titan. I had the impression that I could see

an engine bell. We had the Agena acq lights as soon as it got dark. We'd already had a visual, and just as soon as it got dark and the sun stopped shining on it we had an acq light. There was no time to switch over at all because we were fairly close now. The first sighting of the acq lights was right at darkness, but as far as first sighting of the Agena went, I told Dick I had the Agena in sight, and I asked him for the range, but he was doing something. He did something for a fair amount of time. He finally punched Address 36, and at that point it was 61 miles.

Gordon Let me look up that number. It was right here on the data page for the rendezvous, and I was verifying the addresses in the computer.

Conrad Yes, you were at 25 minutes.

Gordon No, it was just after we switched into rendezvous.

Conrad 29 minutes, so we ought to be able to correlate that because we were in an almost nominal trajectory.

Gordon Well, I can't really tell the time, but I was checking these off, and the reason that I know it was this time was because I punched up 36 during verification here. I wrote 61.45 miles.

Conrad Well, that's data point four, and you are closing at about 4 miles a minute there, and if you go back about 12 miles that would be about right. I'm guessing 75 miles is where I saw the Agena.

Gordon But by the time I got to it, I wrote down 61.45 miles. This was in the sunlight.

Conrad It was before sunset. It was long before sunset, and the sun was behind us and shining on him, and he was just like a first magnitude star out there. I had the optical sight up, and that's actually how I found him. I turned up the optical sight to see where the center was and then turned it down and stared for awhile and sure enough, he burned in.

Gordon The Agena exterior condition - The only anomaly we saw with the exterior condition of the Agena was the paint blistering. This was the section on the Agena that's about 10 feet behind the TDA. In that area there was a lot. We talked to John about that and asked him if he had noticed this during flight. There was all this blistering and bubbles.

Conrad I noticed that Agena over there is not; that picture on the wall, which is the Gemini VIII Agena. I almost had the impression though that they've changed the paint and that the Gemini VIII Agena wasn't painted in the area where we saw blistered paint.

Gordon It was a silver stuff that was on it.

Conrad Yes, and there was gray paint also.

Gordon Some gray, white-gray paint was blistered as well. But it was the only thing that we could see on the Agena that looked abnormal. Everything else looked great.

Conrad We never saw attitude thrusters fire.

Gordon Never did.

Conrad Neil reported seeing it, but we apparently never got the sunlight in the right conditions to ever see the attitude thrusters fire.

Gordon As a matter of fact, the only time we saw anything on the Agena outgassing was one time when you reported the 16 pound thruster firing.

Conrad Yes, that was with the sun behind the Agena. The Agena was occulting the sun to us and we could see the 16 pound thruster. I could see the left upper one fire.

Gordon Sunlight reflections. I'm telling you, that's the biggest shock in the world, when the sun is low shining on that Agena, or when you're out where you can't pick up actual details of the Agena. When you're out that far that thing is a brilliant golden source of light.

Conrad It turns to silver pretty quick also. It's awfully brilliant. It's gold in the airglow.

Gordon Against complete darkness when that thing is above you and you're looking at it against that black sky background, it's just so intense that it actually hurts your eyes.

Conrad The only way I can liken it, is like somebody is taking a blow torch and you're lookingat it in a dark room, or a welding

torch and they turn the gas mixture to the right setting, you know, and it goes from gold to brilliant silver as the sun comes up through the airglow.

Gordon It was sure surprising.

Conrad We undocked many times, station kept on the Agena, and we never noticed anything different about it after we first looked it over. When we left it, it looked as good as new. You couldn't even tell the engine had been running.

Gordon I was surprised about the looks of the nozzle itself, after we were station keeping, and after all those burns, that thing was as clean as it could possibly be.

Conrad One thing I could tell was that the 200 pound thrusters hadn't been fired. They were all nice and silver on the inside and the 16 pound thrusters had a little -- it was obvious they had been burned. There was a little heat discoloration to the 16 pound thrusters.

Gordon I didn't notice this, but the inside of that big bell had a gold color and it looked as clean as it could possibly be.

Conrad We station kept for two night passes using running lights and our dock lights and things like that. The running lights were of the right intensity for flying in close but the thing that really startled me is this. I had the running lights at a greater distance than I thought I was going to have them and that made me think that we were a lot closer than the radar was

telling us and that we were closing a lot faster. I was really getting worried. I never expected to see the running lights at night as far away as I did. This was on the M-1, and I was really surprised. I kept telling Dick I had the running lights, and I think we're right on top of them. This was after TPI, we didn't have any running lights way out there. It was somewhere around the end of the third correction or during the third correction. I should be around 2 miles. The second vernier, we--

Gordon We were at a range of 3.63 miles--

Conrad It was right after that that I saw the running lights, because it wasn't too long after we made the third correction that we did come out in the daylight. I had the impression that it came out in the daylight $1\frac{1}{2}$ miles from us, or 2 miles.

Gordon I recall we were discussing how fast we were closing this thing. We were worried about closing it too fast because of how much you can see. I remember looking at $2\frac{1}{2}$ miles at that time, and you were worried about braking. You thought we were a lot closer than $2\frac{1}{2}$ miles, and I said no. We had some 49 feet per second at $2\frac{1}{2}$ miles.

Conrad I think it was around 5 miles in darkness that we had the running lights. Maybe this isn't too bad, but the fact that the flashing lights are so bright at this time--I never expected to see the belly running lights then. Not only could I see them, but

I could tell at that distance that there was seperation between the two running lights and the flashing light. I could see the flashing light with respect to the location of the running lights, and I could see both running lights and tell that there was a gap in there. I could get a measurement of the vehicle length. I was really surprised.

Gordon As far as the visual sightings while EVA, the only thing I noticed different from being inside the spacecraft, was that you had a complete panorama of the world. I really didn't take much time during the umbilical EVA to gaze around up there. I was more interested in looking at the Agena and at the adapter section. During EVA I looked at the handrails and umbilical guide. Everything was deployed and looked in real good shape. There was no debris around the seperation point. There were a few small pieces of pyro plas still hanging to the edge of the adapter at the separation plane itself, but they were about 6 to 8 inches long and they were not loose. They were still along the curvature of the adapter section. There was nothing flapping back there. There were no big, long pieces of anything that we saw pictures on Gemini VI and Gemini VII. It was as clean as a whistle. I guess I would have to say that the big difference you notice is that you have a tremendous view of everything. You can see a 360 degree panorama of the world that you just don't get to see inside the spacecraft. Magnitude of

stars out there--I tried to look at Pleiades when we were doing the standup EVA and tried to count stars, and I got distracted and never really counted as many as I could see, but I really don't think I was seeing any more or any lower magnitude stars outside than I was actually able to see through the window. It's that order of thing. I don't think the visual reception in going from the glass in the spacecraft to the Lexan visor on the helmet was so different that you would be able to say yes, you can see more in EVA than you can through the windows. That's a difficult statement for me to make, and I am not sure of that. The thing that was startling was that you see so much more of everything and the panorama was so much greater.

Shepard You really have to look at specific magnitude stars.

Gordon This is true; I started to look at Pleiades and count them during one of the nightside passes, but then, during the stand-up EVA, we were too busy. We wanted to make sure we got all three constellations. We were concentrating on those, and those only, as far as pointing, and then while we were looking at them we were operating a camera, and I was in and out of the spacecraft. The auxilary light was on and shining down on the encoder; so I could reach down in there without fumbling with everything and turn the ACS system off and on after Pete would drive at the constellation. So I was in looking at light and

then back up looking at the stars again and operating the camera. I really didn't take the time to evaluate precisely how much more you could actually see. It may be a little bit better but I couldn't say that for sure.

Conrad Geographical - Well, the first two days we spent locked up on the Agena and the weather was bad to start with, so we didn't see much of the ground. You can still see the same old things whenever you're over the places with the dry atmospheres where you can really see detail. I don't think there is anything we can add to what you can see on the ground.

Gordon I'd like to comment though, that the first two days were spent on the Agena in local horizontal flight. We were in FC-1 all the time. You can put your head up high and you can check that the Agena is holding in local horizontal because you get the same angle out the window of a piece of the horizon. So you know it's still in local horizontal attitude, and that's about all.

Conrad The thing that I was impressed with as far as the geographical part once again, was during the standup EVA, when I had time to look at the entire Gulf Coast as we came across on the daylight pass. It was pretty spectacular as we called it out over El Paso and I could look to the East as we are going and all the way to Florida. We can actually pick out the Cape from that area. It was something, you know, you can just see a much greater area.

It was pretty fantastic to see the whole Gulf coast. You can see the outline of Florida out there and you actually see where it goes out into the ocean. You couldn't see any detail, but you could see the general shape.

FCSD Rep Was it outlined by clouds or by land?

Gordon No, it was by the land. There were no clouds to speak of on that pass. There were hardly any at all. We did not see the Astrodome.

Conrad I saw the cars in the parking lot though.

Gordon I don't remember the name of the stars at the moment but there were two prominent triangular group of stars that when the rendezvous was going right in the simulator, were always there. That was my first comforting feeling as far as out-of-plane went and so forth, to see the same stars that I'd been seeing for months in the simulator right where they were supposed to be for a nominal rendezvous.

Conrad Yes, those stars on the right were Fomalhaut, Saturn, and Deneb Kaitos.

Gordon Yes, but those aren't the ones I am referring to, they were there, but they were off to the right. The stars that I'm referring to lay just to the left of the orbital track and they were-

Conrad Well, Saturn was to the left on the orbital track. But these are two little constellations and I don't remember the name of them. One of them might have been - they are in Pisces or something like that. Anyhow the stars that we were looking for were there. The stars that I used time and again for determining how far out-of-plane I was and this sort of thing

were there. I knew what I expect to see in the sky during the nominal rendezvous, and it was there. I think that is the most important thing. My window was so crummy that I can't give you a good time for when I first saw stars. I could be looking right through the middle of the window and not even see a first magnitude star if I wasn't looking in the right place. So, I can't give you any times on that. Maybe Dick has some observations on them.

Gordon Not really, there wasn't anything that required us to be concerned about stars during this flight. The only thing we were concerned about was that Pete was familiar with the star pattern during the rendezvous. We were both familiar with the star field; the constellations we had to use for S-13 and other than that, we really didn't pay much attention to them.

Conrad Now, stars during daylight hours. We took a little time to try a couple of things on that. During EVA Dick did his darndest during the dayside pass to see if he could see any stars up there and he didn't.

Gordon No, I didn't see anything during that.....

Conrad I was inside the spacecraft and I had a good hunk of sky out the right front of the open hatch. I was rolled so that I was shielded from the sun and my visor was clean as a whistle. There wasn't any scattered light on it. I was completely in a shadow and I spent a good bit of time looking out at the

black sky through his hatch while we were rolled over. I never saw a star. However, there was enough brilliant light in the cockpit. I mean the cockpit was extremely well illuminated and it's entirely impossible that my vision wasn't such that I could see them. I just had my face plate with no visor on or anything like that and I never did see any stars.

