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NASA PROGRAM GEMINI WORKING PAPER NO. 5025

GT-3 FLIGHT CREW TECHNICAL DEBRIEFING

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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GT-3 FLIGHT CREW TECHNICAL DEBRIEFING

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1.0 INTRODUCTION

This report consists of the technical debriefing comments by the GT-3 flight crew, Astronaut Virgil I. Grissom, Command Pilot and Astronaut John W. Young, Pilot. The debriefing was accomplished onboard the spacecraft recovery vessel, the U.S.S. Intrepid, on March 24, 1965, the day after the end of the GT-3 mission.

The purpose of the debriefing was to obtain as much actual operational experience and performance operation information as possible for use in flight reports, planning future flights, and crew training. The questions were presented by NASA Manned Spacecraft Center representatives from the Gemini Program Office, Flight Crew Operations, and Flight Operations.

2.0 PRELAUNCH

2.1 Prelaunch Systems

2.1.1 Comment on the ECS performance during prelaunch.

Young — I'd say it was normal during the launch. Both the suit purge and the cabin purge went as well as could be expected. I think one of the important things to emphasize to the crew is to get that suit compressor on just as soon as they are connected into the system.

Another thing is to get the recirc valves open just as soon as the cabin purge is completed. We only had to use the O_2 high rate twice to keep us from breathing down the suit.

Even though we were breathing down the suit, I felt like it was better than going to O_2 high rate, because we would get too hot.

Grissom — We weren't getting warm. We were getting adequate cooling on prelaunch.

2.1.2 Comment on the electrical system performance during prelaunch.

Young — The battery readings were normal. The adapter batteries were up above the knee of the curve. They had been on the line for a couple of hours prior to launch. As soon as we turned on the mains, they took over the entire electrical load of the spacecraft and held it until we turned them off again.

2.1.3 Comment on the prelaunch communications.

Grissom — Prelaunch communications were good. We had a good hardline to the blockhouse and MCC. All the RF was clean. We had no communication problems.

2.1.4 Was the ejection seat adequately comfortable prior to lift-off?

Grissom — Wouldn't go so far as to say that the ejection seat was comfortable. It wasn't too bad, though. We were in there about 2 hours.

Young — I was miserable the whole time.

Grissom — We hadn't reached the point where we were so uncomfortable that it was becoming painful, or in anyway would interfere with our performance. My feet got a little bit uncomfortable. I felt like they were going to sleep at times.

Young — The bottom of my feet felt like they were going to sleep.

Grissom — There's not much you can do with them even when you get them out of the stirrups.

Young — That is what I did. Even after they lowered the erector, I was stomping around in there to increase the blood circulation to my feet.

Grissom — My only source of irritation was something on the back of the head rest that stuck to my helmet and prevented me from raising my head.

Young — Mine wasn't sticking.

2.1.5 Estimate the length of time you could have remained on the pad without excessive discomfort.

Grissom — As long as necessary; 4 or 5 hours.

Young — The prelaunch time should be reduced to an absolute minimum. You start losing efficiency when you stay on your back for long periods of time. It's not something you can put your finger on, but I can't imagine that anyone would think of launching Gordo for a 34-hour mission after he's been on his back for 5 hours. But that's what they were going to do.

2.1.6 Any additional comments or problem areas concerned with the spacecraft systems or crew integration during prelaunch?

Grissom — Everything prelaunch went just as smooth as silk. I don't have any recommendations there.

Young — I think there was some dead time in there.

Grissom — There was some dead time that should be cut out. They were 20 minutes ahead of the count, and they loaded us 20 minutes early. I don't think this is

the right thing to do. We knew we would be in there 20 minutes longer than normal. I think they should have waited until booster count caught up with us, even though it may have caused a short hold.

Young Yes, I guess that engine problem was pretty sticky.

Grissom Later we found they torqued it to stop the leak.

2.2 Prelaunch Procedures

2.2.1 Comment on the prelaunch procedures from ingress through lift-off.

Grissom No recommendations for prelaunch procedures up to lift-off. We knew what was going on all the time and how the count was progressing. Everything proceeded smoothly, and I have no criticism or comment in this area.

Young Did you notice every time you were talking on the MOPS or another channel I could hear everything you were saying?

Grissom We got some cross talk when we were switched to another channel. I could still hear you. I noticed we would block each other out occasionally.

Young Yes.

And I could hear people talking to you. That was distracting to me.

Grissom Yes, they ought to be able to separate those channels.

2.2.2 Comment on the procedures used for firing the RCS and OAMS on the pad. Could you hear the firing?

Grissom Procedures for firing the OAMS if fine.

When you fire those RCS pitch-down thrusters, you get a reddish-orange flame.

Young Reddish-orange. Right.

Grissom You hear them sharp and clear. After we fired them twice, there was no doubt in our minds that they were ready. They were good thrusters.

Young — I didn't think they were as loud as the ones that we fired at the Liquid Test Facility. Did you have your faceplate open then? I had mine closed.

Grissom — I had mine closed too. There may have been some difference in the sound, because we had our helmets on. We didn't at the Liquid Test Facility.

We didn't, but you can sure tell. You can see that it is a good thruster, and when you fire the pitch-up thrusters, you can tell that they make the same sound. You can tell it is okay. Now when we fired the OAMS, it would have been difficult for me to tell if the thrusters were bad.

Young — I thought they were good.

Grissom — I thought they were good, too, and I was going to call it GO, but somebody said NO-GO. I guess we couldn't tell from the sound whether those thrusters were good or bad. So, I guess we need a visual observer to tell what's going on.

Young — What that really proves is that that vacuum filling doesn't hold those lines down.

Grissom — Well, it didn't take too long and they seem to work right in flight. But the first three bursts that were called NO-GO sounded the same as the good ones to me. I couldn't tell the difference. We could hear the firings all right.

2.2.3 Comment on the procedures for the crew countdown including the transfer. Any recommendations for improvements?

Grissom — I have no particular comments there. Everything went very well.

Young — We practived it enough.

Grissom — Went very good, very smooth.

2.2.4 Was sufficient time available for verification of the position of the spacecraft controls?

Grissom — We could have verified the position of the controls a dozen times in the time we had, so that's no

problem. Everything is set up pretty well. You've only got about three or four switch movements to make, anyway.

Young I only verified them at least 10 times.

2.2.5 Would an egress catwalk increase your confidence in egress ability after erector lowering?

Grissom It's an unfair question.

Young Yes

Grissom The catwalk wouldn't increase my confidence a bit.

2.2.6 Were you aware of the GLV status during the countdown?

Grissom That was the one thing I knew that I missed. I didn't know how fast their count was coming along or what they were doing. I had to ask to find out the GLV status. They told me that they were lagging a little and we were ahead of them. That's the one thing that I would like to have had that I didn't have.

Young They did not tell us anytime they were actuating the GLV controls.

Grissom After once feeling those engines kick over and know what the vibration is – well, you know what it is.

Young You know what is going on.

Grissom They told us when they opened the prevalves. The crew needs to know that.

Young Yes, that was an interesting sensation. When they open the prevalves, there's a lot different vibration than anything else that I remember.

Grissom I don't believe they do that on the wet mock.

2.2.7 Any additional comments or problem areas concerned with the procedures during prelaunch?

Grissom I don't think I have any other comments.

Young — Yes, there is something I forgot to say. That prevalve opening is something new and different.

2.3 Prelaunch Training

2.3.1 Did any spacecraft operational problems develop during prelaunch that had not been covered in your mission training?

Grissom — No.

2.3.2 What changes or additional training for prelaunch would you recommend?

Young — I think we should go down a slide wire with a pressure suit on.

Grissom — That's the one thing we didn't do that we should have done. That would have increased my confidence a great deal.

Young — There is no doubt about it, if you had an emergency, that's the best way to get away from that cockpit.

Grissom — I think that should be a requirement for all flight crews.

Young — That's right. Emergencies are going to be in that tank of fuel down there, and you want to get away from the pad.

2.3.3 Do you have any comments on your training with respect to prelaunch procedures?

Grissom — No, I don't think so. You don't need to train very much for prelaunch.

Young — No, I don't think so either.

3.0 LAUNCH

3.1 Launch Systems

3.1.1 Comment on the ECS performance during launch.

Young — About 20 seconds after lift-off, cabin differential pressure rose and went up the scale. During pre-launch- when we were pressurizing the cabin for leak checks, the CO_2 sensor needle went halfway up the scale, which indicated it was still pressure sensitive. During lift-off, at 50 seconds the ECS pressure went up to 5.8 and stayed there for a second or two, and went right on up to 6. Then it rose up to 6.5, 6.6, and 6.7. You could see a lag in the last stages, indicating it was venting adequately. We have to change that mission rule which indicates we will vent at 6.5. After we were in orbit, the presssure came down after a time.

There was a lag in pressure increase in the last rise to 6.7. The thing was operating properly. I think ECS operated real well. We didn't get a noticeable increase in temperature. The water boiler took over. The highest the suit inlet temperature ever got was about 58° or 59°. I thought it was pretty good.

Grissom — I don't have any particular comments on ECS. We were comfortable all during launch.

Young — Yes.

3.1.2 Comment on the electrical systems performance during launch.

Young — It was normal.

Grissom — No.

3.1.3 Comment on the preformance of the booster monitoring instruments during launch.

Grissom — Okay, booster instruments did just what I expected them to do. At ignition, the two engine lights went off at the time they called ignition, and fuel and oxidizer pressures on both the IPS and APS sensors

started dropping slowly. They leveled out and stayed steady. I don't recall them moving enough after that for me to tell. The second stage fuel and oxidizer pressure stayed up. I know at 2 minutes 15 seconds, they were normal for staging. Staging occurred and I don't remember the engine 1 lights blinking on. They could have. Engine 2 light went out immediately. I saw pressure start to drop, and oxidizer pressure must have dropped down just like normal. Of course, there were no rate lights at any time. During first stage flight, there were no abnormal rates in the pitch and yaw axes, other than the normal pitch rate that you could expect to see because of the pitch program. Of course, when we got our roll program, we got roll rate. I could see the roll by looking at the sky, also. After lift-off, I could look at the sky and tell we were climbing too.

Young That's right.

I didn't get much cue from the g forces at lift-off – it's real, real soft.

Grissom Lift-off is real soft. At staging, booster was stable, and when the RCS took over, booster pitched down very smoothly. I couldn't feel those engines gimbal or kick around. It was all very smooth. In fact, the whole flight was smooth.

Young Yes.

Grissom There were no unusual rates, movements, or vibrations at any time during launch.

Young Nothing near the vibration that I expected.

Grissom Pitched over smoothly below the horizon, and then started guiding back up toward the horizon again. The rates were very low all the time – less than 2 deg/sec. I think the booster monitoring instruments are satisfactory and performed as we expected them to.

Young Yes. I could feel the roll and pitch program start, and it correlated perfectly on the ball. The attitude error needle was indicating between 2° and 4° booster-high. The CAP COM called booster high and slowly diverging, indicating that the booster

wasn't normal. From staging on, it looked to me, as far as the behavior of the RGS, as if the needle went full scale and I mean full 6°. I turned over to high scale to look at it. It showed we were still high, and I guess it was about, maybe 10, maybe as high as 20 seconds before the RGS needle came back to the center line, indicating it was steering. The pitchover was smooth as glass. The thing pitched right down on the horizon and started to haul the mail. At this time, the IGS attitude error was indicating 2° to 3° nose-down; but everybody was saying the track was normal, so I didn't say anything.

3.1.4 Describe your cues of lift-off.

Grissom I couldn't feel those bolts blow.

Young I couldn't either.

Grissom I couldn't hear anything unusual. So my cues at lift-off were Gordo calling it, and the clock starting to run at the same time. It was just seconds after that, that I glanced out the window, and I could tell that we were climbing.

Young I thought the noise was a lot less than the noise associated with the LTV simulation.

Grissom It was. The noise level was a lot lower. It was a lot less than we had at Chance Vought. This is a real quiet bird.

Young Yes, just as smooth as glass. Just beautiful.

3.1.5 Describe your flight through max q; through BECO, through SECO.

Grissom Okay. The bird was a little bit noisy. We picked up some aerodynamic noise prior to the time we went sonic. I could tell when we went sonic by the decrease in noise. I could tell out the window also, because we had a little flap on the antenna cover vibrating.

Young Local shocks too.

Grissom I thought the little flap on the antenna was going to come off and come right through the windshield. Then we went sonic and she just quieted down.

Young Smoothed out.

Grissom No more aerodynamic noise and it was quiet and smooth from then on. We never had any vibration.

Okay, at BECO, we were pitched down looking at the horizon. At cut-off, there were no unusual rates. Nothing.

At BECO, we saw flame that came over our window. There was some debris and stuff flying around.

Young Yes.

Grissom Like frost or something, I don't know. The mess scattered around, anyway. But there was no doubt in your mind that you had started accelerating again. We were up to about $\frac{1}{2}$g or $\frac{3}{4}$g when I looked at the accelerometer. The engine light went out and we kept moving on. As I said before, when the RGS took over, it wasn't as sharp as we had seen in training. On the trainer, the needle kicks over real fast, but this was very smooth. We were up above the horizon, and we pitched down below the horizon at a very smooth rate. My rate needles were on high scale, so we were pitching down at about 2 deg/sec. It pitched down about 13° below the horizon on the ball, and I could tell that was about where it was on the horizon, too. Then it started guiding back up toward the horizon.

Young That's about what it did. It was high in the first stage, and the RGS pitched it down below the horizon and then steered back up. That's the way it looked.

Grissom It steered down and steered back up, and then, right at the end, you could tell you were coming right down that horizon.

Young Yes, I couldn't keep my eyes off the windows.

Grissom Yes, it was hard. At SECO, she cut off clean and sharp. You could feel just a little bit of tail-off. It wasn't just sharp dead cut-off, but it was real fast. Then we got all set up to separate. I don't remember what the IVI's counted up to.

Young Well, we recorded it and reported back.

Grissom It showed an overspeed. I have to admit I just started burning. I didn't look at the clock to see what time I burned, so I just burned, making sure I had enough.

Young There was a point in there, when there was a high frequency vibration that I noticed on the back of the headrest.

Grissom First stage or second stage?

Young I think it was right at the end of the first stage, and it felt like it was about 30 cycles a second, or on that order, and at a real low amplitude.

Grissom I don't even remember it.

Young It was near the end of the first stage because I couldn't get my head off the headrest to damp it out.

Grissom I didn't expect it to quiet down until we got through the max q. Max q was very quiet.

Young Yes, very quiet. I didn't notice any bucking, adverse needle movement, or anything. At BECO, fire came around there and surprised me. I don't know what happened. Then the engines lit off.

Grissom That was the engines lighting off.

Young Yes, I know. Fire in the hole. You might have expected it from looking at the movies, seeing these things at BECO, but I had never thought about it. This is smooth acceleration. It's really low acceleration. But that baby pitched over and she was really picking up speed towards the end. Oh boy, that's really something. I couldn't keep from looking out the windows, so I kind of neglected my attitude.

3.1.6 Comment on the FDI display of computer errors during launch.

Young Well, as I said before, the computer attitude error indicated a 2° to 3° pitchdown during first stage boost. I had a smooth, steady steering error all

the way through the first stage that increased, I guess, to about $2\frac{1}{2}$ to 3°. It wasn't any more than that, or I would have told someone about it. Just about the time I thought I ought to say something about it, Gordo came in and said the booster is going high. That was the indication I had. He said it was nominal and nothing to worry about, so I didn't say anything.

Grissom I'm glad he came through and said that though, or we would have been concerned.

Young Yes, we would have. Yes, it was perfect. Then at BECO, the IGS needle went full-scale down. Neither roll nor yaw were off.

Grissom Weren't your needles full-scale down before BECO?

Young No, booster pitch was indicating about $3\frac{1}{2}^{\circ}$. I doubt if it was that much, or I would have been more concerned. The booster pitch was indicating that the booster needed to pitch down to be on the profile. The IGS went full scale at BECO and stayed on the peg for a long period of time, I guess 10 to 20 seconds. It came smoothly back up and centered. Then the booster pitched over and as we got further along the flight path, it went back down again to $2\frac{1}{2}$ to 3°. I don't think we had any IGS drift. I think the IGS was working normally. I think there is probably a difference in the way those things guide.

I could be wrong about that, but a $2\frac{1}{2}$ to 3° differential error is larger than I would expect with a piece of equipment as accurate as the IGS. And this was before it stopped steering for altitude. I knew we would get a big increase in error as soon as we stopped steering for altitude. To me, it was normal.

3.1.7 Comment on the FDI display of rates during launch.

Grissom The only time I saw any rates during launch was at roll program initiate and at pitch program initiate.

And those pitch rates were good and steady except when we got a pitch change.

Young Could you tell that?

Grissom Yes, I could tell the second one because the rates dropped down. It's a steady rate up until the second pitch program starts in, and then that rate drops down. I can't tell the difference between the other two because they are so slight. The only other rate I saw was after staging, when RGS took over. We were stable and had no rates until the RGS took over. It pitched down very smoothly, about 2 deg/sec. As we pitched back up, the rate was so small I couldn't see it on my rate needle. I could tell we were pitching by looking out across the horizon, but I couldn't see it on my needle.

3.1.8 What cue did you have that the scanner fairings jettisoned properly?

Grissom You could hear those things. You could hear those scanner fairings go. I could see a corner of the scanner fairing. I saw it pop off.

Young I saw it through your window. I saw the whole fairing through your window, going out laterally to the left.

Grissom We jettisoned fairings after we were inserted, after we made our burn, of course.

Young I think that is the time to do it.

Grissom The antenna fairing goes at the same time and it really makes a noise when it leaves. Junk all over the place. There are springs and pieces of metal flying every place. You could see some springs out in front of us for a good bit, and that cover out there. There is no doubt in your mind that both of them are gone. The only thing that concerned me was some of that debris. I wasn't worried about running into it. I was worried about some of it getting into the scanners. If one of those springs or pieces of debris got into a scanner head, you you would lose a scanner. I think it's a good idea to have the covers on.

Young — Yes, I'll tell you. I don't like the idea of moving your hands towards those SEP switches under any g-loads at all. If you ever hit the wrong one, it would be a national disaster.

Grissom — That's why they are locked.

Young — Yes, I know.

3.1.9 Did the proper FDI and IVI displays appear at SECO + 20? Describe.

Grissom — Yes, we got a reading at SECO as we expected. As I made my burn, it counted up. I started making my burn on time and then I forgot what time I started, so I just burned until I knew I had burned long enough.

Young — I remember the reading that you gave him. Was it 18° nose down on the ball?

Grissom — We were right on the horizon.

Young — This is what it should be.

Grissom — The nose of the spacecraft was right on the horizon.

3.1.10 Describe and comment on the OAMS system performance during the spacecraft separation period.

Grissom — We couldn't hear the aft OAMS thrusters fire as I expected to.

Young. — I could barely hear them. I thought I could hear them firing.

Grissom — Maybe you were listening to it more closely than I, because I was concentrating on attitude.

Young — I was concentrating on trying to hear those things. I didn't want to hit the SEP switch before I heard a noise.

Grissom — But you can tell when it separates. You can hear the pyros fire. That's very clear.

Young — Sounds like a 105-mm howitzer back there.

Grissom So you know when you have separated. The only thing that concerned me was that I wasn't sure if we were thrusting. Then I could tell by the control system that it was doing just exactly what it does in the trainer. It pitches you down. I was having to use pitch-up control which means that the CG was in the right spot. We should have had more lift than we did coming in.

Young You saw where the thing trimmed down. I mean it trimmed way up from where GT-2 did.

Grissom We might have received a CG shift after we separated the equipment and retro sections.

The CG was right when everything was attached to us. OAMS control was good and smooth. I was glad we had rate command at separation.

Young I didn't give it to you as soon as I had in the simulator.

Grissom The roll rate got pretty high. I thought I was going to have rate command, so I just held it over. Roll rate got pretty high, but we got it damped out and stopped all right.

Young When we separated, all this stuff comes flying up over the windscreen. I never saw anything like it.

Grissom Yes, stuff is all around, like shrapnel. It disappeared pretty fast – moved right out ahead of us.

Young I never saw anything like it. The cue I was waiting on for me to push the SEP switches was to hear those babies fire, more than I was on Gus' hand. I thought I could hear them fire, but then I had a plus two count from Gus' hand motion.

Grissom You counted plus two from my hand motion?

Young Yes, and in addition to thinking I was hearing those things firing.

Grissom I think we have already covered the operation of the OAMS during the spacecraft separation period. Only thing that I know was that I could hear my

attitude control thrusters firing. They were firing with burps and blips and every time we would get into a period where there weren't any firings, I'd think the translation had quit thrusting.

Young — You get a little g-cue, but not much.

Grissom — Yes, a little bit. You could see the debris floating past in the cockpit. During the Texas burn, all this stuff came up and glued itself to the instrument panel.

3.1.11 Was the backup guidance selected during launch? Why? Describe the pertinent indications before and after the switchover.

Grissom — No, backup guidance wasn't selected because it wasn't needed.

3.1.12 Comment on the launch vibrations. If possible, give comparisons.

Grissom — The only time we had any launch vibration sounds was just before we went sonic. On the second stage, our engine was pulsing a little bit. It wasn't as smooth as the first stage engine. It was very low level.

Young — That ride was much smoother than I thought it would be. I can't believe it.

Grissom — No pitch, yawing, rumbling or anything.

Young — Beautiful, just beautiful. I'd like to know what wind shear we had going through max q. We didn't see any rates during that time.

3.1.13 Comment on the noise level during launch. Can you identify the major sources of background noise at various times (booster, aerodynamics, ECS, etc.)? Compare the noise level relative to the mission simulator, the LTV abort simulation.

Grissom — No noise that I'm concerned about. After we got away from the aerodynamic noise during launch, all we could hear was the engine ginning along. A most comforting sound.

Young — Most reassuring. That's after we went sonic.

The mission simulator for second stage seemed to me to be pretty realistic.

Grissom — Actually, the noise in the mission simulator isn't too bad. It's a reasonable representation of the noise you get from the first stage.

Young — No, the first stage is too loud.

Grissom — On the simulator?

Young — Yes.

Grissom — I think you are right. You just don't get that much.

Young — No, you don't.

3.1.14 What were your cues of separation? What motions did the spacecraft go through:

a. From SECO to SECO + 20

b. After SECO + 20

Grissom — At separation, when John punched off the separate spacecraft switch, we got a good strong boot in the tail. There is no doubt about it. Noise, and a fair amount of debris flying around the spacecraft.

Young — Yes. In fact, there was a real large amount of debris flying around outside the spacecraft – so much so that I was fascinated by it.

Grissom — The spacecraft was stable at this time, and we had no difficulty controlling it and holding the nose on the horizon.

Young — Could have done it a lot faster, if I had gone to rate command just as soon as I should have.

Grissom — We could do it all right without rate command.

3.1.15 Comment on the communications through the launch phase.

Grissom — They were excellent. We had no problem at any time. Gordo came through loud and clear. Our communications on the intercom were loud and clear. Never any problem.

3.1.16 Comment on displays location for adequate panel scan.

Grissom — We had no problem there. Everything was right where we needed it. Everything was fine. I don't have any recommendations or comments to make on display locations.

3.1.17 Comment on controls location and configuration with regard to accessibility and manipulation.

Grissom — We didn't have problems with anything on launch.

3.1.18 Comment on the sunlight coming through the spacecraft window.

Young — Sunlight comes through the spacecraft window.

Grissom — We didn't have any problem with it on launch. The launch phase went just like we had expected it to and like we thought it would go. We had no problems in that area.

3.1.19 Any additional comments or problem areas associated with the booster, spacecraft systems, or crew integration during the launch phase?

Grissom — No.

3.2 Launch Procedures

3.2.1 Comment on the launch procedures from lift-off to insertion.

Grissom — It was just as we had planned that it would be. I don't know of anything that I needed that I didn't have. John was monitoring the secondary guidance system on his panel. He might tell you what happened there.

Young — I think it was normal. The secondary guidance was showing a booster loft, and it was reported that the booster was going high on the flight path during the first stage flight.

The RGS takeover was indicated by a full peg booster computer attitude error for 10, 15, maybe 20 seconds. This is normal and they're just about exactly the same things that we saw in the pictures of GT-2. The booster pitch-over and guidance was very smooth.

Our attitude errors centered on the second stage momentarily and went to $2\frac{1}{2}$ to 3° nose down, which, I think, indicated again that we were high on the flight path. But it was real normal.

3.2.2 Comment on the procedures immediately after staging.

Grissom — Yeah, we have covered that at least once. At SECO, we waited our 20 seconds, went through our normal procedures of turning on the maneuver thrusters, unstowing the hand controller, and turning on the maneuver and attitude switch.

Young — I turned to direct.