FCSD Rep Of course, it may have been an area where they were really dim too.

Conrad This could have very well have been, because I was looking at a very narrow gap, you know. I could only see a small area.

Gordon I was in a boad position as far as earth shine was concerned, as the spacecraft was rolled 90 degrees and I was facing the center of the spacecraft so I was looking right straight down at the ground and to look up away from the earth, over the open hatch, I'd have to turn by body and turn by head so I could be looking away from the earth. I never saw anything in the daytime. I think it is a safe comment to make that you do retain stars and pick up stars just prior to sunrise or sunset, but after sunrise and before sunset no. It starts coming in before the sun is actually below the horizon.

Conrad There's twilight by crossing the terminator and you get rid of scattered light and brighter stars begin to burn in, just like they do on the ground. No reason to think that they shouldn't. This occurs as early as 4 minutes or so before

spacecraft sunset. During the flight, we didn't observe any phenomena of celestial importance other than during the D-15, while tracking at night, we both picked up a couple of meteors coming in-meteorites. Dick saw his on the D-15 equipment and I saw it out the window.

Gordon I'm not sure whether I got any of that on the film or not. I tried to and I usually had my hand down on the camera button in case something came up. It went across the scope, the monitors, so fast that it was gone by the time I realized what it was. All the objects are moving through it at the ground speed of the spacecraft. All of a sudden right down the middle of the scope it goes, swish! It was a bright spot really streaking through there and a couple times when we did see them I tried to push the button, but I don't think I was fast enough to capture it on the film. We'll have to wait and see, I don't think I did.

Conrad No unusual phenomena on cloud coverage except that there is just a heck of a lot of it. I think, we photographed one really good typhoon. It was so prominent and so well defined cyclonic flow that we went ahead and used the gas to get in and get some S-6 pictures of it. We were low on fuel.

Gordon We did see that one, but we were docked at the time and we didn't really ever get a good enough look at it from close range.

Conrad I'm not sure how those pictures are going to turn out, because that thing was so huge in area that when you pointed that spacecraft down to get a look at it, all you saw was a cloud.

FCSD Rep Where was it located?

Gordon It was the one off Japan.

Conrad It was somewhere between Japan and Hawaii.

Gordon It was in that area. We did point down and take a couple of pictures of it.

Conrad I think I had you log that one, didn't I? The pictures with respect to time: Look in the photolog. We logged very few things because they were usually in series and it was just easier to label the magazine.

Gordon Yes, typhoon -

Conrad Magazine 17?

Gordon Let me read this, "56:06:40 typhoon on magazine 20, pictures 39, and 40". At the same time, the same typhoon in magazine 17, picture 58.

Conrad Yes, we took a wide angle of it.

Gordon Magaine 17 was on the Hasselblad and magazine 20 was on the Maurer. How in the world did I ever log that?

Conrad I told you to. You only have to log the ones that you have trouble finding out where the heck you took them. The rest of the stuff we had either EVA or tether or it was pretty obvious what it was. There's no sense wasting your time

loging that. Oh, Underwood was the guy who suggested it.

Gordon Well, there wasn't much of a horizon until we got to 750 miles. Then that's all there was - horizons.

Conrad I'll tell you one thing though, I thought maybe it lost definition. You know, the phenomena of looking into the horizon and see it fade into the blue. It didn't seem to fade into the blue any sooner. In other words we could see green land at extreme distance to the horizon. Then it did fade into the blue again like it does at 161. But I tell you it was a sight to see. While going over the top of apogee and sliding into darkness and looking back at the whole bloody world out of one window you could just see it like that.

Gordon You could look back and you could actually see Africa about 500 miles to the east of Australia.

Conrad Yes, you could see Africa, still you could see India and you could see the whole bloody continent of Australia.

Gordon You could actually move your head and look to the North Pole and South Pole all at the same time.

FCSD Red Did you notice any difference in the airglow from high altitude?

Gordon We really didn't observe too much night airglow, because we were doing the S-11 on the western horizon. I was on the gages trying to help him point it out on the gages.

Conrad I was looking thru that sight trying to keep it on the horizon, and I didn't notice any difference appearance in the airglow.

I really didn't give that particular question a great deal of thought, but the night airglow was very distinctive. It was just as distinctive at 750 miles as it is at 161. You could very definitely pick it out. I was looking through that sight on the Maurer camera where you get these two pippers and bring them down to the horizon and stabilize to get these time exposures. In looking through that I really didn't notice anything. The thing I noticed most about this high altitude is when you're looking to the west the great distance the terminator is from you. You're still in broad daylight and the terminator is.....

Conrad I bet if anybody was watching this from th ground they could have seen us for one heck of a long time going by in the sunlight.

Gordon It was a long time. We were, I'm guessing, some 600 miles or so to the east of Australia and you could see the terminator cut Australia right in half. You could see the western half was blacker than night. But the terminator itself is not a very definite line. We noticed this when looking at the terminator from 161. It's probably a little sharper at that altitude than it is down low. It goes from this slight sunlight into a little dimmer light into kind of a gray area for a little distance and all of a sudden it fuses right into cold

blackness on the ground. My impression was it has a sharper definition at higher altitudes than it has down low. And it's a gray nothingness when you're down at 161.

REP One of the reports we got on visual sighting was the Carnarvon sight on the first pass. Saw you and the Agena and the second stage of the Titan.

Gordon Oh, is that right?

Conrad All at one time?

REP Yes, all at one time.

Conrad That must have been--

REP --dont' know what they had, binoculars or what they had, but the report came back over the net that they saw all three at one time.

Gordon I'll be darn.

Conrad That's fantastic.

Gordon Gee whiz.

Conrad I never thought about that, but you certainly would be able to at that point.

REP The light would be just about right for them.

Conrad Yes, you'd just be going into darkness then. Well, you're in darkness, yes. The TPI was right there in between so you're still in sort of sunlight, probably. They are in darkness on the ground. Thruster firing you can always see quite clearly. Dick could see it on the D-15 equipment quite clearly too. And I fired an attitude thruster--

Gordon There was no doubt about--

Conrad We didn't see anything new that hasn't been reported before on thruster firing. Both translation--

Gordon Okay, let's talk about this for a minute. When the attitude thrusters were fired in PULSE, at the top right hand corner of the monitor you could see this flash of light coming across. And then you just for the duration--

Conrad Oh, something that I did see. Something that I had never noticed on Gemini V, because we weren't allowed to fire them, was the forward firing thrusters, but in the low daylight conditions, or if the shadow is correct on your side of the spacecraft, on either side, depending on where the shadow is, in the daytime, just like a couple of jets coming out there, you can see the flame pattern from the forward firing thrusters going right by the window. Quite clearly. They are 5, 6, or 7 feet along the side of the nose. You can see the orange flow in the daytime. I don't think I ever fired them at night.

Gordon The night dockings, when we were station keeping--

Conrad I guess that's when we did do it--

Gordon We did pick up some--

Conrad But that was more the white flashing you see in any of the thrusters at night. You see a white flash, but then at day time I was aware that this was a flame patter, an orange flame pattern. You see a little streaking in it which is indicative of some of the ablative material coming out of the throat when

you're firing. Of course, it has been reported that you also saw the impingment on the Agena, and stuff like that. When I was doing this nuzzle business and got that nosed over, I was overlapped about 4 feet of the Agena. I had the docking cone right next to the window and had the nose up along side the sensors, and when I fired the forward firing thrusters, I could see it rattling wires and all kinds of stuff inside the adapter.

9.4 Retrofire and reentry

Gordon Retrofire and reentry.

Conrad We didn't see anything on the adapter SEP. Or I didn't, did you?

Gordon No. No. I sure felt it though.

Conrad Dick looked out the window at retrofire to see if he could see the retros firing because it was at night, and it was still black as anything out there. He didn't see anything. Retro pack jettison. I saw something that scared me to death because I had forgotten about the scanners being blown off, and I shedded the retro pack, and there was this flash out there in front of me, and I thought I had deployed the drogue or something. I had a great moment of panic there. I had completely forgotten about the scanners out there being jettisoned, and that big flame shot out up there, and I expected to whistle in the daylight and see the chute just sitting out there or

something. I didn't know what I had done. It really scared me so badly that I went back, and I just kept reading Retro Jet on the switch, and I said you did hit the right one, you did hit the right one.

Gordon There was a comment--

Conrad What was that! I'm sure they could find that on the biomed.

Gordon 202 reentry. Okay. we just started to pick up the horizon at 400K.

Conrad But I noticed something that I had never noticed on 5. Way before 400K, it seemed to me that we were ionizing something that I couldn't see.

Gordon This red glow--

Conrad I couldn't see a distinct trail, but I had the impression that the whole spacecraft was surrounded in a red glow coming into daylight. I didn't notice that in 5. Once you really start burning, you got this cone you can tell you are surrounded in a plume, but this was just a dull red glow all around where ever you looked.

Gordon Very strange. I noticed that very distinctly myself.

Conrad I don't know what in the heck that was.

Gordon It was just a real faint rose-colored--

Conrad The only other thing I can think of is that--

Gordon The whole sky, the whole area out in front of you, it wasn't any trail or anything like that. Just that fused pattern.

Conrad The only other thing I can think of is that something in the retro pack, in the way of a fluid or something, because the adapter you've left without retro velocity, was diffused around the spacecraft, and we were getting carona effect by the sun coming up behind us and making whatever it was surrounding the spacecraft red, because it was red where ever you looked. I mean if you looked out here it was red, and it was just a very dull, but noticeable red sort of glow around the spacecraft all around it, and I didn't see that in V.

FCSDREP Was the retro different on V?

Conrad No, it was almost identical. We retroed almost at the same time. On V, we crossed the terminator at White Sands, and we were crossing the terminator pretty darn close to White Sands again.

Gordon That's a diffused pattern too, you couldn't really tell when you actually had good horizon during reentry because it's a long period of time where it is at gray nothingness out there. You can't pick up a distinct, definite horizon. I did one thing. I hadn't heard anyone talk about this one before, but that retro fire, it's dark, and all the lights in the cabin are up full bright. Actually, it was simply an instrument type approach problem. There is nothing outside for you to be looking at. We did look at the yaw star; we had a better one yet, because the Agena was up there for two orbits before

we retrofired, and then we left it right in plane so we could see the Agena and know that our yaw angle was right on, but in coming down, before the 400K, I'd turn off the lights and look out and you could very definitely see the night airglow. You could actually see a good horizon, as much as you could at night in orbital flight, where you could look out with the lights down in the cabin and see the night airglow and a very distinct earth/sky definition. But normally we don't do this; usually we had the lights up full bright. I never heard anybody comment about this before.

Conrad 400K-- No doubt about ionization; you really shed the stuff. I could see the horizon quite plainly through a part of reentry as long as it was out there. Even in the big flame burning part. Spacecraft oscillations were pretty obvious with respect to the drogue; the only other way I could see any spacecraft oscillations was by looking on the ball. We didn't have a horizon late in the game, and you can almost get the impression though that it's oscillating in the ionization cloud. As far as oscillation was concerned, I did not refer to any cockpit instruments. So I don't know the gross excursions on the attitude ball. But in looking out the window you can't see any oscillations of the total combination, in other words, the drogue and the spacecraft. You don't know that it is oscillating this whole unit together at all. But very definitely you

could see the oscillations between the drogue, the shroud lines, and the spacecraft. And the spacecraft very definitely had a real high frequency oscillation about the attached points, where the three straps come down and attach to the spacecraft, you can see that the pivot point of that oscillation is right there. The spacecraft is just shifting back and forth at that pivot point. You tell this was oscillating at that point real distinctly, because as it oscillated up to my direction, one of them became completely slacked, and the other two were tight. Then as it started to go back the other way you could see it tighten up, and one of the others would go slack, as it oscillated in the other direction.

Conrad It's obvious that the whole combination is doing some yawing and pitching.

Gordon It's not obvious looking out the window.

Conrad Well, I guess maybe it's obvious picking it up on the ball.

Gordon Because when I was looking out, that drogue never left the trail we were leaving behind it.

Conrad Yes, it was right smackin the middle of that stuff, whipping like crazy.

Gordon Right inside of it, you know with this buffeting effect. Drogue deploy was straight forward. I could see some puffs of smoke in the debris go, and you deployed, and there it is. R and R SEP was - again, you can hear it.

Gordon It was easy to see; you could look at the nose of the spacecraft, and when that main chute deployed, you could see the RR section leave. You could see it leave the spacecraft. And there wasn't any doubt you were free falling again for a short period of time. And that main comes up pretty good. That's a sight to see, that thing coming out of there.

Conrad After main chute deploy, it was obvious before we went to single point though, we were oscillating on the chute a lot more than we had in V, for some reason; I suspect it may have been the wind that day. We had a lot more wind than when we came down on V. When we went to single point, I was aware of the fact that we were rotating.

Gordon Very definitely rotating.

Conrad We were aware that we were oscillating a little bit, but not to any great extent. I was not concerned about anything.

Gordon I was very definitely aware that this rotation was taking place, but I couldn't by looking out, I couldn't perceive any of this oscillation at all.

Conrad About 2000 feet we saw a helicopter go by.

Gordon The R and R section.

Conrad The R and R section almost hit us. It really came close. I could see it coming down through the chute and it went by Dick's window, about 20 feet away. On landing I thought the first helicopter in was trying to land on us and not help us. Boy,

he really came close.

Gordon He acted like he was trying to blow out a fire or something.

Conrad Not only did he come so close, but those big turbine powered helicopters make their own ocean out there, and that really was bobbing the spacecraft twice as bad as when we were just sitting out there floating. The other thing was, I all of a sudden looked out the window, and there was the Guam, sitting right there. Boy, it looked like it was a mile over there.

Gordon We hadn't seen it on the way down, but after we were in the water and the spacecraft floated around, you could look out the window and there it was sitting right out in front of us.

10.0 EXPERIMENTS

Conrad Why don't you give them the first two experiments of your stuff.

Gordon We talked about these experiments in the de-briefing itself for the large part. I'll just make a general statement about all the experiments. They were done on time in accordance with the flight plan. Updates were not required. All the experiments were done as they were preplanned. There weren't any deviations that we made in flight, other than the few flight plan updates we got from the ground. We obviously incorporated these into the experiments right away and did all of them as preplanned.

10.1 Mass Determination (D-3)

Gordon So leading off of that, as far as the D3 is concerned, the mass determination translation was at 1 plus 55 plus 10, prop quantity was 55 per cent, O_2 and H_2 were off scale high. Delta T had a translation of 25 seconds, address 80, at the end of the seven seconds, in other words from 18 seconds to 25 seconds, in the burn, read minus 0029; 81 read 00001; 82 read 00005. Prop quantity was 53 percent, and the water gun reading was 450. And that incidently was the launch

water gun reading as well. We hadn't taken any water up to that point. The thruster calibration for the D3 was done during this standoff, burn on that last day, where we set up for the second rendezvous. Translation time on that was 54 37 27, prop quantity was 15 percent, O_2 quantity was 47 percent, H_2 quantity was 46 percent. The Delta T of the translation was 11 seconds, address 80 at the start of the burn read 8.9, at the end of the 11 seconds of burning was minus 0009. Propellant quantity at the end of the burn was 14 percent, roughly, and the water gun reading 137. There were not anomalies encountered during the burns for the mass determination. They were done in rate command, using the aft firing thrusters.

10.2 Night Image Intnesification (D-15)

Gordon The night image intensification was thoroughly briefed during the flight plan portion of this debriefing. Equipment set up and used was done as procedure book outlined. The tracking tasks, there wasn't and awful lot that we tracked during the D-15. There were a couple of occassions where we picked out a coastline or a very prominent feature and did track for awhile. The tracking tasks on the D15 were no more difficult than trying to track an object in the daylight; it was just a matter of looking at the scope and getting the rotation rate of the spacecraft up to the required per orbital rate, and

once you got it there it was no problem keeping what every you were looking at right in the center of the scope. It was no more difficult to track using the monitor than it was to look out the window. Once you saw it, it came into the top of the scree, and you could get right on it and track it. I will say that the objects we tracked were right in the orbital plane; in other words they were right down the center of the scope. We didn't try to track anything that was off-set in yaw. So this obviously made the task a little bit easier. Acquisition pointing update - we didn't use them. We used the onboard map in the procedures book for the D15 experiment. We did it according to that. Now we didn't take the pictures as specified on this map; during a tracking test or a scanning test it said two 30 second exposures. Well, I only exposed the film when I felt that there was something on the monitor worth recording. And there was enough of that that they can work that out later on. Propellant usage was virtually nothing; we were in pulse control mode all of the time during all of this, and there was no problem in keeping up with the ground motions with the pulse. The voice recorder usage was done by both Pete and I. The tape was on continuously and we recorded our own visual observations. Mine were off the TV monitor. He was talking and describing what he saw out the window. Once again, I will make the remark that

in looking out the window as there is enough light from the TV monitor itself, and his red lights are up bright, he was not night adapted. You couldn't get night adapted unless you completely shielded the monitor itself. It's just like a radar scope in an aircraft. You got it up, and this is all you can see. It's quite bright. The D15 photo recorder usage - I have already commented on that. I took pictures when I thought there was something worthwhile to take picutres of. And as far as I'm concerned there were no anomalies encountered, with the exception of one. This was late in the flight, when we were using the D15 equipment for S30, where we were fully powered up, and we had lost stack 2C, and the voltage was getting down near the 22.5 reading that they asked us to look at. I could see on the monitor itself that it wasn't getting quite enough power to come through. So, we did turn on the number 3 battery, and this jacked the voltage back up to a level where everything cleared up and came in. It was required to get the raster on the TV monitor to come in.

10.3 Minimum Reaction Power Tool Evaluation (D-16)

Gordon I'm sorry to say that I'm not going to be the first space mechanic. All I got to do was look at it, and the only comment I can give is that the door covering the D16 package was deployed. It was fully opened, as was the door on the S9. There were no anomalies in this regard. I did have the

knee tether on during the EVA, and this caused no particular problem.

10.4 Radiation and Zero g Effects on Blood and Neurospora Cells (S-4)

Gordon Neurospora package activation was done in real time, on time. There was no trouble actuating the handle or anything else. It was done in real time on a mark from the ground and forgotten about until the next time they called us and asked us to do something with it. The same is true for deactivation. Stowage or temperature problems. The neurospora package, once it was activated, was over on the left hand side for a short period of time; when my hatch food pouch became empty, I took the S4 neurospora package and stowed it up over the hatch, and it stayed there for most of the flight. For reentry stowage, I put it back in the bracket in the footwell. Now this caused some little problem. I think I got ahead of myself in that I stowed the TV monitor in the footwell first and then had a heck of a time seeing the strap that held the S4 package in place. I knew how it went through the straps anyway. So I was able to feel where the straps were and stick the handle through the wide part of the straps and pull them down tight, and it didn't move during reentry at all. I don't think it was exactly back in the same spot where it came from, but the straps were engaged again and I was able to pull it down tight enough so that it was solidly in place. No

temperature problems as far as we could determine. The S4 package was cool; it maintained the proper temperature throughout the flight. Everytime someone would ask about it, or he would think about looking there, he could tell that the package was cold. In fact the handle was cold to touch.

10.5 Synoptic Terrain Photography (S-5) and Synoptic Weather Photography (S-6)

Gordon We've already talked about this. Most of this was done during the high altitude portion of the flight, and it was done between Africa and Australia. Now there were other times that we took general photography such as this typhoon out in the Pacific, but it was done much later in the flight where we knew we had the film and we did not need it for other purposes; so we shot a few extra pictures of phenomena we saw on the ground. They were in the log. The equipment operation was fine. The general purpose Maurer camera worked; we didn't have any trouble with the lenses or the film backs or any of this type of equipment. I want to make a comment concerning the S-11 stuff.

10.6 Nuclear Emulsion (S-9)

Gordon When we went to the Mode 1 operation via the flight plan, we left it in mode 1 the entire flight.

I didn't turn the switch off when I retrieved it or anything.

Then when I got back in after the EVA I did turn the switch to the off position. But it seemed to be operating properly. Spacecraft attitudes - we were always in the local horizontal with the spacecraft, with the exception of the time during rendezvous, and it was after that we actuated. So the spacecraft attitude was always in the local horizontal.

After the normal maneuvering we had to do for the D3, the S26, the spacecraft was in FC 1 and it was BEF throughout the entire sleep period. It was BEF until the time we gyro compassed to TDA south just prior to the EVA, and the package was retrieved with the TDA to the south. Equipment recover. I had a little problem getting it out. It wasn't a serious one: I pushed a lever that disengaged a handle: It flipped up. I put the tether on it right away before I tried to move it out of stowage space. When I grabbed the handle, or tried to jerk it out of there by jerking on the tether, there wasn't enough space between the handle and the top of the package to slip my fingers under to get a hold on it. So what I actually did was take the tether and jerk on the tether and try to jerk it out, and I couldn't get it out. So then I put my hand on the back side of the handle and pushed it all the way over to the left, which apparently completely disengaged the dogs down below, and I was able to pull it right out. So it was probably my own

fault that it didn't come out right away. I played with that handle for a minute and it slipped right out of the package without any problem. We didn't have any stowage problems. I handed it in to Pete, and he attached his tether before he took mine off, shoved it down between his legs, and handed my tether back to me, which I installed back on the ELSS. No, as far as I'm concerned there were no anomalies other than this little ditty about getting it out of the adapter section.

10.7 Airglow Horizon Photography (S-11)

Gordon Equipment set up and use. This is one I really want to comment on. It was the one we had an awful lot of problems with. I had a hell of a time getting that lens on after the film back was put on. I sat there, and I swore at that thing for fifteen minutes before it finally worked.