Grissom — John turned to direct and we waited until our IVI's gave us an indication of whether we were overspeed or underspeed. It did give us an indication that we were 17 ft/sec overspeed. As soon as it stopped reading, I started thrusting. Then 2 seconds later, John punched off the SEP spacecraft. At this time, we got the loud noise and jolt of separation. He switched me back to rate command. I rolled the spacecraft right side up and continued to burn for about 10 to 15 seconds.

3.2.3 Describe and comment on the procedures used from second stage shutdown through proper spacecraft insertion.

Grissom — Everything was normal there, I don't see any way we can improve on what we did.

3.2.4 Comment on the scanner fairing jettison procedure.

Grissom — The procedure is simple. You reach up and push a button.

3.2.5 Was adequate information available to cue you on the events from liftoff through insertion?

Grissom — Yes.

3.2.6 Could you determine that the OAMS was operating prior to spacecraft separation? Describe.

Grissom — No. The last indication we had that the OAMS was working was on the pad, when we fired them. I had

no reason to believe that they wouldn't work. All our indications onboard were normal.

Young — Yes. All our fuel and our pressures were normal, and I still think I could just barely hear the translation thrusters fire, but I wouldn't want to count on that sound to use for spacecraft separation.

Grissom — I don't recall hearing the OAMS translation thrusters fire.

Young — I was looking for that cue to separate the spacecraft. The noise, which I figured would be a real loud noise, was just not there.

3.2.7 When during the launch did you accomplish the following?

a. Stow the D-ring

b. Stow the arm restraints

c. Unstow the maneuver handle.

Grissom — Just by check-list. Right down the line.

3.2.8 Do you have any recommendations for changes in the launch procedures?

Grissom — No.

Young — No.

3.2.9 Any additional comments or problem areas associated with the procedures during launch?

Grissom — The launch went very nearly perfect, and we had no problems. No other comments.

3.3 Launch Training

3.3.1 Compare the launch with those that were simulated on the following:

a. Mission simulator

Grissom — The mission simulator was reasonably close to what we actually saw in flight. Their sound of booster noise may be a little bit louder than we heard.

The simulator always shows a pretty good kick in rates as we go through max q. We didn't see any on this flight. I don't know what the shear was that day, but we didn't see any. The rest of the things looked just like they do on the simulator. The thing we saw at RGS initiate was actually smoother and looked a little better than what we saw on the simulator. On the simulator, the needles will suddenly give a big kick. At SECO, the booster just pitched down. All the other launch simulations in the GMS are close to what we actually saw.

b. Centrifuge

Grissom I would say the ride on the booster is a lot smoother than the ride on the centrifuge, and the new centrifuge is a good smooth ride now. They've taken a lot of the jiggle and chatter out of it. The g-forces are in the same ball park. The g's on this launch were very nominal.

c. Launch abort (LTV)

Grissom This booster ride is a lot smoother and a lot easier than the simulation at LTV. They are very extreme. All the vibrations and noise they have in it, and the POGO and everything else they have put in it is very extreme. We saw nothing like that at all. This booster is very smooth all the way. We never felt it steer. It's like riding a Corvette.

Young It sure is. I agree with Gus. I think the noise in the mission simulator at engine ignition and liftoff is a lot louder than it is in the actual vehicle.

Grissom Well, it's probably pretty similar.

Young Actual acoustic noise, as soon as you go supersonic, really dies down; whereas, it dies down in the second stage in the simulator.

Grissom I think the only thing that needs to be changed on the GMS is that the sound of aft-firing and forward-firing thrusters should be eliminated.

Young Well, I'd swear I heard them a little.

Grissom — You can hear all the attitude thruster in pulse mode, and on the night side you can see the light from them. You remember the first time it got dark, John? I said, "Look it's lightning." This was the thrusters firing.

3.3.2 Did any unexpected or unplanned spacecraft operational problems develop during the launch that had not been covered in your mission training?

Grissom — No.

Young — No.

3.3.3 What changes or additional training for the launch would you recommend?

Grissom — The only thing I would like to have seen more of during training was an outside visual display.

Young — Yes.

Grissom — It would have given us a better idea of the pitch attitudes and how the spacecraft responds. It seems to look different when you look outside, than it does when you're looking at the 8-ball.

3.3.4 Did the following simulators provide you realistic training in the spacecraft tasks during launch?

a. Mission simulator,

b. Centrifuge,

c. Launch abort (LTV),

Grissom — We covered this under 3.3.1.

4.0 ORBIT

4.1 Orbit Systems

4.1.1 Describe and comment on the control system performance.

Grissom — Control system performance was as I expected, with the exception of this slight drift in yaw. I think that this gradually worked itself out. On the first orbit, initially it was pretty bad. Right after separation, it was pretty bad. It would turn me around 30 to 40° before I really realized we were moving, and I'd bring myself back to zero on the ball, and it would start drifting me again. I fiddled around and did everything I could think of. We changed to secondary drivers. In fact, we stayed on secondary drivers the rest of the flight. Went to secondary ACME on the yaw channel.

Young — On recommendation by the ground.

Grissom — I couldn't see how it could do any good either. The only recommendation that the ground made that I wouldn't follow was that I cycle the propellant valve on and off. I didn't see how this could effect it, so I wouldn't do it. That valve was open, and I was going to leave it open. It wasn't caused by the thrusters firing. It must have been a leak because it was a continuous left drift, and it would accelerate. I think it was completely gone during the third orbit. It just dawned on me along about half way through the third orbit that we didn't have the left drift anymore. It occurred in the horizon scan and pulse modes for sure, and it could have been there in the others. It would have been masked because I was probably doing something else. It was probably there all the time, but the times I was in rate command or direct, I was performing a maneuver where it wouldn't have been apparent. That was the only control system problem we had. Everything else worked perfect. Rate command rates were almost dead beat.

Young — Yes.

Grissom — The only thing that was surprising, and wasn't as I expected it, was the reentry rate command. Those

dead bands were something tremendous. They were on the order of plus or minus 5 or 6 deg/sec. I was glad we had already made up our minds to fly in direct, because those dead bands were just too big. It would have been difficult to control.

Young — I thought pulse mode was just beautiful. It did just exactly what I expected it to. It did what it did on the simulator. There was a little drift, but there is going to be a little drift in a system that is not damped about any axis. I was pleased. Rate command was dead beat. It was just right on the money. When you let go after putting in a full rate command of 10 deg/sec, it just stopped it right now. You couldn't ask for any better control system.

Grissom — I prefer to fly in pulse mode.

Young — Yes, it's easiest. It uses less fuel.

4.1.2 Describe and comment on the control and performance of the ECS condensation problems.

Young — The ECS condensation problem was taken care of by turning off the cabin fan and turning the cabin cooling system to full hot. The cabin temperature got up to 92° and I don't think we ever had enough water at the end of three orbits to condense out The most water in the cabin was introduced by me in missing the uriceptical on the first try, and that introduced a ball of water a couple of inches in diameter. Most of it I managed to sop up, but at those cabin temperatures you would get water eventually. I didn't notice any, did you, Gus?

Grissom — No.

Young — I have to be honest about it and admit I didn't notice any. But I still don't think that takes care of the water problem in the spacecraft, and they had better do something about that.

Grissom — I looked a couple of times for water, and I couldn't see any anyplace.

4.1.3 When did you:

a. Switch to single coolant loop operation,

b. Switch the evaporation to normal,

c. Radiator to flow?

Young I think we switched to single loop over Carnarvon. We went to flow on the radiator the first time at 1430 over the Canaries. They said that the outlet temperature was off-scale and the inlet temperature was 73°, which indicated that the water boiler was doing its job. Then, at CSQ at 37 minutes, we went to flow on the radiator and they gave us an outlet temperature of 42°. So I left it in flow, and when we got over Carnarvon we went to single loop operation. At that time, our suit inlet temperature was 54°. I want to base going to the single-loop operation on crew comfort. It seemed to me as if we were nice and cool. So, I shut off the secondary loop and went to normal on the evaporator instead of max flow. We stayed in that configuration for the remainder of the flight. The suit inlet temperature -- except during the times when we went to high rate flow where you don't have a good indication of what your suit inlet temperature is -- never got beyond 54 or 55 at night, and 58 or 59 in daylight. I consider that really good. For workload periods, our compressor flow was marginal. You could tell this from a heat load buildup in the suits. Think of the things that Ed White is going to be doing; like opening the hatch and standing up. It's going to require a workload in which he has to get that heat out of the suit or run the risk of compromising the mission. Two compressors running at the same time may be a way to handle this situation.

Grissom I never really felt uncomfortable. It was not as cool as it was when we were on the pad.

Young That's right.

Grissom It was marginal, and I could see the work John was doing could build up a heat load which could develop into a serious situation before too long.

With no more physical activity than I was doing, there wasn't a problem, but I thought it should have been cooler than it was.

Young — Any heat load that I put in the suit Gus got, too. That is a problem.

Grissom — At times I got warm when you were busy, I guess.

Young — I think the worst heat load case was when I turned around and stowed the drogue pins.

But the biggest heat load I put in the suit was trying to break that bacteriacide bag into the defecation bag. I really put a heat load in the suit that time. It wouldn't break, and I was really frustrated.

4.1.4 Comment on the electrical system performance.

Young — I think it was beautiful. The mains were tremendous and the adapter battery main bus voltage was around 23.6 and 23.7.

Grissom — The dc-dc converter is part of the electrical system.

Young — Yes. I'm not too happy with that.

Grissom — It dropped off very early. As a matter of fact, it failed right after we passed the Canary Islands.

Young — I had been looking out the window. Things were so bright out there. When I looked back in, the first thing I saw was the ECS O_2 pressure reading 250 psia.

All I could think of was that it had backed off on the dome like they said it was going to, and that we had better put some manual heat into it or we were going to be breathing some liquid oxygen.

Grissom — About that same time, we saw the cabin pressure indicating zero, with both face plates open. We had a scanner light. Everything was going all wrong at the same time, which should have given us a clue, maybe a little earlier, but it probably didn't take us more than about 10 seconds to take care of it.

Young — No. I think we caught the thing almost instantaneously, but by the time I had caught it, I had to shut the mains off, and turn off the O_2 manual heaters, and everything else.

Grissom — You had already shut the mains off before this thing dropped off.

Young — Yes. I shut the mains off, but I turned them back on again and went to manual on the O_2 heater.

Grissom — Yes, but when you shut the mains off, that's when my horizon scanner light came on. We may have dropped that whole thing off when you shut those mains off.

Young — I went back to primary dc-dc converter, but the converter didn't come back on.

Grissom — That's right. It was shot. That was the biggest surprise in the whole flight.

Young — Yes. The only thing I can think of that might cause that would be some piece of equipment shorting it out at zero g.

Grissom — Well, the thing I was concerned about was that it was going to short the other one out, too.

Remember those bad sensors we had in the ECS system that would short a dc-dc converter?

Young — Yes.

Grissom — I wonder if that's what it was.

Young — They put one of them on the line, and one of them was wired to the 24 volts.

4.1.5 Comment on the performance of the horizon scan attitude control mode.

Grissom — The horizon scanner control mode worked fine. The only thing that is bad about it is that it should shut off altogether when the scanners get an ignore signal, and leave you right where you are and not throw you out of attitude. It did a real good job. It would stay within its limits as long as I didn't

have an ignore light. The ignore light would just come on at times. The funny thing was it came on at night too. The thing that was happening was that these horizon scanners would get an ignore and pitch us down. I would regain control and get stabilized, and then I would wait 30 seconds or a minute for the ignore light to go out. Normally, it wouldn't, although sometimes it would go out. If it went out in a minute or so it would come back on. I would switch to the other system, and in 15 to 30 seconds the light would go out and the scanners would work fine for about an hour. Then the ignore light would come on, and the same thing would happen again. I'd switch back to primary and that would work fine for about an hour. It seemed like they would work only about an hour at a time without rest. We lifted off with an ignore signal and we expected it to stay there until fairing jettison. If the scanners ever acquired during that time, we never saw it. The horizon scan system should be a pilot relief system. I guess, I could have ignored it and just kept drifting around, but it kept accelerating us all the time. I didn't want to do that until I found out for sure how all these things were going to work. I wanted to stay at some attitude that I knew.

Besides that, I figured I had to do that, because if I lost the 8-ball I wanted to find out what all my important attitudes looked like while I had a ball for reference.