Conrad We had to start out that first one for about 40 minutes ahead of time, and if we hadn't been a little ahead of the whole flight plan we would have fouled up right there.

Gordon I knew what the problem was right off the bat; we encountered this before down here. It was that problem where you start to put the lens on, and you couldn't get that last quarter inch of rotation in on the thing. In other words, the white lines were not lining up. And I probably wasted several frames because I would have to take the lens off, and I advanced the

film again, and I'm sure I did waste several frames, 2 or 3 possibly. And the problem is this - that the normal procedure of assembling that Maurer camer is to put the lens on first and then to slip the back on. Well, with this wide lens, you can't do this because you can't get the levers up that lock the back in place. So what you have to do you have to reverse your procedures; put the back on first, put the levers down in place, and then try and lock the lens in. Now, looking at the face of the camera, on the left hand side of it there is this lever that swings in and out that does lock the lens in place. It's got this spring pip pin type of thing. Well, as you rotate the lens this spring has to move outboard as this pip pin is raised on the cam on the lens itself. It has to be raised so that you can turn the lens, and when you get it to the right position, this spring forces this pip pin back down into the lens body so that it doesnt't rotate once it is well on. Well, with the back on there it wouldn't allow this spring to come out far enough. So that you'd get to the high part of the cam that pushes this pip pin out, and the pip pin couldn't move out any further. It was up against the side of the film back itself. Now I noticed this, and I knew that this was what the problem was right away. So I started all over again. I took it all apart, took the back off and everything, and this time when I installed the back on, I tried to

install it so I was forcing the film back to the left away from the spring, so I could give it as much room as I possibly could. And even after I locked it in place, with the levers down - the film back was locked on the camera body - I hit the film back off to the left and then when I went to put the lens on it gave the spring clip enough clearance so that it finally went out far enough and snapped into place. Now as much trouble as we have had this Maurer camera and equipment, it's almost inconceivable to me that you could all allow yourselves to get trapped into this particular position. We complained enough about that equipment.

Conrad It only happened that one time, but it only takes one time to foul up an experiment.

Gordon Well, it happened here on the ground.

Conrad I mean it happened in flight only one time.

Gordon I was really humping, cause we were coming up on the time to get S-11, and I had that camera completely apart in my lap. And I was playing with the ratchet that advances the film and the shutter control.

I was making sure that it was tangent to the radius of the lens itself so that was proper. I didn't want to break that off as we did one here on the ground during training, by trying to force that lens on there. I was really sweating blood and tears trying to get that thing ready to go. Fortunately, I was able to identify the problem of why that lens wouldn't go on, but all they would have to do is take that film back and shave some of that portion of it off right in the area where the spring clip moves outboard away from the body itself to give it just that clearance so you can finish rotating the lens. Then it will lock in place. But I was really worried about that.

Scott Before we get off this equipment set up and use. Since you weren't ever able to get the pointing data on that bracket--

Conrad No strain. We worked that out in flight. No problem.

Gordon This is what we did. All these sequences--

Conrad Now, let me say this. If we had the pointing thing and had known a good ball angle or we had known a good yaw, pitch, and roll for it, it would have saved us a little sweat on, not S-11 because S-11 is really easy to set up, but this S-29 type pointing, where we wanted to point to a specific area in the sky and then set the Agena up inertially and everything. I could have done this better and turned it over to Dick,

rather than have him looking through the camera and trying to fly it, because in straight pointing like that this is off in pitch, roll, and yaw and when he starts maneuvering it gets to be a more complicated control task for him to track than it is for me to get it set up if I know where it is pointing.

Cordon What we had to do on that particular thing. We knew the area of the sky we had to photograph, in general terms so Pete would fly the spacecraft to this attitude and then I would look down the nose of the spacecraft out at the area of the sky and I would say, "Okay, That's where I want the camera pointing when I take the picture."

Gordon Then I would take the spacecraft and I'd keep the sight of the camera where he had been looking. That's exactly what had to be done. Then I'd have to keep an eye on that point in the sky where there was something else I could recognize readily and I would look through the sight fly it over there. It's not the best way to do that. Sequences 01,02,03, and 04 were done by thenumbers on time in accordance with the flight plan. There was no problem in stabilizing that combination on the horizon. If I didn't have it completely stabilized, it seemed it would generally be in pitch, with the vernier control on the bracket itself, it was no problem in keeping those markers, the two pip markers, on the horizon. In fact, it was a very menial task. I was quite surprised at how easy it was.

A lot of the times I could take the whole sequence of pictures without ever touching the control.

Conrad There is something that's not obvious though. The Gemini control system was not designed specifically to do small fixed inertial type tracking tasks. Tracking tasks with the Gemini over the ground with the pulse system is easy, but the thing that put the frosting on the cake for S-11 and made it so much more easy for us to get the pictures than it was for Tom and Gene, is the fact that we had the Agena hung on the nose. With the Agena hung on the nose, using Gemini pulse system, you double the mass and you got--

Gordon Big long moment out there

Conrad Pitch and yaw is just great of course, roll is an easy one and roll moment of inertia isn't a heck of a lot bigger, but pitch and yaw was great. We would get that thing locked on out there would fire through a series and it really made things work great. And there is no doubt about it. We had some arguments in the beginning when planning this flight using around the Agena, but I'll tell you, if we had not had the Agena in the nose for two and a half days, we wouldn't have gotten anywhere near what we got done. From a fuel point of view, a tracking task point of view--just the whole thing worked better than we had planned for it to do.

Gordon Just a general statement--that Agena did more than its share

of the work, I'll tell you. It was great having that thing out there.

Conrad Saved Gemini fuel using it to go inertia was by far the best way to do it. We would just never have gotten these inertia type of things as accurately without the Agena.

Gordon When we get to S-13 we'll comment about that, but I don't think S-13 would ever have been done without the Agena. I've no other comments on all these sequences for S-11. They are right with the flight plan and that's it. There was no problem in doing it. This bracket change--let me make a comment on that. Dear old Bill Anders. He'll love me for saying this, but that was one of the better changes that we insisted upon, or he insisted upon making, because changing the angles on that thing got it so that my head position was almost the normal position in that seat. I had to get down just a little and move to the left but there was nothing uncomfortable about that position. It really worked out well. And I'm glad that change was made as late as it was made.

10.8 UV Astronomical Camera (S-13)

Conrad Right over here with S-13. That equipment set up was standard.

Gordon Everybody's been complaining about that bracket and the way it goes in--that fitting in the hatch. That was the easiest thing I had to do. I could slip that thing in and out of there with no strain at all. I think one of the things that

made this operation easy was that adjustable tether strap.

Conrad I kept letting him up or hauling him down, wherever he wanted to be and we'd lock him up right there. He was just anchored. He would get both feet on the floor and I would haul that tether down and he had a three-point anchor.

Gordon I had my feet on the floor and that tether was just snug so that I wouldn't float up. I wanted to be down that low, generally to reach down and turn the ACS on and off when we had to go inertia for the picture taking.

Conrad Of course that was the one unknown that we were worried about and that was going to put the frosting on S-13. Could we get the Agena on and off? First we were going to have me do it with the swizzle stick that would have never worked. It was real easy for Dick, though. He could turn to the right, see, and just stand in the footwell and reach down with his arm and turn the Agena on and off with no strain. We left the red light on it so he could see it real plainly. I left my red cockpit light on and everything else in the spacecraft was out. I had the old star pointing book out on the instrument panel. He'd tell me which way to go and we'd arc over and I'd tell him what I needed to get the roll orientation right for the pictures, and as soon as we'd get there, I'd just hold it there in rate command. By the way, this flying the spacecraft in a hard suit--if we had ever tried to do S-13 in pulse mode

without that Agena we'd still be up there arcing around. You can't fly that thing----

Conrad He'd either hit the hand controller--that was another thing that helped, because if we had had a hot hand controller in there, when I was maneuvering I'd tell him don't move anywhere and I'd have to keep his hoses out of the way. He was all over that hand controller.

Gordon I kept hitting it with my leg for some reason.

Conrad Not really--what was happening was your hoses were hanging down, and you know how wide they are where the interconnect is. All that garbage was hanging down there between your leg and the console, and whenever you'd move your leg hoses would hit the hand controller . That was what it was. I kept having to get them out of the way, but they would always wind up back there again.

Gordon But as far as the equipment and use, there wasn't any anomaly with the S-13 equipment.

Conrad I guess the 12 crew went ahead and changed that bracket. They insisted on making a change and they called us up and wanted to know if we wanted to change and we told them "No", we didn't care whether it was better that way or not. We trained this way.

Gordon I seriously doubt that the 12 crew's change is an improvement for this reason--you can see the backside of that guide, that's

bolted on the hatch sill and you could just move your head to the left and you can line up the grooves on the bracket and the guide and just slide the bracket in. It was simple and it didn't surprise me at all, because once I stood up there and realized how well I was able to control my body position, or have it controlled for me, it was-- it is going to be easy to do things while EVA if you can anchor yourself down. When I had both hands free--man, I didn't work at all doing that S-13

Gordon There was no work load associated with it. The only reason there wasn't any work load was that I didn't have to worry about where I was going to go, or how I was going to end up. I was standing in the seat. If I wanted to be let out of the spacecraft a little bit, I'd ask Pete to just loosen the tether. It had this adjustable tab. He would lift the tab and lengthen the tether out and I could push myself up to the height I wanted. When the tether got snug, there I was. I stayed right there. An interesting phenomena on this--with the configuration I was in with those hoses on, and no ELSS, there were many times when I was standing in the cockpit where I was not having to exert any force with a slack tether and I would stay right where I was. There wasn't any of this up and out of the cockpit sensation.

Conrad There is no doubt about it. That ELSS jet-propells you.

Gordon There were times when I would actually have my feet on the

floor and I could take the strain off the tether and just kind of hang there, suspended in the zero g environment with no tendency to move anywhere, other than the motions I wanted to make with my arms.

Conrad I am convinced all this floating up business on EVA that Gene had and Dick had and everything else, is the ELSS that putting out too much exhaust velocity. To recap S-13, we didn't have any problems with the setup of the equipment. We didn't have any problems during the EVA. We didn't have any problems with star acquisition. The pointing might not have been as well as it could be because I just couldn't see the stars through my window.

Gordon I want to make a comment here, Pete. I believe that on the very first one, Scorpio, your orientation was wrong. Remember, you were arguing with me about where Antaries was?

Conrad Yes.

Gordon Well, I could see it plain as day and I am still convinced you were 180 degrees out of phase. And it was simply because you couldn't see the darn thing.

Conrad Well, Antaries was supposed to be 45 degrees under the left wing and pointed at --

Gordon Well, it was 45 degrees under the right wing.

Conrad Okay, then it was the wrong orientation.

Gordon But that is the only one. The thing about that one is the

constellation and the stars were in the field of view. And it just may be that the orientation might not be as planned. All the rest of them, I felt, were okay. As Shorty Powers would say, A-OK. Pete couldn't see the - you couldn't see. You had another star over here -

Conrad Yes, I thought it was Antaries.

Gordon I think you had the stars that he wanted photographed in the pictures.

Conrad The inertial hold capabilities were just fantastic. We would turn that Agena on and in 30 seconds it was locked up.

FCSD Rep Wait a minute. Have you covered the inertial ball during the high apogee stuff? Did you discuss how that worked out?

Conrad We described it was much easier to keep track of what was going on in the real world--

Gordon The reason we did (together) We came up with a little diagram of the platform, when we went free, and we used the platform itself--if you were over here pointing in this direction, you could come down here and point here and you can tell what angle you were in the ball.

Conrad Yes, and I had a gage on the bottom there for the critical maneuvers if we needed to use the inertial ball for anything.

Gordon So we had that all pre-planned and figured out so we wouldn't get confused. In the real world situation where we were aligning the platform before the retrograde burn, it looked

like we expected it to look. We had looked at it enough in the GMS that we took all the surprises away.

Conrad This was during the time when we brought the Agena back up to the right attitude so that it would be very close when we powered it up. And it was, it was right on the money. I just could hardly see it move when we powered it up. It just gyro-compassed right in and away we went.

10.9 Ion Wake Measurement (5-26)

Conrad The Agena sensors all deployed normally and everything looked real good to us. Maneuvering was real easy. We did it the best way we could and accordance with his procedures. I got night photography on all the night stuff and day photography on all the day stuff, so he should have all the data he needs for calculating distances from the Agena. It was all taken at one frame per second.

Gordon We were going to use the radar on that too, to help with distances, but we got nothing out of the radar.

Conrad The radar wasn't working, so we didn't use it. I guess we had voice tape in, I don't remember now. I did not log the start/stop time for the camera correlation because I only turned it on for each series and let it run through the whole series and let it stop. That ought to be quite plain on the tape, for time correlation. We did everything the way we planned to do it. The only thing, was we didn't have the Agena recorder on for the 360 degree turn at apogee. After we did it we figured Carnarvon was getting the data in real time. They told us they were having telemetry dropouts, so I don't know whether they got that data or not. We didn't get it on the tape.

Gordon Well, am I wrong. We had the tape on but we let it run longer than the 20 minutes, so it wrote right back over itself.

Conrad No, remember, we dumped the tape at Carnarvon, and we never turned it back on again--

Gordon Yes, I guess that is right.

Conrad --until after we did the 360. We were still in contact with them. He will get all kinds of Ion-Wake data off the sensors from rotation of the Agena and anybody that was taking real-time telemetry would get that from the Agena.

10.10 Libration Regions Photography

We did not get the libration photographs on S-29. We took two comets and the Gegenschein and we did them just the way we planned to do S-29. We just locked up inertially at the right pointing commands and took the pictures at the right settings.

10.11 Dim Sky Photographs

Dim sky photography. We did all dim sky photography with D-15 and I understand the pictures came out pretty well of the D-15 equipment. There was nothing there. It was straight-forward. We did it by the numbers.

11.0 Premission Planning

Conrad Okay, what would you do differently or recommend for improvement now that you have the experience with Gemini XI in regards to the following?

11.1 Mission Plan (Trajectories)

Mission plan. I wouldn't do anything different. Would you?

Gordon No, but I think we should make some strong recommendations about control of the mission plan, in not overloading crews with things to do. We probably had the skinnest looking flight plan in the world in the last four flights, and we humped the whole time to keep up with it.

Conrad Well, you are tying the mission plan and the flight plan together. The mission plan is the overall objective of the flight. And we certainly have no argument on the mission plan. However, the things that we thought were bad in the mission plan, we fought to get rid of. We were successful, along with the help of John Young, in getting rid of probably the most time consuming thing that would have been in our flight plan, which was orbit determination. If we had had that, gee, we would have never made a dent in this one.

11.2 Flight Plan

The flight plan. We got on it early, we stayed with it, we kept our fingers on any changes that were proposed, and we

fought to keep any garbage out. We also fought to get in the things we thought were worthwhile, namely the high orbit. If we hadn't made those high orbits that would have been the biggest mistake in the whole world.

Gordon Boy, no doubt about that.

11.3 Spacecraft Changes

Conrad Spacecraft changes. We stayed on top of all spacecraft changes and gave particular attention to not letting anybody change something for us without consulting the crew first, for the plain and simple reason that we were trained on most of this stuff and we looked at changes in that light--how they would affect the flight plan from a training point of view and we kept a lot of stuff out. It turns out that we made the right decisions. We didn't need them.

Gordon Recommendations for spacecraft changes--there was one thing that just plagued us for the whole flight except for the last day and this was the manual heater operation. Now it is a fact that we did fly, and it has been flown in that configuration, but it is a terrible annoyance and task for crew monitoring of oxygen pressure to turn that manual heater on and off all the time. What you tend to do is turn it on and forget it. The warning light no longer means anything to you. You just leave it on as long as you need to get the oxygen pressure back up to where you want it. You stand a chance of

venting and everything else.

Conrad Those guys will be plagued with that on 12.

Gordon You can live with it, I guess, because we have, but it is a real petty annoyance.

Conrad There were four changes proposed to take care of that and one of them, the simplest, was to just take the manual heater wire and double wire it, one to the auto position and one to the manual position. So that any time you are in auto, it would cycle the manual heater within the temperature limits, which was enough to keep up with it when the tank was real full. If you needed manual operation, leave it on continuously, you could also do that by going to the manual position. That was a change we would have liked to have seen gone in and it was about 4 or 5 weeks before the flight that GPO, Mr. Mathews, decided not to put that change in. As Dick said, we got by with it all right, and John and Mike got by with it all right, but one of the biggest things they kept talking to us about was your manual heater operation. They either wanted it on, or we had to pay attention to it ourselves, and it was just an added inconvience.

FCSD Rep There was a CCB item on that. What was Chuck's objection to it? Remember?

Gordon We have already proven we could do it by crew monitoring and it was a change to wiring and he just felt--.

FCSD Rep We might hit him again on it.

Conrad This won't happen in Gemini again because there are no more Gemini flights after 12, but let's talk about some of these spacecraft changes. When a crew gets up at a stowage review on a spacecraft and they start talking about how they like to do it, two things can happen. Either they have their own preferiential way of doing it, or, and the more important thing, because of their differences in flight plan, they may not want to operate the same piece of gear the same way for a good and valid reason. When we had our stowage review, I don't know whether I had gotten in 10's or 9's knickers by the changes that we put in, but when 12 had their stowage review, these guys had a lot of stuff that we had and they wanted to do it differently. They probably had good reason for wanting to do it differently. The next thing I would find out is, they would say, "Man, if the 12 crew thought it was a good idea, we will do it for 11." They wouldn't tell us about it and then the next thing I would know was they were getting ready to change something in the spacecraft. My biggest point was, the flights were too close together and although their's might have been a much better way of doing it, we were already trained. I didn't want to change something. Now Apollo is going to be even worse this way. I am trying to make the point in both directions. Every crew has his

right to sit down and with his own flight plan and figure out the best way for two old bumpty-bump to do something, but they should not impose it, nor should the Project Office necessarily impose these changes, down the line to do some other crew a favor, without at least checking with the other crew first. I stayed particularly close to Kapryan's office because these changes would come in to his office when we were at the Cape. I stopped several changes. One of them was this S-1B bracket. Buzz wanted to put it on from the front.

Gordon That was a mistake.

Conrad We felt that was a mistake anyhow, but I told them I didn't care what they did to leave it alone on XI. I am trying to think of another one that we had to beat them over the heads about.

Gordon Changes on the ELSS hookup.

Conrad Oh, yes. Buzz wanted to change the ELSS hookups and we had trained in VIII and already started to train in XI on the ELSS, just the way it was. If we didn't know anything else we knew how to hook that thing up, as we proved. We hooked it up too fast.

Slayton That's probably something we're going to have to work out inhouse among ourselves. Really, when something like that goes to the CCB it ought to go as a specific item for that

spacecraft--.

Conrad I'll tell you what I did, and I know some of the other guys have done it. I always talked to John or Tom, as the case may be when we were working on XI and wanted a change that would also affect them, as either a favor or a hindrance. I always called those guys on the phone, no matter where we were or where they were, before I ever went ahead. I said, "Look, we've got to do it this way for the following reasons." Now, it is either a good idea or bad idea for you guys, and do you want to have it or don't you want to have it. That way, all we said to the Board was this is specifically for XI, and not for anybody else. A couple of times, Bilodeau would get the change and, then, if it was change that we wanted and we weren't available, he would call somebody else. They would say, "Oh, we did it this way in the flight, they don't need that." Now, I remember this came up a couple of times, where some of our own guys, because they didn't understand our particular problem with respect to our mission, couldn't see why we wanted the change. Well, we had enough training behind us where we could spend the time following these nuts and bolts details to a gnat's eyebrow and really did stick on them early in the game. We had the stowage and the flight plan and the spacecraft changes with our fingers on them. I saw Neil and Dave get burned too many times that way and I was going to make sure it didn't happen to us.

Gordon I will tell you, there is one thing that can really kill a crew and all the training and negate 6 months of work, and that is late changes. Boy, it just tears you up. You would be surprised at the number of people who would just walk in this door the last week before flight wanting to change something.

Conrad That is another thing. My experience has been on three Gemini flights now that stowage is going to grow. There is no way around it. And ours grew at the end and it grew in a useful manner because we had the room for it and we expected it to grow and we were the ones that allowed the particular items to go. There were only two items that I remember specifically. We carried an extra Maurer camera body at the end because we had the room to do it. And we carried six extra film packs because we had the room to do it. But I threw out 37 items of stowage at the first stowage review and many of those were items added from other flights. I will give you a good example: Shaky and Frank had trouble with the sunshine bothering their faces and in 14 days of sleeping that probably would have bothered me too. But there were two tin shades in there. There is no way in the 3-day flight that we needed tin shades to sleep with because we weren't going to get much sleep anyhow. I threw those items out. The other ones were standup hoses and we had to work our way around that one. So, I found

out that I was small enough to do that standup business out of the left hatch on the suit hoses by making them just a couple of inches longer. So, I deleted them before the requirement was deleted. And when the requirement was deleted we went ahead and dumped the extra hatch closing device. We did it then only because we had the pulley to replace it. I felt that the pulley was good if it was needed. We had so much confidence in the hatch on the second and third openings that the pulley never came out of the stowage box, after the first one. We were never concerned about closing that hatch again and we didn't even hook it up. Of the 37 items most of them were useless and the flight proved it. We didn't need a one of them. I don't even remember what they are now. But if we had had those 37 items plus what our final configuration was we would have never gotten in the spacecraft.

Gordon That is a fact. We would have never been able to execute the flight plan, because execution of the flight plan depends on stowing exactly in the order in which you are trying to use this stuff. We had to restow every night for the next day. Even as well organized as we thought we had the stowage. You just have to spend the time to do it.