4.1.6 Describe and comment on the yaw inputs necessary in the horizon scan mode to hold near 0° yaw attitude.

Grissom This isn't really a very fair question, since we had that continuous yaw problem. Otherwise, I think it would have held very well because the pitch attitude would stay stable. After we once got the rates down to zero, there was very little drifting. You could hear it every once in awhile. Blurp - back and forth. When I'd let it drift, it would work down - back and forth. But normally it stayed pretty steady and worked very well.

4.1.7 Comment on the alinement stability of the platform in the orbit rate mode.

Grissom — The orbit rate mode worked fine until the second night time. As a matter of fact, the first time we really noticed the attitudes were off was when we were getting ready to make the horizon scanner check. We yawed around 180°, and I noticed the ball didn't look right at the 90° point. During the translation maneuver, everytime we went to a 90° point the ball didn't look right. That's the first time that I noticed that it was off. We were about 12 to 15° off attitude and above the horizon. On the horizon scanner check, I tried to get my rates damped down to zero before I put in my yaw. The thing went right up over the ball, up above the 90° point, and then I think I put in a control pulse. We might have been pitching up a little bit, but according to what I could see of the horizon, we were out of attitude quite a bit. When we came back to zero-zero on the horizon, the ball was way off.

Young — It surely was -- way off.

Grissom — About 20° or 30° off.

Young — 25°. I thought you were trying to roll it one way or another when you first came back. I was looking out the window at the horizon and thinking, "Boy, that's nice."

Grissom — Surely looked bad. The bad part was that this happened right at the time we were going into the dark side. That's a black night side there. There's not a thing you can see.

Young — No. No stars that you can recognize.

Grissom — So, my full concern was platform alinement. But we went ahead and went through SEF position and attitude. It looked like it was coming in all right from what little I could see of the horizon. The alinement mode worked fine. And in all the alinement checks, it worked properly. From what I saw on the horizon, it was good compared to what it was showing on the 8-ball. But if I'd go back to orbit rate, the ball would start going off in roll.

4.1.8 Describe and comment on the coolant pumps during the check in the second orbit.

Young — Fortunately, Guaymas reminded me to do the coolant pump check during the second orbit. But, I think they were a little too interested in finding out how it came out. I don't think it was all that important at the moment. Anyway, the B-secondary system had been off, so I turned the B-pump on, and I wanted to wait a little while to get some of the sludge out of the line because I figured that stuff was pretty cold back there. I knew we would never get the A-pump on with the B-pump if that stuff was even viscous. So, I wanted to wait. But they wouldn't have it. I turned on the A-pump and sure enough, it didn't come on. So, I turned them both off and on together, and that time the A-pump came on the line and the B-pump stalled out and wouldn't come on the line. This was the secondary loop and is about what you would expect to happen. One of them is going to stall out. So, I reached over and turned on the A-pump in the primary loop and it wouldn't come on. I didn't want to trouble-shoot the primary loop by turning them both off simultaneously, so I turned it back off and then I turned it on one more time to double check. The only requirement for ever having both pumps on at the same time in one loop would be, if you lost one loop in the wrong fuel cell and you're having marginal flow. You ought to be able to get both those pumps on the line during that kind of situation, if you want to stay up there. That's the only case I know of, and even that is theoretical. We didn't have a requirement.

4.1.9 Comment on the operation of the RCS during the first orbit check.

Grissom — Well, we started making the RCS plume check in that first orbit night side. Man! It puts out a lot of fire. You cannot see the horizon through the plumes at night.

Young — No. We took the pictures of it. They really are bright.

Grissom — Especially when those yaw thrusters fire.

Young — Yes!

Grissom They wipe out the horizon completely, more so than do the pitch thrusters. You would never see the horizon at night. I think it would be impossible to retrofire out the window at night. The plumes were bright, but I can't really say that it surprised me. It looks about like what we saw at the Liquid Test Facility, maybe a little bigger. It spreads out more. On the ground and on the pad, it's a very narrow flame – and not much flame – but at night it goes out a good 10 or 12 feet and spans out probably 20° to 30°. There are lots of sparks. And you can't do a night retrofire through it. Now in the day, you don't notice them. You are seeing fire, but you really don't notice it.

4.1.10 Describe and comment on the use of the oral temperature measuring system.

Grissom It's all right.

Young Yes.

4.1.11 Describe and comment on the use of the blood pressure measuring system.

Young We had the problem in that we couldn't get the blood pressure fitting into the suit.

Grissom Your blood pressure worked all right, but I couldn't get the bulb plugged in the hole in my suit. The suit plug would go in the hole, but I couldn't get the blood pressure fitting to go in.

4.1.12 Comment on the use of the MDU insertion of computer parameters and the checking of ground inserted parameters.

Young I checked the first maneuver load over Carnarvon, and it all checked out right on the money. I read out the last two maneuver loads, the first one over MCC and the last one over Carnarvon, to verify them. It is really simple to check T_R and the backup parameters. We could have inserted them, although we didn't have to do it. It is just as easy to insert them when you check them out. I don't think it would be any problem, but I don't really see the need for it if this thing works like it's supposed to. It surely is a lot easier when you send it up

from the ground than having to sit there and punch all those buttons, which is going to take 3 to 4 minutes anyway, even if you do it as fast as you can. Once we got confidence that the DCS would accept the first load, and that all the parameters went in properly, why bother to check it every time? I was verifying the latitude and longitude. The computer parameters received in flight should all be referenced to Greenwich and point of liftoff, so that with a nominal mission, which most missions are going to be, you will be able to compare the insertion parameters with onboard data. We couldn't do that because the Goddard axes are different than the ones MCC used for initial update. I think that is something we ought to correct for later flights. We could have compared those parameters, and they would have come within yards of being on top of each other. In fact, along the one axis that is the same, the difference was about 200 yards out of some 3 million, and that is pretty close.

4.1.13 Describe and comment on the catchup mode check during the first orbit.

a. Did the FDI and IVI indications agree with the prelaunch calculations?

b. Did they agree with the horizon and 8-ball indications?

Grissom — The catchup mode check worked just like we had expected it to work. Just like it had worked in the trainer. The numbers came up properly. I went to the right attitudes. I got all the velocity in the fore-aft window, and my attitudes were just as advertised.

Young — Yes. In fact, a lot better than it had worked in the simulator.

4.1.14 Estimate the accuracy with which you were able to aline the platform. How did you determine the platform was alined?

Grissom — I think I could aline the platform within ±1 or 2° in pitch and roll and ±2 or 3° in yaw. That is visually, out the window.

Young — I'd say it was even better than that. He was probably closer than that. I think he was right on the money.

Grissom You can pick up your yaw, immediately. When you are up at zero-zero-zero attitude, nose on the horizon, you couldn't tell those fine yaw movements, except you could tell if you were within plus or minus a few degrees. But when you pitch down a little, there is no problem determining yaw. You can pick it up from the stars too, very easily.

Young Yes. You are really moving along.

4.1.15 With respect to the 1:33 OAMS translation, describe and comment on the following:

a. Operation of the forward-firing thrusters

Grissom Forward-firing thrusters fired just as we expected. I don't recall seeing any flame, do you?

Young I saw the light. I was looking for that.

Grissom I was strictly on attitudes. I don't recall hearing them either.

Young I remember, I heard them very faintly, but not like we expected to hear them, based on the trainer. When you close that helmet, you really shut out a lot of sound too.

b. The attitude control mode used

Grissom We used rate command and I had no difficulty controlling the attitudes. It was just as I had expected. The alinement of the thrusters with the CG was just about as I had expected. I got a very slight pitchdown, and had to continually pitch up to hold my attitudes.

c. The 8-ball and FDI displays

Grissom The 8-ball attitude displays were just as I had expected.

d. The IVI displays

Grissom The IVI's counted out at exactly the rate I expected them to, and the expected delta time of burn and the actual delta time were very close, within a second.

Young — It was a minute 15 seconds, the first burn. I timed it right on the money. She burned down to 2 ft/sec and the time was right, so we just quit burning at a minute 15 seconds.

Grissom — I went to COMP on the computer 3 to 4 minutes before the burn, and 48 came up in the aft window, just perfect, with zeros in the others. But by the time we got ready to thrust, it read 51. So when I fired, I just fired aft to count this thing down 48 ft/sec, and that came out with the time and left us with 2 ft/sec in the window. I used the IVI's, backed up by time. I came out just right. The same thing happened on the other burn, but we will get to that later.

e. Any systems problems?

Grissom — No systems problems.

Young — No. It was beautiful. Just perfect!

4.1.16 Comment on the operation of the event timer during the entire mission. The G.m.t. clock.

Grissom — The event timer worked perfectly all through the flight. How about the G.m.t. clock?

Young — Ha. Ha.

Grissom — You mean the clock was probably running, but you couldn't use it.

Young — Well, I used the G.m.t. clock for elapsed times. Punched it 3 seconds after engine ignition, and then wanted to punch it again after retrofire, but I just couldn't quite get there from where I was. Stuck back in the cockpit, I could just barely read G.m.t. on it.

Grissom — That clock is bad.

Young — I would surely like to have an event timer on my side too. For a long duration mission, it probably wouldn't be necessary.

Grissom — We should have two event timers in there, that count up to more than 99 minutes.

Young — I wore two watches. I used the Acutron for Greenwich mean time. We were getting G.m.t. time hacks over stations, and I wanted them given to us on the minute, but they kept giving them to us on the odd times. We can't set our stop-start features on odd times. If they would give them to us on the minute, we would have been within milliseconds of having the proper G.m.t.

Grissom — We had plenty of clocks onboard, so we had no problems. My Omega was keeping good time and so was my Acutron.

Young — But before the next mission, we really should make some effort to get the watches calibrated and adjusted.

Grissom — Well, they were calibrated, but they weren't adjusted.

Young — They should have been corrected.

Grissom — They said one was running 15 seconds slow, and it would take 9 days to adjust it. Well, we were at the point where we didn't have the time.

Young — 9 days! We didn't get the watches until a few days before the flight.

The G.m.t. clock. They wouldn't allow us to look at that on the sim flight or during the rest of the tests, because they were calibrating its accuracy.

4.1.17 Describe and comment on the operation of the platform caging and alinement system during the platform alinement and caging check.

Grissom — Platform caging and alinement system worked just as we expected. I moved off 10° in attitude, held them visually, caged at that point, zeroed the needles, and I was back alined within about 5 minutes. I really didn't need a full 10 minutes to get perfect alinement. About 5 or 6 minutes and we were back in real good shape.

4.1.18 Are the containers used for the dehydrated food and juice adequate for future Gemini missions? If not, what improvements would you recommend?

Young I think that we should move that check valve to the end of the food bag, so that all we have to do is remove a piece of tape from the check valve and insert the water nozzle and reconstitute the food. If you have to cut into the seal, it might float around in the cockpit somewhere. Having to go into the check valve seal with a pair of scissors to make sure it is opened so you can get the nozzle into it, and then not being sure of what you've got after you put the scissors down in the valve is bad. Removing the feeding port with your gloved hand requires an amount of manual dexterity which we don't have. On one of the containers, the germicide food pill just floated off and I never did find it. So, I could not put the germicide pill in that container. I did reconstitute both applesauce and grapefruit juice. Unfolding the bag and eating was okay. I do feel though that we need, for liquids, a tape over the feeding port when we seal that package up again. Putting the germicide pill down the bag with gloves on requires considerable manual dexterity, too. There is no velcro attachment on the pill, so control has to be maintained. I suppose that the food reconstitution is adequate for a mission where a guy had enough time to do it. And I recommend we always allow adequate time. The chicken bites are edible. We decided not to use the brownies because they have oil in them. We didn't want to open the package, and take a chance that we would get oil in the spacecraft. My recommendation remains that we move the reconstitution check valve to the end of the package and seal it with tape, and that we get some tape to seal over the end of the packages when we seal them up after eating. I noticed this on the grapefruit juice--little droplets of liquid were crawling out the end of that feeder flapper even though it was folded over. This liquid spreads out in one molecule lengths and goes on forever. I think the feed bags should be sealed before they are stowed.