Conrad This is something else. When we wrote that flight plan, I sat down there and I made Dick and Neil and Bill and myself talk about stowage, because one thing I learned in 8 days up there

was how to juggle stowage. That was the whole key to this flight, getting things done. We would have never gotten the last day done if we hadn't been stowed right. We sat there and did the whole third day the night before during the sleep period and restowed the spacecraft so that it went by the numbers. Some of this we hadn't figured out on the ground. We tried to but I knew we wouldn't figure it all. The last items entered in the flight plan are under my handwriting, where Dick and I sat down. These were stowage items. We added a place where we had to unstow an item because we needed it 4 hours later when it was a tight point in time. The only way we got that done was because nobody changed our flight plan either. I really sat on those guys on that flight plan. Our flight plan changed the least and our stowage changed the least of any Gemini flight. I think that any measure of success on this mission was largely due to that item alone.

Conrad Even if they had juggled anything in that flight plan during the mission, we didn't need a flight plan update except for time. They didn't have to tell us another thing. And that's the only way to do that.

Gordon All they had to do was give us S-30 at such and such time and we didn't need any more updates. I don't think anybody ever needs...

Conrad I made a lot of enemies over there in the SSR group by telling

them I didn't want to hear from them unless we asked for it. I made an agreement with Charlesworth that they were going to leave us alone on that Agena because we were trained to drive the Agena ourselves and I didn't want to hear them reading up 9000 commands. We didn't need any commands. We maneuvered the Agena, not necessarily in accordance with the flight plan. When we needed to do something, we cranked the Agena around and did it. They didn't bother us. They didn't ask us why. I guess maybe once they asked us why we did something because they found us in another mode or two. They kept track of us on the flight plan and there was a time or two we needed help from them. We had forgotten to do something one time. We stayed in FC-2 and we should have gone back to FC-1 or something like that. But that helped. There was probably the least amount of ground chatter. Granted, we stayed on the flight plan, but three days before the flight, the flight plan guy was down here with this great stack of flight plan updates and we just threw them all in his face.

11.4 Mission Rules

Conrad I didn't have any arguments over that.

11.5 Experiments

Conrad Experiments. I think we probably spent as much or more time on experiments as we should have and we were really well versed in the gear. Of course, we were lucky in that a lot of this stuff had been used before so the gear was around. We weren't plagued with too much new equipment. We did it the standard way with the experiments briefings, integrated into the flight plan, worked out the procedures book so that it covered what the experimenter wanted, and we were able to do the experiments by the numbers right out of the book. We usually read it to each other as we did them.

Gordon I think somebody deserves a blast on experiments. This was readily apparent to us when we first started working on experiments and we looked at the first overall flight plan; it became rather obvious that somehow there was a lack of coordination for experiments on a particular flight. As an example, the experiments for Gemini XI were all essentially night time experiments.

Conrad There was nothing in the daytime.

Gordon This meant that all the dayside passes were utilized to set up for the night experiments in a large number of cases, with nothing to do in the daytime in a lot of instances. I have a feeling that when experiments come through the office and they get the stamp of approval for a particular mission, the overall

effect on the rest of the flight plan ought to be looked at rather than evaluating an experiment on its own merit. It ought to also be evaluated and coordinated with the rest of the experiments onboard and fit in the flight plan real early before it gets approved for a specific mission. Now as it worked out, on this one, a large part of the daytime pass was getting set up for the night ones. But I don't think it has to be this way. Utilization of time could probably be better spent.

Conrad One other thing on experiments. Because we had so many night experiments--these were obviously star photography and things like that--we made a special session at the planetarium and brought all experimenters that required pointing commands into the stars to the planetarium and sat down with them and specifically went through their experiments with them so that we knew exactly what it was they wanted and they understood how we were going to go about getting it. I think this was very beneficial. It certainly made the S-13 and S-29 work and S-30 work very useful and very easy for us to do. Also, we had the S-11 airglow guy come there, and we had an opportunity to talk with him about his experiment at further length than the normal thing. So, I think this helped tremendously.

Shepard Yes, I think it's important that we get to talk to each experimenter.

Conrad Oh yes, and there's one other thing on experiments.

Gordon You've got to find out what his requirements are and coordinate this with the operational constraints that you might have, because the experimenter is not always aware of how the crew has to do these things. He's not aware of the limitations of the spacecraft control system and configurations stowage and this sort of stuff.

Conrad That reminds me of the other thing. There is no scientific experimenter in this country who is so big that he can't personally talk to the crew. And the only experimenters we had any trouble with were those who sent their representatives, and the representatives went back and talked to the experimenters, and then there was something the experimenter didn't like and the coordination broke down. In particular, was the S-9 experiment. That experimenter almost cost us the high altitude orbits when there was really no problem. And once we managed to get him with the right people, it turned out that everything was okay. I've had this experience on Gemini V also. We finally got to head shed and had an opportunity to sit down and talk to him and explain to him our problems, and he could tell us in his own words what it was he wanted with his experiment. We always got excellent results on the experiments, and we've also gotten excellent coordination all the way around. And I think the experimenters have been happier in the long run.

Gordon I think that's a real valid point that shouldn't be taken lightly. If the experiment itself is worth being taken on the spacecraft and we're spending the money to do it, then I think it's essential that the chief experimenter himself talk to the crew.

Conrad And this experiments business goes right on back into the flight plans, spacecraft changes, and stowage. They're all tied together. And the crew, in conjunction with the flight planners back in Houston, are the best people to be able to integrate this package into a flight plan.

Gordon Well, I think they're the only ones who can integrate it. There isn't anyone else who has the capability to do that. They're just not up on everything that's going on.

11.6 Training activities

Conrad Training activities. When we started out, we took the normal Cape schedule for a launch with our launch date, and we filled in all the surprise holes that always crop up, and six months before the flight, we scratched out the days that we absolutely knew would not be available to us starting from launch day and working backwards. Then we wrote in what we thought were the right times for the experiments briefings and things like that, and one thing that I did that really paid dividends was that I had Don not schedule anything more than three days a week. We left two days a week open every week. Because we knew that

there were going to be meetings that we didn't know about, orbits and trajectories meetings, last minute mission planning things and all sorts of items like that, management meetings, that we just couldn't foresee. And we'd gotten trapped on this on Gemini V and we got trapped on it on Gemini VIII in that we made a tight plan and scheduled stuff five days and a one day slip fouled up the whole schedule for weeks in advance. And this way, we had the opportunity to, if we lost a day on Tuesday, drop it in the following Wednesday, because we left two days open every week, all the way through.

FCSD Rep And we never had a day off.

Gordon We never did get a day off.

Conrad We never got a day off our schedule for that reason, and we never went through these great pains of rejuggling like we did on Gemini V and Gemini VIII.

Gordon Well, you have planned activities for three days out of the week and you say, well those other two we're probably not going to have anything to do that day, but I think Don's point is that there never was a single day that we didn't have something scheduled when it got down to the day in question. Even if it was only sunshine.

Conrad I got a little bit accused of filling squares there early, but by golly, we got the right squares out of the way, and those we felt we needed later on, some touchup on, we had time to get.

Gordon There's another point that I'd like to make that ought to be reflected somehow in crew training so that a real honest picture is presented concerning crew training. I honestly feel that I was halfway trained for this flight before we ever started working on it. And that was simply because of all the work that was done as a backup crew on Gemini VIII. The familiarity with all the EVA activities, the equipment to be used, the rendezvous procedures and the training that goes into this, these things reflect in the state of readiness of the crew when they come up to their own launch date. And that's all training whether it's done two years before or seven months before. It ought to be reflected in the entire training that the crew has to do to get ready for a flight, and I honestly feel that we were as ready for this flight as we possibly could have gotten. And it wasn't done in six months. It was done in a year, as far as I was concerned. I wanted to make one other comment that's probably Pete's area, because he insisted upon it, but I want to start him off, and he'll talk about it. I think the thing that made this M=1 rendezvous for us, as distasteful as it was, was the number of hours we spent suited in the GMS with the actual spacecraft stowage. And we went through M=1 rendezvous in flight configuration so many times that I got sick and tired of wearing that suit, but it made the whole operation a success. If I'd have been not that prepared for

the subtle differences you experience of wearing a suit and trying to get out the stowage and trying to write with a glove on your hand and flip pages in a rendezvous book, we'd have never made it.

Conrad We ran maybe eight hours suited in the simulator for Gemini V and there were things like launch aborts and reentries. The biggest shock of my life was the day we suited up for flight and I got in that spacecraft with all the stowage. I couldn't believe it. I just didn't honestly believe that they were going to launch me in that thing. It didn't resemble anything I'd seen before. And I learned right there, and Dick's right, I was really fooled flying suited with the stowage. And I got a glitch even as well as we did that. We'd planned to take the Pentax light meter out, and we'd had it in there with the voice tapes, and the day they stowed the spacecraft for flight, they put the Pentax light meter in, a stowage towel, and the voice tapes, and I never got the light meter out because I didn't have enough time to look in there, and I didn't see it, and I saw that towel, and I felt, and I didn't find it.

Gordon We thought we didn't have it on the spacecraft.

Conrad But that's the only item we missed.

Gordon Pete said "For cripes sake, they forgot to put the Pentax light meter in".

Conrad It wasn't where it had been. But we were in high gear, and that

was the only way to get M=1 docked. That's all there was to it. And it's like I thought, when we finally finished down here running suited with all the gear, we had time to spare. But that never turns out that way in flight. We just made each time line by the skin of our teeth.

Gordon Boy, that's the most relentless thing in the world, that clock ticking over. Boy, it's as unforgiving as it can possibly be. It's just amazing where that time goes. In the rendezvous book, I probably have half the numbers in flight that I am capable of putting down in the GMS. And I haven't any idea where this time went. I was working as fast as I could possibly work. And I still didn't get half the stuff I was able to pick out in the GMS.

Conrad And you wouldn't have a gotten a third of that unless we'd have done all that suited operations training.

Gordon It was fantastic.

Shepard Part of it is that you're being more careful in the flight. Just taking a number of checks on time.

Conrad Yes, this one's for real.

Shepard That could very possibly be important.

Gordon But that clock, boy, its just ticking over there all the time, and it doesn't stop for anybody, except when Pete turns off the circuit breaker.

12.0 MISSION CONTROL

12.1 Go/No Go's

Conrad Go/No Go's were straightforward.

12.2 PLA and CLA updates

Conrad PLA's updates came when they were supposed to, and we copied them.

12.3 Consumables

Conrad Consumables, we ran ahead on all of them. We could have stayed up for another day. We had 20 percent hydrogen left when we dumped that thing. We'd been running powered up for 3 days. So we never thought about them. We didn't keep any consumables. We lucked out on OAMS propellant. Read 99 when we started and read zero when we finished. And I'm sure that we had some 60 pounds left. It wasn't quite on zero, and we might even have squeeked another rendezvous out of it. I wouldn't want to brake on that one.

12.4 Flight-plan changes

Conrad Flight plan changes. There weren't any.

12.5 Experiments real-time updates

Conrad Expeirments real-time updates. There were a couple, but I think they just alked to hear themselves talk.

Gordon They gave us some pointing commands when we substituted those pictures for S-29.

Conrad The only reason they had to is because we never pulled the star

charts out, and those two comets are on the star charts. I just saw them.

Gordon I did, too. I just looked at them. But there's something to be said about that. I think John Young probably did an outstanding job of filtering on his job as CAP COM.

Conrad That's right.

Gordon Because we didn't want to have any updates. We insisted that we not be bothered with them. Because it just takes time to scramble around, grab the book, sit there and write it down, read them back, and make sure you've got everything right. When they're not essential to the conduct of the experiment, if you're already prepared, and know how to do it, you don't need that kind of stuff. And John, I'm sure, did a remarkable job because the stuff that was passed to us, I felt, was necessary in practically every case.

Conrad I can't say enough for how much--they really did keep track of it, and there were times, and there are going to continue to be times, where no matter how well you plan something, you forget something. They picked those items up and passed them to us, like I say, when we were in the wrong Flight Control Mode one time. It saved us gas. Things like that.

13.0 TRAINING

13.1 Gemini Mission Simulator

Conrad I don't have any comments that we haven't already made. Have you?

Gordon Let's go through it. Procedures, we didn't have anything there.

Conrad That was straightforward.

Gordon GOH and checklist, that's nothing. No problems.

Conrad That was done the way it was always done.

Gordon Systems training was adequate. Launch, orbit, no problems. We didn't have any orbit determination or predict navigation. Rendezvous, we've already commented on that. The amount of suit work we did and unstowage.

Conrad We did very little EVA work in it because we used the mockup.

Gordon We didn't do any EVA work in it. We used the crew station mockup that was over here in the AMS building. Retrofire reentry, nothing to say about those.

13.2 Launch Abort training

Conrad Launch abort training was standard. We cranked up on it, and we did some double training with the abort enabled in it where we go through the abort and continue on in the abort. We rang out our checklist in preparation for launch abort simulation with the net, so that both Dick and Bill were up to going

through the whole Abort Checklist from the time of the abort on through, which we could do in the Launch Abort Trainer which is something we couldn't do before.

13.3 MAC engineering simulators (rendezvous, reentry)

Conrad We used the MAC engineering simulator for rendezvous. We worked out the initial M=1 stuff with them up there. We did not use it for anything else.

Gordon Yes we did. One quickie Agena control--

Conrad We looked at the Agena PPS burns--failures. The Agena hard overs and this sort of stuff. Two three hours.

Gordon Two three hour total on that.

Conrad John had them work up a program through him, and we just went ahead and looked at it.

13.4 Translation and docking trainer

Conrad I logged 8 hours or so on that, and that is a complete waste of time now. Docking, as far as the Agena is concerned, is ridiculous. It's so simple.

Gordon I think what Pete's referring to--the tasks in actual flight are insignificant, whereas the TDT itself, the task of docking with that thing are far beyond what it is in flight. There's just no direct comparison between the two at all.

Slayton Would you recommend eliminating some of the docking training?

Conrad I don't think you can do that, Deke, until you look at it and just get an idea of just the sort of things you're going to see.

The actual learning how to dock is not a problem, but going up there and seeing what you see out of the window-- the perspective-- that is good. I can't knock that, but the formation flying and station keeping is so simple, Gemini/Agena-wise I'm not sure that this is going to be true when you start talking about LEM Command Module, because they're much bigger vehicles, and I don't think their control power is the same proportion as the Gemini is.

Gordon I think you're almost obligated to look at it.

Conrad Yes. I spent 8 hours over there specifically training for docking, and I could have learned all I needed to know in an hour, with respect to looking at the Agena lights. I'm being unfair to this thing. I did practice the S-26 a little bit on it and used it to see if I could really get 15 feet above the Agena and still see the antenna down below and still see sufficiently to make these close passes to the sensors and a few things like that. Practiced this nuzzle thing--we took the stops off so that we could run past it out to the side. Took the force sensing off and those sort of things. I used it. I used it, but the 8 hours that were logged as Docking Training, were done with these other things. Thruster failure in there is an unfair simulation, because if they gave you a hard on thruster, you normally couldn't correct it before the trainer got in to the stops, and the other reason it wasn't good was

because the type failures that they gave you were such that you were not wired correctly in the Docking Trainer to take care of them the way you would in the Gemini. I did gripe this fact, that if they were going to make me practice thruster failures then they had to wire the circuit breakers and the OAMS switches, the OAME package switches, in the same manner in which they were in the simulator and the Gemini itself. Their failures were not realistic. I think in the Lunar business, you're going to have to look at this. You're going to want to look at how the sight works out, where you line it up on the vehicle, and things like that, and you're obligated to do that. You're not obligated, it's necessary. But I don't think as a training device you're going to find a guy has to go over there and log 8 hours. We picked 8 hours because Wally logged 8 hours and everybody historically after that logged 8 hours of TDT time. I wasn't going to argue with them. I was going to fill squares, so I went over and got my time in and got 8 hours done. It's got benefit.

Shepard Did you get 8 hours in also, Dick?

Gordon No. It was less than that. I spent time in it on Gemini VIII. I would guess maybe 4 hours on Gemini XI.

Conrad You do have to cover it.

13.5 Planetarium

Conrad Let's see, we made three trips to the planetarium. We made one

on our own after the first experiments briefings so we had an idea of the pointing to do the experiments--then we went up there on our own and took a look at that and also, of course, set up the orbital track rendezvous type stars and worked that all out. The second trip up there was when we did go up there with the experimenters, and we did some more rendezvous stuff, worked with them, got the pointing commands down to where we knew what it was we wanted and it was in agreement with them, or the third one, we went up there for the dust up just prior to the launch which was two to three weeks before the launch. And we looked at the orbital track one more time, looked at all the stars and the experiments, made sure everything was okay for the last refresher. I think that's essential.

Gordon For catching the last bit of changes and launch times and launch dates or whatever the case may be, and you brush up on an item you may need.

13.6 Systems briefings

Conrad Systems briefings. We took the normal boat load starting in Houston with the GMS people, and we had some earlier systems briefings which Dick and Neil and myself attended on a rather sketchy basis, but it was mainly to bring Bill up to speed, and then we started out with the GMS lectures and ran our hour or two per system--went through the failures and looked at all those sort of things. We had no systems brieifings that I can

think of up at MAC because we didn't need any. I don't think we scheduled any systems briefings at MAC. That took care of the spacecraft up until the time we came to the Cape. We did schedule 25 hours of Agena briefings. I don't think we made quite all 25 hours, but I wanted to make sure that we really knew how to run that Agena and as much about it as possible. I think we had about 18 hours of Agena briefings until we were completely satisfied that we really knew the Agena as well as we needed to. The last of those briefings took place at the Cape. We spent a good deal of time in Agena Flight Control system and propulsion system so that we were familiar with it. We picked up the spacecraft systems briefings with the MAC people at the Cape and had the normal one where they went over all the things that they knew about Gemini XI systems that would be of interest to us, other than just general systems lectures, just specific items. We brought up questions that we had worked up to this point that we wanted answers to, and they came back and gave us those answers at the normal last systems briefing before flight. GLV--we only had one briefing on the GLV. We got Frank Carey in to give us his views on what they hold for and anything they wanted out of us, and the GLV is certainly a straightforward vehicle, and there's not a heck of a lot you need to know about it, really, other than the abort procedures, and that's covered by the other training.

Now, I think that sort of takes care of systems.

13.7 Flight experiments training

Conrad Flight experiments training. We added an extra briefing.

Gordon As far as the experiments briefings were concerned, Pete started to say we had one extra briefing scheduled, and this was in association or in conjunction with the visits to the planetarium. We had the normal experiments briefing early in the program so that we could start to work and coordinate all these experiments in the flight plan itself and then we could be aware of the operational problems and/or constraints. The next one was the experimenters that were associated with star photography--UV photography, and dimlight phenomena. We spent a day at the planetarium with these people making sure that we knew exactly what they were after and how it would affect the flight plan. The final experiments briefing was done here at the Cape about three weeks before the flight. We had all the experimenters in here and went over our procedures book, mainly, with them, so that they were well aware of how we intended to conduct their experiment in flight. We wanted to make sure that our procedures book had all the steps necessary and all the camera exposures, etc, for their particular experiment. And I think this in itself paid off a great deal, because of this fact--the experimenters knew how we were going to conduct the experiment and it obviated the necessity for flight plan

updates, to conduct these experiments. Equipment operation. One comment here, and it is of a general nature, but the camera training equipment that we were to work with was, as far as I was concerned, unsatisfactory. We had no results from the pictures that we took. Nobody came around to explain what we were doing wrong with the pictures we took in the training session. And we had very unsatisfactory results as far as camera operation is concerned during the training cycle. In fact, I can't recall ever seeing a roll of film that I exposed for the Gemini XI training. I did have some of this for the Gemini VIII training. I was shown the film but nobody ever came by to explain to me what was wrong with the exposures, time, or anything else. And we were late getting the equipment, and when we got the equipment it very often did not work. Now we did have a real head-knocking session with Kuehnel's people, and he came down himself, and we went over the entire procedures book as far as exposure time, lens openings, the whole bit. We were very meticulous in making sure that we were going to take pictures with the right exposures. And we reviewed the whole page on general photography, the field of view of each lens, each camera, the exposure settings for sun angles between 30 and 90 degrees, between 15 and 30 degrees, and between 0 and 15 degrees. We were refreshed on the speed at which we would operate the cameras for each activity we would

be photographing. In that regard, I felt that we did have a good handle on the way to take pictures. But as I mentioned before, it was really unfortunate that we were not better prepared to have training equipment available that we could use and be brought up to date on all this time. It was a very weak link in our training.

13.8 Spacecraft systems test

Gordon I think we probably cut down a lot on the amount of time we spent on the spacecraft systems test. What was that first one we got involved with, Don? We went up there for the Systems Assurance. Well, Bill participated mostly in that to help him get up to speed with the rest of us. I was CAP COM on Gemini IX at the time with Neil, so we didn't participate in that. We participated in Sim Flight. There were a couple of days we had off from the Gemini IX stuff when we went up and participated in the Sim Flight. The next big one was the Altitude Chamber. Everybody was there for that one, and we participated in that whole test. We came down here, and we did the timber tower test, which was of great value to us, because we started right away looking at the tether installation on the Agena at that particular time. And then we did all the normal tests on the pad. Sim Flight, SLD--I guess that's all we participated in there.

FCSDREP We spent a lot of time on the adapter reviews and--

Gordon The reviews of equipment, as far as spacecraft equipment is concerned, we did an awful lot of that, but as far as the spacecraft systems tests themselves, those were the items we participated in. I feel that it was enough. At this stage of the game in the Gemini program, I don't think the crew is required to spend an awful lot of time with those particular tests. I might add the stowage review--we spent some 20 hours on that one.