4.1.19 Comment on the waste disposal system with respect to the following items:

a. Transportation of the contents of the launch urine bag to the evaporator

Young I did my level best to keep from urinating on the pad. I managed to do so because I didn't want to waste time transferring urine.

b. Normal orbital use for the collection of urine

Young I used the system after we got into orbit and did exactly what I expected I'd do. I spilled a ball of urine about 1 inch in diameter, which is maybe 5 percent of what I urinated. There is no way to tell. One of my problems there was that right after I plugged in the uriceptical into the QD on the spacecraft, I went from FLUSH to NORMAL on the waste valve. This, of course, left a 2-$3\frac{1}{2}$ psi differential on the bellows. Therefore, I had to open the uriceptical to the cabin so that I could relieve the psid and pull the bellows out. There is a lot of procedure involved in using the uriceptical properly. I used it better the second time. I didn't spill any urine, expect maybe a couple of drops which I really feel is inevitable. But I feel that unless we are lucky, we are going to spill some urine, which conducts electricity. We need a system with which a pilot does not have to control the rate that he is urinating to avoid getting urine in the spacecraft. The system is just not set up to handle zero g. When you inflate the seal around the waste valve, it gets wrinkles around it. Of course, in zero g, there is nothing to prevent the urine from crawling out around the side of your penis unless you maintain a positive pressure at all times around that bellows. It will not always be possible to do that. The bellows is limited. I had to call on Gus one time to hold the thing. It did work. As soon as we went to FLUSH on the waste valve, it pulled the bellows in and dumped through the water boiler. I didn't try urinating directly with the waste valve on FLUSH – 2.5 to 3 psi differential – putting it directly into the water boiler. I'll leave that to Ed White to check

out. But, that is probably a good way to do it, and it certainly would eliminate spillage if you had a 2.5 to 3 psi differential on the system. You could do this on the night side when you weren't boiling water. (5.5 psi differential)

c. Was there any noticeable tendency on the part of the system to trap gases? If so, describe.

Young I think that the system ran the odors around one time and cleaned them right out. The odor removal capabilities were really pretty good. It quickly removed the defecation odors.

d. Did you simulate the defecation procedures? If so, describe.

Young I simulated the defectation procedures all right. I won't describe them except to say that I didn't have enough time to do that evaluation justice. I didn't get a chance to evaluate the finger on the defecation glove properly. It's going to be a mess and there is no question about it. We have to have some way to handle the paper that goes with defecation. There is nothing to make the feces go down in the bag, which is what I keep telling everybody. This finger on the bag is a great idea. But if you have a wet bowel movement, all you will do with the finger is plaster the feces all over your rear end. I had a medium-loose type bowel movement, and that is exactly what happened. I think we might as well learn to live with the fact that going to the bathroom in zero g is a mess.

e. Are there any additional comments you would like to make with respect to the above items?

Young I don't know what we can do about it, except be very careful and practice, practice, practice.

4.1.20 Describe the operations of the drinking water facility.

Young The drinking water facility operated. We operated with the pressure off the whole time, drank water and reconstituted food. We had plenty of pressure and we operated with the pressure off. We used

the blood pressure bulb to drink some when we were down on the water in the spacecraft, and that worked fine. However, it took a tremendous amount of pumping, and I was sweating so much from pumping that I was just breaking even as far as getting my water table back up. One end of that blood pressure bulb was of no use to us. Having two ends on the bulb was something new. I am sure I spent fully 5 minutes trying to plug the wrong end of the bulb into my suit when we first got into orbit.

4.1.21 Describe and comment on the ECS system operation during the O_2 high rate check.

a. Was the use of the manual heaters required?

b. Comment on your comfort during the high rate period.

Young I think this was about 2:50 in the flight plan - about 10 minutes after we were supposed to be doing the O_2 high rate check. I brought the mains on the line and used the manual heaters one time during that check, which was at about 4:30, and I held the heaters on the last minute of the check. During this check, the ECS O_2 pressure came down. It had been pegged at the top, above 1000. It came down to around 800. The manual heaters made it climb back up to around 840, and, as I recall, it stayed in the area of 840 for the rest of the flight. I don't think it ever pegged again. The only thing I can say about high rate is that you are not nearly as cool during O_2 high rate as you are at any other time. O_2 high rate is not the way to get cool at all. You just heat up. You close that suit system off and you heat up. We should investigate running on O_2 high rate with the suit compressors where you might be cool. When you shut those suit compressors off, as you initiate O_2 high rate, your cooling just goes to pot. You don't get the flow that you need for cooling. I would never recommend O_2 high rate for anything except for maintaining a differential pressure or cleaning CO_2 out of the

suit. I certainly would never recommend it for cooling; and that includes reentry. We stayed on the regular system all the way to the water. I would be willing to bet you that we were not nearly as hot as we would have been if we had gone to O_2 high rate. Subjectively, it wasn't as bad, during the high rate check for 5 minutes. Our comfort wasn't as degraded as I thought it was going to be.

4.1.22 Comment on the use of the cryogenic quantity measuring system. Is the configuration of this system adequate for future orbital flights?

Young Sure, I think it is adequate. I think it worked fine. I think it worked just like it was supposed to work. One thing I didn't understand was why the auto system kept the oxygen pressure off the scale the whole flight until we shut it off. After we'd had this dc-dc failure, I went to O_2 high rate during a suit integrity check. The oxygen pressure came down to about 800. When I went back to auto-heaters, the oxygen pressure climbed right back up and cracked the relief valve. The pressure stayed up there the rest of the flight until we went to O_2 high rate again. MCC suggested - I guess it was Larry Bell - suggested we shut the auto-heaters off and see what happened. So, we left them off the rest of the flight, and the oxygen pressure seemed to be operating within limits. It may be that we don't need a heater, or that the auto-heaters were malfunctioning full-on all the time for normal breathing oxygen. I think it would depend on how much the guys breathe too, and the cabin leak rate, which was low. It didn't appear that we were using much oxygen, even with the venting overboard. Maybe the calculations for how hot the adapter gets were not completely correct, or else the heaters were malfunctioning. My guess is that the automatic heaters were on when they should not have been on.

4.1.23 Comment on the suit pressure, suit flow, and cooling provided on each of the following faceplate and recirc valve configurations:

a. Both faceplates opened, recirculation valve opened

b. Both faceplates closed, recirculation valve opened

Which of these configurations provided the best operating conditions?

Young — Both faceplates open – recirc valve open was okay, and both faceplates closed – recirc valve open was okay. I think the operational mode should be with the faceplates open and the recirc valve open, because there are just too many things to do that require you to have your faceplate open to get at things, see things, and operate. And I don't think you notice a lot of difference as far as suit ΔP inside the suit, whether the faceplate is open or whether it is closed. There is an increased ΔP with the faceplate closed. I know you get better cooling flow with the faceplate closed, but still the operational mode, I think, will be faceplate open. In zero g, the suit floats away from you. Don't you agree with that Gus? Faceplates open.

Grissom — Yes.

4.1.24 Comment on the operation of the horizon scanners with respect to sun angle during the second-orbit horizon-scanner check.

Grissom — I am not really sure how well the check went because there is where I first noticed the platform misalinement. I am not sure about our roll and pitch attitudes at that point. We were getting set up for it and so I am not too confident that check went properly.

4.1.25 With respect to the 2:20 translation system check, describe and comment on the following items:

a. The use of the forward-firing and the aft-firing thrusters

Grissom — There is no problem going rapidly from forward-firing to aft-firing thrusters in the check.

b. The visual appearance of the forward-firing thruster plume

Grissom — When we used the forward firing thrusters, we could see the flame. We could see the sparks way out in front of us. John probably saw more of the plume than I did. Why don't you describe it, John?

Young — It is a big orange-yellow glow with a lot of sparks in it. It really goes out in front of the spacecraft, about 30 or 40 feet, and lights up the whole spacecraft.

Grissom — How far does it fan out?

Young — It stands out, as far as I could see, about 35° or 40° angle. It is pretty spectacular at night. It really lights up the area.

Grissom — I used the direct system to control attitudes and had no problem. The attitudes, displays, and IVI's all worked like we expected. No problems.

4.1.26 Describe and comment on the operation of the horizon scan control mode during the horizon-scan control-mode characteristic check.

Grissom — I was busy and I didn't make the horizon-scan control-mode check, and John was busy and didn't want me to be fooling around with the control system. But I had seen it operate in almost the same mode all along, and it worked properly when the upper limit is reached. It thrusted me back down, and if I got a rate going it would take me through one of the limits. I could go right on through and get the scanner ignore, and it would boost me out further in that direction.

4.1.27 Comment on the operation of the pulse mode during the tracking task.

Grissom — The pulse mode isn't adequate for the tracking task. I was moving along too fast and the pulse mode can't keep up. Maybe, if I could have gotten a target in mind early, I might have been able to do it with the pulse mode. We didn't have very good visibility and I had difficulty picking up a target. By the time I did, it was almost underneath me. At this time the pulse mode wouldn't begin to keep up with

it, so I used direct and controlled to within a few degrees of the target. You can't see the pipper on the target on the bright earth, so it is difficult to tell. The pipper was really faint.

Young I was taking a picture of what he was tracking.

Grissom I am not sure that he could see what my pipper was on.

Young That's right.

4.1.28 Comment on the operation of the reticle.

Grissom The reticle sticks up in your way and interferes with your outside vision, and you can't see it. It isn't good for what you want. When I was at zero-zero and the ball was at zero-zero, I was alined on the horizon. This pipper stuck way up above the horizon. The thing was supposed to be alined with the Z axis. It may be my position with the nose that made it look that way, but it surely didn't look right at all.

Young Gus, why don't they consider using something like that little ring-site on the camera? Wouldn't that focus it?

Grissom I don't know. That reticle is not very satisfactory. It is too big. In addition, you don't have enough control over the intensity, and when you get down on the bright earth, the pipper disappears.

4.1.29 Did the backup CO_2 sensors operate as predicted? Comment.

Grissom I opened the backup CO_2 sensors and I got an indication that we had 2 mm saturated. It looked like 4 mm were just about saturated. I didn't get an indication on six and eight. I was surprised at the way they were packed. They weren't packed like the ones I had seen before. You could take those and open them up. With this one, you had to take the scissors and cut them apart. It was a nuisance. I don't see why they have to be made that way.

4.1.30 Comment on the use of the communications control center (selection switches, volume controls, etc.).

Grissom — The biggest nuisance here was John's being in RECORD half the time when he was trying to transmit. I think we should have a separate record switch.

Young — I would like to see one on the box somewhere. It surely would save a lot of time.

Grissom — I would like to see one on the center panel, so that both of us could use it to record whenever we want to. Everything that is said to the ground is recorded, so I guess it is not important to record that.

4.1.31 Describe and comment on the UHF performance. Was there any noticeable difference between the adapter and reentry antennas?

Grissom — The UHF performance was perfect. I didn't see anything wrong with it.

Young — It was beautiful. We operated on adapter antenna. At Bermuda LOS, I switched to adapter antenna just as we lost them, but we stayed on adapter and both UHF number 1 and 2 operated on adapter over the Canaries.

Grissom — I couldn't tell any difference between adapter and reentry antennas.

Young — I couldn't tell the difference. Great communications. The only time we had a little fade problem was over Canton, talking to Cordo on that first pass.

Grissom — Yes. We weren't getting much out of Canton. We weren't getting much out of Kano either, but that was probably due to the relay.

4.1.32 If HF was used in orbit, describe and comment on its operation.

Grissom — HF wasn't used in orbit.

4.1.33 Comment on the spacecraft internal arrangement. Any recommendations for improvement?

Grissom — We need a larger cockpit, and we need a better way of storing things. The storage just isn't satisfactory.

4.1.34 Comment on the spacecraft lighting. Any recommendations for improvement?

Grissom — You can't see that center instrument panel as well as you need to see it. It should be back-lit. The flight plan roller is difficult to read and probably ought to be back-lit.

Young — After you have looked out of the window coming around in the daytime and look back in the cockpit, you can't see anything. I don't care whether you have your light turned up bright or not. You just can't see a gage.

Grissom — You can dim them properly at night. You don't have any problem there, but when you get them dimmed down so you can see the flight instruments well and see outside well, you still can't see the center instrument panel. We need more intensity during the day and the capability to control it down at night. We can't control it properly at night. If the flight plan roller was back-lit, that would relieve a lot of the problem, because that was one of the things most difficult to see. I used the finger-tip lights a lot more than I ever thought I would.

Young — So did I.

4.1.35 Did the visibility through the spacecraft window change during the flight? When? Describe.

Grissom — Yes, visibility did change. There was a little bit of haze that accumulated on the interior of one of the inner panes.

Young — I could see it looking through your window. It looked like a haze. My window was clear.

Grissom — It looked like a little bit of moisture or fog on the window. It got worse as I went along, but it

wasn't bad enough to obstruct my vision. Also, during reentry, a film or something suddenly burned off the outside of the window. I don't know if you saw it or not John.

Young — I saw it. It isn't evident on the spacecraft window now, but it looked like the entire window crinkled all over – little crinkles all through the window. It must have happened at about 125 000 feet.