Conrad There is no doubt about it that when you have a good mission simulator that is truly in the spacecraft configuration and you can stow it, that this is the place to do this sort of work. And the Gemini had obviously gotten operational enough that we did not have to spend a great deal of time with the actual spacecraft. You have got to get in there and feel it, because it has got to be a little bit different. I think we had just about the right amount of tests for this point in time for Gemini Gemini.

Gordon You were out of the room at the time, Pete, I did the debriefing on the flight experiment training and I sort of knocked the camera bit.

Conrad Well, I couldn't agree with you more. We told them 6 months ago that we were going to be with the Maurer, and if it fell on its face it wasn't going to be our fault. We were going to do everything in our power to learn how to use it. We worked

with it and any reservations they were going to have were not going to be on our part.

Gordon Well, I've made a specific comment concerning the pictures we took with these cameras. The film we got back was never reviewed with us. The mistakes we were making in taking pictures were never discussed with us; in fact, I never saw a single roll of film that I had taken for Gemini XI training. Bill Anders did, but there was no associated training with it. And I commented on the equipment itself. I thought it was in very poor condition to be used as training equipment.

Conrad Well, we were fortunate in having the majority of the flight equipment availabel about two weeks prior to the flight. And we had enough opportunity just before the flight to go up and assemble it and disassemble it and have a good feel for the actual stuff. I'll say one thing, we had no surprises in flight. We had seen everthing adequately prior to it being packed.

13.9 Egress training (pad and water)

Conrad I never knock the water egress training. Both times that I have flown, we splashed down on the water, and I was glad I had the training, even though we didn't have to use all that stuff.

Gordon It's always good training. You and I, for this flight, did the Gulf Egress Training; we didn't do the tank training. Bill

did. Neil also didn't do the tank training because of the previous experience with it. And the Pad Egress Training, we had another briefing by Jim Regusa on it. A new slide wire, hardware, and all that pad egress work just before the flight.

13.10 Launch simulations

13.11 Reentry simulations

13.12 Simulated network simulations

Conrad I think I can just take all three of them; launch, reentry, and simulated network simulations, and say that that's the most essential part of the training to put the frost on the pudding. They were well done. The Sim people thought up very good failures--exercised both the flight crews and the net real well. We really dusted up the actual flight procedures of running M=1 with the loop on the line and everything to where it worked just like it should. And they really paid.

Gordon Yes, as far as I'm concerned, that's the best training that we ever got at anytime. This mission and as far as the training in Gemini VIII, the work with those people is the best training, is the most realistic training, and is done in real time, and you get a much better feel for your state of progress or your state of readiness than you do at any other time.

13.13 Zero "g" flights

Conrad Ingress, egress, is very good in a zero g airplane, I think.

Gordon Well, I'm not sure what to say, but I think we have found,

certainly after the flight, that zero g training in the zero g airplane is not anything like it is in the real world. I think there is a certain amount of familiarization that you can gain from the zero g flight, but it certainly doesn't prepare you for what happens in the actual case. And a good case in point is the tether attachment. There is a certain amount of it that is essential, as Pete said, the egress and the ingress. We knew exactly how to do it, exactly what had to be done, and there were no surprises in this area. Now things like working the adapter, working on the Agena, this type of stuff--it can be misleading unless you are awfully careful in evaluating what you are doing at the time. We have talked a lot about this; you are starting off from a stabilized position each time; you get a rest period between each parabola; you're not working against a suit all the time. This is, I consider, valuable training, but you have to be awfully careful in the conclusions you make from this type of training.

13.14 Air bearing table

Gordon When this decision was finally made to give us enough time to do all the experiments and in fact use a hand held manouvering unit, we shot for some 10 hours training time on the air bearing table. I think I ended up with about 8. Is that right, Don?

FCSDREP Yes.

Gordon We shot for 10 and I think I got about 8 hours.

FCSDREP I think you finally had 10.

Gordon Did I finally get 10? The last portion of it was done in a hard suit and all the work associated with the gun in all three axes. When we first started the training cycle, the air bearing table was not available for a considerable length of time. So this training was left to the very end of the training cycle. The HHMU went through several modifications, and I thought that we finally came up with a satisfactory configuration of the gun as far as redesigning at that time. I think if we were going to start out again, the actuation of the trigger devices could be just a couple buttons you could push for tractor mode or pusher mode so that you don't have to have a great big handle to hang onto. It could probably be simplified a great deal. I felt at the time I was perfectly satisfied with the redesign of that gun. It was thinned down, it was easier to hang onto. The forces to actuate the triggers were quite reasonable. I have no idea how valuable that training is for flight, obviously, because I didn't get the opportunity to use it.

13.15 MSC altitude chamber

Conrad MSC altitude chambe--I used the B Chamber and it was specifically to get an end to end check on the ELSS that I was to use

in flight, its capability to carry my particular work load. Work tasks were set up. This has all been documented. I do feel that that particular test was essential for me. For no other reason than to give me the confidence that the ELSS was going to work and was going to handle most of the stuff that I anticipated doing. I felt very good about the ELSS before flight and I still feel that there is a lot of work to be done in this particular area as far as the ECS system for EVA. But my recommendation is that any time that you work with EVA equipment the flight gear ought to be checked out by the crew in an altitude chamber.

13.16 Gemini crew station mockup

Conrad Man, we got our pound of flesh out of that. We flew it to the Cape and used it right up until 3 days before the flight to do all our EVA work and our stowage work. We got 50 hours in it and it really paid.

Gordon Did we get 50 hours in that thing?

Conrad Yes. That was one of the better things that we did--getting that down here. We trained in it once a week and sometimes twice a week for about 6 weeks and worked out all our stowage to a "gnat's eyebrow" right with Ray and Joe and everybody, so that we all knew what it was we wanted and how we wanted to do it. We dusted off our EVA checkoff list in it and had them down to a real fine edge. I can't say too much for using that

kind of equipment. It just has to be done.

13.17 Gemini adapter mockup

Gordon The Gemini Adapter Mockup, I think, falls along in the same catagory. Certainly, I felt familiar enough with the equipment installation of hardware in the adapters that if I had ever gotten back there I think it would have been a familiar task for me, once I got back in there and got into the foot restraints. I wouldn't expect or anticipate that there would have been any surprises at all but it was utilized during EVA training and it was a good thought to get that down here too, in conjunction with the Crew Station Mockup.

13.18 Agena mockup

Conrad Take the Agena Mockup and the sextant together--again we went to great lengths to get the Agena Mockup to the Cape and we put it down on the end of the runway two nights and had them haul it up and simulate daylight lighting on it at night. It was a chore for everybody but it really paid dividends. It really helped on this second rendezvous. Dick was giving me sextant readings and telling me that I was still closing and it looked like it was good. He gave me range readings and it really helped. We had no radar. It sure sounded good coming out of the right seat. This training was good for me too. I had a good idea of 9000 feet and 5000 feet in my mind, what it should look like, and it was good training.

Gordon I'd like to make a comment on this sextant. We never anticipated that we would ever use this sextant to get horizon to star measurements for our particular rendezvous. It was in the gray area of sunset and past experience, particularly on Gemini X with Mike, was that to measure an angle from the target to the horizon, I feel, would have been impossible. There is just no reliable horizon that you could ever possibly use to make this measurement.

Conrad It turned out that way in our rendezvous. At the 14 and 16 minute data point, we're in that never, never gray land and there's no horizon.

Gordon If you have to carry one single device for an angle measurement --and we had never anticipated to use it--but to use a split-image like that for ranging, I think, was a very unsatisfactory way to go. It did do the job, I must admit that. It was used during the second rendezvous. I was able to read ranges and come up with the range rate and tell Pete whether he was closing or opening, but I think you'd be far ahead if you could use a telescope approach with a reticle in there and you knew just dimensionally what field of view the target would take up at specific ranges. You can do the same thing without trying to split an image, change an angle, take your eye away from it, set a new angle in--

Conrad All you need is a mil-scale type binocular.

Gordon The sextant for ranging is an unsatisfactory piece of gear. You can do it much better and much easier with something else.

Conrad Or, if you really want it for exact direct range readout, you ought to get a stadimeter-type device rather than a sextant.

Gordon The first time I tried the runway bit and tried to use that sextant for ranging, I almost threw up my hands right then and there. As it turned out it paid off and I'm darn glad we went down there and did that because it was very useful in flight. You can get a little tiny telescope with any reticle you want to put in this thing, and do the same thing. It was useful for that particular purpose, but we never intended to measure angles with it. This trying to divide light--so much light going to the star and so much to the horizon is hoakie to begin with.

FCSD REP You mentioned the use of the sextant for ranging, but in the debriefings you ought to make it clear that this was only helpful to you during the last part of rendezvous, which was pretty well made by that time anyway.

Gordon The thing it does, is allow you to break and it could keep you out of that very embarassing position of not closing the target, which you can't see with the naked eye. For those things alone, it was pretty good.

Conrad Or you could tell if you had a high closure rate.

Gordon It could have been done better and easier, as I mentioned, with some other device.

14.0 CONCLUDING COMMENTS

Conrad I'm going to talk about auto-reentry and the mission rules. I am afraid that I went under the wrong assumption for 5 months and 29 days in that I was going to convince everybody that it shouldn't be done. So, it was awfully late in the game when we finally realized that we were going to have to do this, and we were extremely dissatisfied with the amount of support we got on it out of the Gemini Program Office, in the way of analyzing the proper procedures to do this. There were no mission rules published on the auto-reentry until the crew pressed for some of them, and it turned out that the crew finally wrote them by their own analysis, namely Neil, who had the time to do it right late in the game. He went down and looked at the failure modes in the auto-reentry and we came up with a set of ground rules which were adopted. But, I feel that this sort of thing should have been thought of and the work done by the Gemini Program Office and not by the flight crew, at least the early work on it. We could get nobody to tell us anything about failure modes. This type of auto system is such that at some times, when things went wrong with it even when you salvaged the situation the miss distances were in the order of 130 miles. There is no way to regroup from a late failure. You just can't turn it off and fly to the runway. You'd run out of lifting capability. So, we were a little

unhappy with this and I feel that in the future items like this that are put in should be given some more thought. There's one other comment that I have. It's something that we probably were very hard-nosed about and it paid dividends. That was keeping out last minute little flight plan favors to be done. One of them cropped in there late in the game, and because it did crop in late in the game, it didn't do anything other than cause an inconvenience. But, it's an example of what can happen. This was the H_2 heater check on the vent plug where we were going to run the H_2 tank pressure up the second night to a high value and leave it on auto-heater. The points I'm trying to make is nobody said how long it takes that little heater to run the normal pressure from about 450 to 670. It was a spring-loaded switch and we wound up spending half an hour holding that thing on manual. This was one of those little surprises that got in there. When we should have been doing something else we had to jam the thing in. Anyhow, that's just the type thing that gets thrown in the flight plan at the last minute, when enough people don't have enough time to look at it and think about it. That one surprised us.

Gordon It required one guy to pay attention to it all the time.

Conrad We didn't want to just get it manually jammed on and blithely forget about it and have it pop the relief valve and dump H_2.