Grissom — I couldn't see well through the crinkled part. We were in the reentry when it happened. As soon as we hit the water, my window fogged up and it was difficult to see through it, but John's window stayed pretty clear.

4.1.36 Comment on the stowage facilities.

Young — On a long mission the crew is really going to have trouble with storage. For example, I didn't have any place to put the urine collection device. I couldn't think of any place to put it, and it had filled up with air and was twice as big as before. I had to cut it to get the air out of it.

Grissom — It must have been caused by gases forming in the urine.

Young — I didn't urinate in it.

Grissom — That was fairly normal. It was stored 15 psia and we were up there at 5 psi, so I guess that would do it.

4.1.37 Did any of the warning lights illuminate? Which ones? When?

Grissom — Yes. The horizon-scanner warning light came on quite frequently.

4.1.38 Comment on the operation of the 16-mm camera, the Hasselblad.

Young — I thought the operation of the 16-mm camera was fairly straightforward. You can operate both cameras. I don't know if I took any good pictures or not. I don't recall that I had the film settings for the night photography on the 16 mm, and, if they were different than prelaunch settings, we didn't get any pictures.

4.1.39 Comment on the operation of the voice tape recorder with respect to the following:

a. Controls

b. Cartridges

c. Warning lights

Young I think changing the voice tape-recorder cartridges was easy. I never did see a warning light, and I don't really know if the thing was operating. I didn't have any way to tell. I guess you take it on faith that the thing is working after you get the top closed. The difference between the top of the recorder being closed and not being closed is not a very positive thing. I recorded for a short period of time with the top not fully closed, I don't know if it will operate like that or not. I wish we had a separate switch for controlling the recorder, not on the communications control center.

4.1.40 Were there any peculiarities in hand-controller characteristics?

Grissom The hand controller was just what I expected it to be. It was just like the one in the trainer.

4.1.41 Can you identify the major sources of noise at various times during orbit (inverters, fans, etc.)?

Grissom The only noises I recall hearing in there were the thrusters firing and the cabin venting.

Young You could hear cabin fans and suit compressors.

Grissom On O_2 high rate, you could hear the clunk of the valve. You could hear the retrorockets fire, and you could hear all the separations.

Young You could hear the OAMS isolation valves and the RCS squibs going off before launch.

4.1.42 Could you audibly detect the firing of the OAMS attitude and/or maneuver thrusters?

Grissom — We knew when the OAMS attitude thrusters were firing, but I couldn't tell when the maneuver thrusters were firing.

Young — Maybe I was just imagining it, but I think I could hear the maneuver thrusters fire. I was really listening.

4.1.43 Did you encounter any unexpected problems related to reaching any of the spacecraft controls?

Grissom — We could get to all the controls all right.

4.1.44 Any spacecraft system tests you would recommend preferring on the next mission?

Grissom — I don't have any recommendations right now.

Young — I think the only test they should do is to keep it up there for awhile. I think it is a good ship. I think they ought to see just how much ΔV you get for things like separate spacecraft and separate adapter, because that is a real boot.

4.1.45 Did the experiments equipment operate properly?

(See 4.3.7, f.)

4.1.46 Did you encounter any difficulties in seeing displays and controls?

Grissom — No.

4.1.47 How could you detect the forward and aft OAMS acceleration other than the IVI cue?

Grissom — You could tell when you were firing the forward - firing translation thrusters because all the dirt and debris would move toward the instrument panel. I really never saw anything move back when I was firing the aft-firing thrusters, but I guess there wasn't any debris in front of me at the time. I noticed when I made the burn over Texas, there was

a screw that came up and lodged on the instrument panel. It just stayed there and didn't move for a long time.

4.1.48 Any additional comments or problem areas associated with the spacecraft systems or crew integration during the orbit phase?

Grissom No.

4.2 Orbit Procedures

4.2.1 Comment on the planning of the in-flight activities. Suggestions for improvement.

Grissom I thought we had plenty of time in the flight plan, but actually we were a little rushed all the time. When we ran into any problem, we had to decide what to cut out. If you are on a 4-day flight you will probably have plenty of time, but in three orbits we didn't have much time to look around. The way that flight plan roller is made, you just don't see enough of it so that you are aware of what is coming up next. You don't get a chance to prepare for it.

Young I agree.

Grissom There is something wrong there with that flight plan roller. It is a good idea, but there is not enough space. You need a better way to keep track of the mission, and how the mission is going. You need a better place to write down any information that comes along. I wrote my times down on my suit. We need a knee-board.

Young Gus and I agree on this. You have to have some way to write down these times when they call them up to you.

Grissom The plotboard is not a lot of use to us.

Young No, I don't think that plotboard is useful. It's just something to haul around. We need two knee-boards – one with a flight plan roller that is spread out on one knee, and one with something on which you can write information. You need those things right at your fingertips, and available at all

times. On a long-duration mission, you need those, and you need to be able to wear them at all times. During and right after retrofire and just before you start pulling g's, you need to write those times down somewhere that is easily accessible. You've got to coordinate that information because it is important to your reentry.

Grissom — Otherwise, the activities were fine. I didn't really realize beforehand that certain things would be done at night. I had been kidding John about taking a picture of him having a bowel movement. Well, it was pitch black! It is surprising when some things happen at night that you expected to happen in daylight.

Young — That didn't help the mess any, either. At least it covered it up. I couldn't see what I was doing. Helped out a little.

4.2.2 Describe and comment on the procedure used for monitoring the status of the spacecraft.

Grissom — I don't think we had any difficulty. We kept a constant check on all of our gages and all our quantity readouts. When we were using a system, we watched its performance closely, and I think the spacecraft is pretty well set up for monitoring spacecraft systems. There is only one thing that I am a little bit concerned about. We were operating a lot of the time with the faceplate open and part of the suit off, and it dawned on me, in flight, that the cabin pressure could drop and you would never know it.

Young — You never would.

Grissom — Of course, if you had your suit closed, you would know it. So, I wonder if we don't need a light or a buzzer or something to let the crew know that cabin pressure is starting to drop. I was a little concerned about that, and I kept a close watch on the cabin gages. That's what you would normally do, but if the cabin pressure dropped rather rapidly, without some other clue besides the gage to let you know it was dropping, you would be dead before you knew it.

Young — I am not really sure that the location of the cabin pressure gage is the best place. The gages for the left and right secondary O_2 bottles are right out there in front of my eyes, but the cabin pressure gage, the gage you watch on liftoff to see now much your cabin pressure is relieving, is not in the scan pattern between you and the horizon. I suppose that would be a 10-million-dollar change to interchange those gages, but it would bring it closer to the right-seat pilot's scan pattern.

Grissom — That is one thing that's critical to us.

Young — Not only that, but the pilot would be able to watch it every time he looked out and looked back in.

Grissom — The thing that really bothers me on this is that I believe we used to have a warning light and a buzzer on that, and I made them take it out.

4.2.3 Comment on the insertion checklist. Any recommendations?

Grissom — Fine. No recommendations.

Young — I didn't get around to doing the battery check until over Kano.

4.2.4 Comment on the procedures used in controlling the radar beacon and T/M.

Young — The problem was that we revised our flight plan a couple of times after the last time that we practiced turning the beacons and T/M on and off, and we didn't go through a complete flight plan with the final procedures. We had agreed to keep the C- and S-band beacons on continuously throughout the flight, and we didn't have a delayed-time transmitter, so we were using an entirely different procedure for dumping tape. It wasn't too clear in my mind when to turn that stuff on and off, but I think it worked all right.

Grissom — I think it was all right for the ground stations.

4.2.5 Comment on the procedures used for the manual dump of the delayed-time tape recorder.

Young — Well, we didn't use the delayed-time tape recorder. We used the standby T/M and there was nothing hard about that. We had agreed before we took off when we would turn on the standby T/M, at about 1:30 after the first burn. I forgot to do that so we had a little delay, but it was insignificant. It took less than 30 seconds for the transmitter to warm up and get ready for manual dump.

4.2.6 Comment on the procedures used for the OAMS thruster checks after insertion.

Grissom — The procedures for checking the thrusters were fine. I think I rushed through it a little faster than I actually should have. I don't know why I rushed, other than the fact that I was still excited from the launch. I checked them enough to know that they were working and working properly, and that is what the check was for -- just a confidence check.

4.2.7 Comment on the procedures used to verify coolant loop operation and to change from two-loop operation to one-loop operation.

Young — The procedure is with the ground stations and is satisfactory - where they tell you what your radiator inlet and outlet temperatures are. At 37 minutes, we went to flow and stayed on flow because our outlet temperature was at 42° F over CSQ. We went to one-loop operation on the recommendation of a ground station. I really feel that going to single-loop operation depends on how comfortable the crew feels and what the suit inlet temperature is. Even though the coolant system has a great deal of cooling capacity, single-loop operation should be based on crew comfort. If the suit inlet temperature had gone up after we switched to the single-loop operation, we would have gone back to two-loop operation.

Grissom — That would be information enough to switch back.

Young — It is difficult to subjectively note a 5 or 10° F rise in suit temperature, but if it had gone up, we would have gone back to two-loop operation. As it was, it worked beautifully as far as providing a

decent suit inlet temperature. It was in the neighborhood of 54° to 59° F. I don't know how the rest of the equipment was operating. The bypass loop that allows coolant to be bypassed around the cabin/suit heat exchangers should be removed.

4.2.8 Comment on the procedures used during the 1:33 translation.

Grissom — The procedures for the 1:33 translation burn were perfect, as near as I can tell. I don't recommend any changes. The only thing you might consider is starting the computer a little bit later if it does have some sort of error that accumulates. You might start your computer a minute or 30 seconds before the maneuver. You don't want to start it too late. You want to make sure you've got your burn parameters in there. The first time we tried to check the parameters, there wasn't anything displayed, and John had to punch it in again. So, you want to give yourself enough time to do that. Other than that, procedures were fine.

4.2.9 Comment on the controllability of:

a. The aft-firing thrusters

b. The forward-firing thrusters

Grissom — When I asked for thrust, I got thrust with both the forward-firing and the aft-firing thrusters. There was a pitching moment just as I expected, just as it is in the GMS.

Young — But he held it real well. I was watching him.

4.3.10 Describe and comment on the procedures used for platform alinement.

Grissom — Either method of platform alinement is satisfactory — visually alining the spacecraft on the horizon or using the needles. Alining with the needles requires about five minutes, and visual alinement doesn't require very much less time, if any. I think the needles do a better job if the scanners are working properly.

4.2.11 Describe and comment on the procedures used to verify the computer parameters that were updated by DCS from the ground.

Young — We only verified the first computer load, over Carnarvon. I was pleased with it. I got the last two computer loads, and called those out to see what they were. Since we were able to verify the parameters coming in from MCC, and were able to verify in the air the parameters coming up from Carnarvon. I think that is adequate checking on the first load. Those were the only two places where we received a load that I felt I should check.

4.2.12 Comment on the preretro checklist. Any recommendations?

Grissom — It is adequate.

Young — I think the equipment stowage should be out of the preretro checklist. I think equipment should be stowed before you get to the preretro checklist.

4.2.13 Comment on the procedures used for the control of the event timer.

Grissom — I let it continue running from launch until we made the burn at 1:33. By the time I completed the burn and got squared away, I was at an elapsed time of about an hour and 40 minutes. I then set it to 40 minutes from elapsed time on my wrist watch, and I kept it set all the time such that it was either 1 hour plus what I read on the event timer or 2 hours plus what I read on there, until I set it for T_R minus 34 minutes over Carnarvon.

It surely is a help to keep track of the flight plan, especially if you have a flight plan that is keyed to elapsed time like ours. On a longer mission, I am not sure it's going to be as handy. A wrist watch does a good job of keeping track of the time. Elapsed time there is fine. I wish the event timer had more capacity for elapsed time, but I do like to set it to the countdown to retrofire. After retrofire, I just reversed its operation and added 2 minutes to whatever I read on there.

4.2.14 Comment on the planned station pass communications procedures. Suggestions for improvement?

Grissom I don't think we had a problem.

Young I think we can stand improvement on those station passes when they pass up to us the backup reentry quantities. Each station used a little different terminology, and at one time I didn't know whether he was giving us time for 400 k. I think we can standardize these procedures and cut them down. For example, for retrofire all they need to say is retrofire and give you the time, and for 400 k they don't have to continue the use of GMTRC and elapsed time. Anybody can figure out what is elapsed and what is GMTRC.

Grissom Since we're working in G.m.t. they should just drop the G.m.t. part. In fact, I prefer them to say retrofire at such and such; then I will know what it is. Every time they say GMTRC, I have to think if that was reverse bank or ...

Young They were calling parameters to us in a different order than I was used to, and I was all over that little card I had. It didn't make any difference, except I think that the next time we should standardize the procedure. After we had been over the Canaries for a second, they said, "We are going to do a radio check," but the whole time we had been on that radio checking it and they had been talking to us and hearing us. Then they wanted us to go flow on the radiator, but we were on flow on the radiator before we ever got there.

Grissom Well, I don't know what you do in that case, because I think it is all right for them to call and check sometimes. If they had just assumed that we were going to do everything on the flight plan, a couple of times the sea urchin eggs wouldn't have gotten fertilized. If an experiment is coming up, it is all right for them to call us up and say, "Is it completed?", or "Have you started?", or tell you it is time to start something. I don't object to that. I do object to them asking for all the details of what went on. They don't need to know it, unless it is something that affects or has a bearing on a system problem.

4.2.15 Did the ground provide the necessary information?

Grissom The ground gave us all the information we needed.

4.2.16 Comment on communications procedures used to transmit computer parameters to the spacecraft.

Young I thought the procedures were adequate. The only time it was done was over Carnarvon. He did a beautiful job. He did it just exactly the way we discussed doing it. We got all the information down, and we verified all parameters in the computer before we left the station. Can't ask for anything better than that.

4.2.17 Comment on the procedures used for the gage correlation report.

Grissom The gage correlation report procedure was adequate.

4.2.18 Comment on the communications with respect to the blood pressure, oral temperature, and respiratory maneuver.

Grissom Everything was satisfactory. I couldn't work my blood pressure, and I kept forgetting the oral temp.

4.2.19 Comment on the use of the earth to obtain a yaw attitude reference.

Young You can't beat that earth for a yaw reference. Surely glad we've got it in case we get in trouble!

Grissom That's right.

4.2.20 Describe and comment on the procedures used during the tracking task.

Grissom That tracking task was a pretty wild operation. When we started across the States, we had the reticle in place, and John saw some targets to one side. He tried to get me to turn sideways, which I did, but it turned out he could see a target, but I couldn't. I couldn't see his target, so we turned it back around, and we picked up a target just about underneath and tracked it for quite a while. I don't really know how closely we tracked it. Pulse mode wouldn't hold us there, since it was right under us, and I had to use direct. I

was following it closely in direct. If you picked up your target early, then it wouldn't be any problem to get set up. I think a switch to direct or maybe rate command might be better.

4.2.21 Was the necessary information available in the flight plan strip? The chart book? Recommendations for improvement.

Grissom — All the information was there on the flight plan strip, but as we have commented on it before, it is difficult to read. You don't have adequate lighting on it. Wally and I had some things written on there in pen that I couldn't read. In fact, I didn't know some of them were there, until I got it back and looked at it yesterday. I think we need knee-boards. It looks like that is the only answer.

Young — I agree. I took the chart book out, but there was no place to put it in zero g. You just have a big, nice bunch of checklists in the chart book, and I use these little cards.

Grissom — The little cards were handier, weren't they?

Young — They sure were a lot handier. You can just slap them to the wall. I used the flight data cards, and this retrofire information.

Grissom — I like to keep often-used information in the pockets of my flight suit, so I can readily get to it when I want. The material in the plotboard is good information, but it is so difficult to get to. You really are not thinking about copying down your data, until you get to the station. Then they say, "Are you ready to copy?" You start scrambling for paper. Something like these little cards are a lot easier to get to than opening the plotboard and finding a page in there.

Young — What we are saying is, a knee-board is handy when somebody asks you to copy something. You must be able to pull out a pencil and start writing. Gus was writing on his knee. I thought that was a great idea! I was sorry when I saw you had a Pentel.

Grissom — That is the reason I wanted those Pentels along.

Young — Why didn't you tell me before?

Grissom — You can see where I wrote on the plotboard with it, on the instrument panel and on the suit.

Young — You will find there is a lot of writing on the instrument panel on my side.

Grissom — The Pentel writes anywhere – anytime. That was perfect to use in the flight. If you want to write on the window, you can.

4.2.22 If any malfunctions occurred, describe and comment on the procedures used to detect, isolate, and correct them.

Grissom — The first malfunction was the primary dc-dc converter. We switched to secondary. The other is the malfunction of the orbit rate. We stayed in BEF or SEF. I discussed the scanner problem earlier, so I won't go into it again.

Young — I'll bet you a hundred bucks that the yaw problem was caused by the water boiler.

Grissom — We never did find out what the yaw problem was. It disappeared on the last orbit.

Young — Well, the water wasn't boiling. It shouldn't have been. It should have been out of water by then.

Grissom — Maybe that was it, because it kept getting less. That might have been it, because right after insertion is when it was real bad. It was yawing me pretty bad, then.

4.2.23 Any additional comments or problem areas associated with the procedures during orbit?

Grissom — No.

4.3 Orbit Training

4.3.1 Did any unexpected or unplanned spacecraft operational problems develop during orbit that had not been covered in your mission training?

Grissom — I would say no to that.

Young — No.

4.3.2 What changes or additional training for the orbit phase would you recommend?

Young — Out the window would be nice.

Grissom — Out-the-window display would be nice. I would like to have something onboard to show me - soemthing to give me a better chance to plan ahead. I never felt really like I was ahead of the thing anytime. You can't see anything on that checklist. You roll it up and there it is. You get started doing it; but I never really had a good feeling of what was coming next, except the OAMS burns and retrofires. Those are important and I knew ahead of time.

Young — Maybe a couple of summary flight plans rolled up somewhere would be a good idea. It would give you an index as to what is to be done. Yes, just over the hatch-overhead so you could look up and see what you are going to be doing next.

Grissom — How can you do that on a four-day mission? You would have the whole thing plastered.

4.3.3 Did the performance of the various control modes compare with what you expected as a result of training on the various simulators?

Grissom — Other than the reentry rate command, the control modes compared almost exactly with what we saw on the trainer.

4.3.4 What recommendations for training in observing and identifying celestial phenomena would you make?

Grissom — If you are going to observe anything at night, you have to turn all the lights out and get night-adapted. If you have any light in there, you can't see as many stars as you can sitting down here on earth. I would recommend that you turn out all the

lights and open the hatch if you want to see any more. I don't know how else you could see any more, do you?

Young — No. It is really tremendous. They're up there just like they are supposed to be.

Grissom — I have no recommendations.

Young — No.

4.3.5 Did the mission simulator provide you realistic training in the spacecraft control tasks during the orbit phase?

Grissom — Yes, very good!

4.3.6 Did the absence of out-the-window displays for the simulator significantly affect the inflight performance or cause any problems?

Grissom — An out-the-window display would certainly be of value. It would give you confidence that you can aline the spacecraft in yaw. The first couple of times John and I tried looking out the window, we had a little bit of disagreement as to exactly what was zero yaw. We came to a mutual agreement, finally, but it takes a little while. If we had a good out-of-the-window display, I think it would add a lot to our confidence that we can do it. That was one of the things that concerned me, initially, when the scanner was coming in and out. I was really concerned that we had a real good alinement.

Young — You know, they could paint a stripe down the front of that spacecraft. Right on the nose of that spacecraft. You could look right down that stripe and pick up yaw. Sitting in there like that, you are looking right on the side of the spacecraft, picking up yaw.

Grissom — A real slow light plane flying squares in a strong wind would be a good training aid.

Young — Yes it would, wouldn't it?

Grissom — That would be pretty good. You remember back when we used to fly those squares around the field in flight training?

Young Yes.

Grissom That would be good practice.

4.3.7 Do you have any comments or recommendations for training on the following:

a. Flight plan

Grissom I think we have covered the flight plan. (See sec. 4.2.21.)

Young I think so.

b. Spacecraft systems

Grissom We had good training in spacecraft systems. We knew what we were doing.

c. Spacecraft procedures

Grissom I think we knew all of the spacecraft procedures well.

d. Spacecraft control tasks

Grissom We knew the control tasks we were doing. We went through those properly.

e. Pilot hand-held equipment

Grissom How did you use the camera? You received training there, didn't you?

Young There was no problem there. I do think, though, that the pilot should establish a confidence level with the cameras. I had no practice with that 16 mm. I had no confidence in my ability to take good pictures with it. I'm not sure of my results.

f. Experiments

Grissom I am sure the experiments that I saw in the simulator are not what I had on the flight. I am only talking about the sea urchin eggs. The handle on the one in the spacecraft didn't feel anything like the handle I had on the one in the trainer. It didn't appear to rotate the same.

Young — Well, I would say the same thing about the blood experiment.

Grissom — When you do something that's back over your head and you can't see it, you've got to make it pretty fool-proof or you can't get the job done.

Young — The dimensions in the area of the blood experiment in the spacecraft are totally different than the spacecraft simulator.

Grissom — I tried that in the trainer lots of times and it works easy. You never make a mistake on it. It just turns one way and only turns so far.

Young — So does the one in the simulator on my side. They put this insulation on there and they put a big bracket out where you stick your hand back to grab the handle.

Grissom — The number of times you turn the sea urchin egg experiment is critical.

Young — Yes, that's right.

Grissom — That's a lousy setup.

Young — Mine was actuating it on time. By the time I got my hand on it to actuate it, 20 seconds had elapsed. I'm sure it was 20 seconds after we called it at 50:18.

Grissom — 50:18. It was right on.

Young — Well, I grabbed the handle but it was about 20 seconds before I got it actuated.

5.0 RETROSEQUENCE AND RETROFIRE SYSTEMS AND PROCEDURES

5.1 Retrosequence and Retrofire Systems

5.1.1 What was the control mode selected for retrofire? Backup?

Grissom — Rate command, both rings used for retrofire. It held us absolutely tight. We didn't deviate 1° from the center of that 8-ball.

Young — No.

5.1.2 Comment on the performance of the selected control mode.

Grissom — I had to use control too, because that last retrorocket wanted to yaw me to the left.

5.1.3 Was each RCS ring checked prior to retrofire?.

Grissom — Almost like on the trainer. Each RCS ring was checked before retrofire in both the direct and ACME modes.

5.1.4 Describe and comment on the OAMS retro translation.

Grissom — I think we have talked enough about the OAMS retro translation. There's no problem. The burn came off on schedule. The time worked out within a second or two, didn't it?

Young — Yes, we put 96 in the computer.

Grissom — Well, it came up 96.

Young — Yes, it came up to 96 and then jumped to 97. I don't understand how it jumps. The computer was started about 40 to 50 seconds before the burn.

Grissom — Yes. We had this problem before. We thought perhaps it was because we had been in the mode too long, so I started the computer later this time. But I still pushed START COMP about two minutes before time to do my burn. Well, the velocity wasn't in there. It came up with all zips. Then John reentered it, and we hit it again. Then it came in, but this time we were within a minute of burn. It still started increasing. I don't know why.

Young — I think the burn time was 1:46 or 1:47. It was supposed to be 1:48. Couldn't ask for any better than that.

5.1.5 Describe the spacecraft disturbances during retrofire.

Grissom — Well, there were some disturbances from each one of the retros. I could tell it was starting to yaw me one way or the other. I'd cross-check out the window with the ball and we were holding real good all the way. There was a slight pause between the second and third firing. One fired, the second fired right on time, and then there was a slight pause. I thought at first that we didn't get them all – then the other two fired.

Young — I didn't know until we got the numbers in the window whether we got them all.

Grissom — I could tell there were four. I heard the ground calling up each time one fired. The thing that concerned me a little bit was the ground called up, "Number one fired, number three fired." I then wondered what happened to two? Then I realized that they were cross-firing.

5.1.6 Comment on your use of the instruments and/or window during retrofire.

Grissom — I used the 8-ball as my prime attitude reference. I also cross-checked out the window to make sure that I was in retrofire attitude. I checked very early on the second orbit when the 8-ball and all were working good. That out-the-window retrofire attitude agreed with what we expected it to be. When we went to retrofire attitude, I checked the window. It looked right and the ball looked right. Since I was used to using the ball in training, I went ahead and used the ball.

5.1.7 What was displayed on the FDI during retrofire for the command pilot? For the pilot?

Grissom — Rates were displayed on my FDI, and the rates were very low – I kept them damped well. Almost zero.

Young — Really zero. I was on rate, too.

5.1.8 Did the IVI correctly display the ΔV obtained during retrofire?

Grissom — As far as we know, the IVI's displayed the right ΔV. We were in the right attitude and I have forgotten exactly what the IVI readings were.

5.1.9 Did the sequence lights operate properly at T_R-5? At T_R-1?

Grissom — Sequence lights operated at T_R-5. They didn't illuminate amber at T_R-1 because they aren't supposed to. They operated at T_R-30 like they were supposed to. At T_R-1, we did separate the spacecraft and the lights did operate properly. They came on green when we had every function.

5.1.10 For the following items describe any verification you may have had of proper operations – sound cues.

a. SEP OAMS line.

b. SEP electrical.

c. SEP adapter.

d. Arm auto retro.

Grissom — Okay. We could hear pyros fire on every one of those steps. We heard a pyro fire on the SEP OAMS on the SEP ELEC.

Young — The SEP OAMS was medium loud. The SEP ELEC was a little quieter, and the SEP ADAPT was a real jolt.

Grissom — That was a real boot in the pants. There's no doubt about when that SEP ADAPT fires, because it really does give you a good kick.

Young — Like a little retro-rocket.

Grissom — As a matter of fact, it even kicked me a little bit out of my attitude. We were on rate command. It gives you a good solid boot. That might be where the ΔV comes from to bring us in short.

Young — I don't know whether it was that much or not.

Grissom — I don't know how much it was either, but you get a good solid push. You might get 5 to 10 ft/sec out of that thing. Arm auto-retro – no cue to that, except the light goes green. Worked properly.

5.1.11 Did you initiate O_2 high rate prior to retrofire?

Grissom — No.

5.1.12 Did the indicate retro attitude telelight switch operate properly?

Young — Yes.

Grissom — The light operated properly. I didn't use the needles in the attitude mode, so I wouldn't know whether it worked or not.

5.1.13 Did the separation of the adapter affect the spacecraft in any way?

Grissom — We just discussed that.

Young — Tell you one thing I did see. Right after SEP ADAPT something flew out the side, and I don't know what it was. It looked to me like the pump package. I could see it through Gus's window at almost 90°. I wonder if they shouldn't look into that, and see if the pump package can stand a jolt like that as far as its being mounted on the back is concerned. If they have equipment in the adapter flying around loose, it is liable to come up there and off-set one of those retro-rockets.

Grissom — All of that junk flying around concerned me a little bit.

Young — Yes. That's something to look into. It was some kind of equipment flying out there, and a big piece too?

5.1.14 Could the individual retro-rocket firing be detected? How?

Grissom — They surely can. Just felt them. We could hear them also.

5.1.15 Did the separation of the retro-adapter affect the spacecraft in any way?

Grissom — No, we could tell when the retro adapter jettisoned, but it doesn't give you a very big kick. You could feel it, but it's nothing like that equipment section separating. It's very clear to you that it's gone. You don't even need the light.

5.1.16 Comment on the suitability of the out-the-window view for attitude control during retrofire.

Grissom — On the daylight side, I think you can control your retrofire very well out the window. I don't think it would be any problem at all. We have already discussed this at night. I don't think you can do it at night. If you have a contingency landing where you have a retrofire, that has to be out the window, you will have to do it on the daylight side. This will restrict the contingency landing areas.

5.1.17 Comment on the RCS thruster plume during retrofire.

Grissom — I never really notice them too much on the daylight side. You could see them all right, but they weren't of any real consequence. They were faint red flames in daylight, against a dark blue sky. Against white clouds, the flames are fainter.

5.1.18 Any additional comments or problem areas associated with the spacecraft systems during the retrofire phase?

Grissom — No.

5.2 Retrosequence and Retrofire Procedures

5.2.1 Describe and comment on the procedures used for the OAMS retro translation.

Grissom — Procedures were fine. I have no recommendations to improve them.

5.2.2 Describe and comment on the procedures you used from T_R-5 to T_R-1.

Grissom — We did exactly what we planned to do on the checklist beforehand. It went well and didn't vary one bit from what we planned to do.

Young — No, and we must have gone through the checklist at least three times. And I heartily recommend it.

5.2.3 Describe and comment on the procedures you used from T_R-1 to retrofire.

Grissom — Again, we did exactly what we planned to do. At T_R-1 we separated everything and waited until T_R-30 light on arm auto-retro. We armed that and immediately armed retro-rocket squib number 1. We waited for 3 or 4 seconds to make sure it didn't fire, and then armed the others. We had them all armed by at least T_R-22 or 23.

Young — I planned to start my elapsed time clock on T_R but I just didn't make it.

5.2.4 Would you prefer daylight or night retrofire maneuvers? Why?

Grissom — I prefer daylight retrofires. If you have to do a night one, it has to be on the 8-ball.

5.2.5 Were the checklists for T_R-5, T_R-1, and retrofire adequate?

a. Suggestions for improvement.

b. How did you use the checklists?

Grissom — Yes. No suggestions or improvements.

Young — We didn't go to platform-free. He's trying to fly the spacecraft, and you don't want to be reaching around there, throwing switches at retrofire.

Grissom — The only recommendation that I'd have on a checklist is to use bigger and darker printing, because sometimes your lighting is very dim and you need a higher contrast. I'd like to see darker printing with large capital letters. We need more space between each one. Don't you think?

Young — Yes.

5.2.6 Comment on the ground support of retrosequence and retrofire.

Grissom — My support from the ground on retrofire was perfect. They gave me a countdown and they fired right on schedule. The countdown is appropriate. I wouldn't want to do without that.

Young — Yes. We're checking T_R on the computer up to 10 seconds before retrofire by punching 02. It checked within a second.

5.2.7 Any additional comments or problem areas associated with the procedures during the retrofire phase?

Grissom — We had no problems. No comment.

5.3 Retrosequence and Retrofire Training

5.3.1 Compare the actual retrofire with those simulated on the following simulators:

a. Mission simulator

b. Part task trainer

Grissom — I think the retrofire I had was probably easier than most of those I have practiced on the simulator. It's been so long since I used the part-task trainer, I don't remember how they compare.

Grissom — I think we should practice harder retrofires than we expect, with the easier ones interdispersed.

5.3.2 Did any unexpected or unplanned spacecraft operational problems develop during the retrosequence and retrofire that had not been covered in your mission training?

Grissom — No.

Young — No.

5.3.3 What changes or additions to training for this phase would you recommend?

Grissom — The only thing I would say is they might make the pyro noises a little louder on the trainer.

Young Yes. Especially that SEP ADAPT, because there's going to be no doubt in anybody's mind when they let go of that thing. Usually, when they say we've lost pyro noise, you don't get a light. Man, if you don't get that noise, you haven't received the function.

6.0 REENTRY

6.1 Reentry Systems

6.1.1 What control modes were used during the reentry?

Grissom — I used direct, both rings after retrofire. I just wanted to make sure both of them were working. I went to pulse for about 1 minute. I didn't know when this thing was going to start reentering, so I went to the mode I was going to use for reentry. I went to direct both rings and stayed there.

6.1.2 Comment on the performance of each selected control mode.

Grissom — The selected control mode was perfect for reentry. No problem. I think it will be far superior to reentry rate command. I guess you could fly inside that 4° deadband. Direct was very good. I had no problem damping out the rates. John had the rates on his FDI needles, and I could see on the ball the displacements we were getting, so I didn't worry very much about them, unless John said the rates were getting high. Then, I would look over and damp them out. I could damp them out in about one or two actuations of the control handle.

Young — I wasn't paying very much attention to the ball rates. I was looking out the window. The vehicle seemed to me inherently stable. I don't think we have enough control authority to turn it over.

6.1.3 Comment on the use of the window as a backup to the FDI's and 8-ball for attitude and rate control.

Grissom — You could see the horizon all the way down. I used the ball as my primary reference, and I was concentrating on the ball, trying to guide out my downrange and crossrange errors. John can probably comment more on the window than I can.

Young — Well, I could see the horizon all the way out the window. I could pick up the rates out the window. The spacecraft was going back and forth across the horizon, but the 45° bank angle never varied until we went to max lift. I could see the horizon at max lift attitude, but I had to put my head down

and lower my shoulders. That is pretty hard to do. I was full down in the seat.

Grissom — I don't remember seeing the horizon anymore after we went to max lift.

Young — I could distinguish between pitch and yaw oscillations out the window at 45° bank angle.

Grissom — In fact, we could tell the proper pitch and yaw attitudes by looking at the trail back behind us. Something's coming off the spacecraft all the time. You've got some kind of contrail or flame or something. You can tell exactly what your attitude should be.

Young — I subjectively saw that the particles coming off weren't going up like they did in the GT-2 pictures. They were going right straight out, as if we didn't have much of a trim angle. I suppose the sparks that were coming off were coming off the pork chops back there on the side, going off more or less straight. Didn't indicate very much of a trim angle. There was some. We could see the whole ionized pattern — funnel-shaped. We saw the retropack burn up when we reentered.

Grissom — Yes.

6.1.4 Describe the spacecraft oscillations during reentry. Maximum rate and amplitude.

Grissom — The oscillations during reentry were not bad.

Young — I was on low scale on the FDI.

Grissom — The rates never got up more than 4 deg/sec and probably not more than 2 deg/sec. Just one or two blips of the control, and they would dampen out.

Young — And they did just like the book says they will do — going up the g-curve, the frequency would build up and the amplitude damped down. Coming down the back side, they built up a little, but nothing significant, and definitely no instability that I could see.

Grissom The maximum rate was never more than 4 deg/sec.

Young I don't think it was that high.

Grissom Well, those needles got about half scale at one time, but the amplitude was never very great. I looked on the ball, and it wasn't varying very much at all.

6.1.5 Did you select O_2 high rate during reentry? If so, describe its operation and cooling ability.

Grissom No.

6.1.6 Did the retro-jett telelight function properly following retrofire?

Grissom Yes.

6.1.7 Could you verify that the retro adapter did jettison?

Grissom Yes. You could feel it go off, and we saw it later.

6.1.8 Comment on the computer display of down- and cross-range errors on the FDI during reentry. When and how did you verify that the closed loop guidance was operating properly?

Grissom Okay. I'll go through the whole thing here. After retrofire, I rolled to inverted attitude – max lift attitude – and at about 4 minutes after retrofire time, I got a command from my roll needle directing me to roll inverted. That was at about 400 k – just about one time. It started working, and at 6 minutes after retrofire, I rolled to my 45° bank angle. It was just shortly after that, I got guidance on my needles. The crossrange needle was all the way to the right. The downrange needle was about half-scale, and it moved up slightly, and then came back down a little bit. I think maybe it made one more oscillation, and then hardly moved after that. The crossrange needle came right on in. My time to reverse bank angle was 11 minutes after retrofire, and at 10 minutes 15 or 30 seconds, the crossrange needle was centered. So, I started taking out the bank and holding max lift. I held max lift the rest of the way in. The downrange needle never centered. It came down a little bit to what looked like 50 to 60 miles short.

Young — Gus was holding max lift all the way. I don't know what you can do after you've done that.

Grissom — Actually, the g's started building up on the spacecraft sooner than I had expected. At reverse-bank-angle time, you really don't expect to have too many g's on the spacecraft, and we were pulling about 1 to $1\frac{1}{2}$g at that time. So, I knew then we were not going to get very much more lift. the g's built up to 4, and we stayed at 4g for quite a long time. We were up there pretty close to a minute. Don't you agree, John?

Young — Yes.

Grissom — We were at 4g for a long time before it came back down. In fact, when it came down off 4g, we were almost down to 80 000 feet.

Young — That's right.

Grissom — When it came off 4g, it dropped to 2g quickly. All I could think of at the time was that I hoped the computer was wrong. I think the airborne computer was right. I think that computer knew where we were going. That's about the g-profile you would expect on a max-lift reentry. Since I pulled max lift most of the time, I didn't expect it to get much over that. If I had pulled max lift all the way, it wouldn't have gone much more than about 3g. But we were pulling a 45° bank angle for about half-way down, and then went to max lift. So, that's about what I expected. We had to be getting some lift, or the g's would have gone up higher than that.

6.1.9 Comment on the operation of the RCS during reentry?

Grissom — The RCS worked perfectly. No troubles at all.

6.1.10 Comment on the communications during reentry.

Grissom — Communications were good right up to point of blackout. We received our reverse-bank-angle time from the Cape, but evidently they didn't hear us transmit back. I could actually tell when they

were fading out too. Upon entering the blackout area, communications got fuzzy and dropped out.

6.1.11 Comment on the operation of the FDI needles during reentry.

Grissom — FDI needles worked just as advertised. John's FDI needles showed the rates and they were easy to read. Mine showed the downrange and crossrange errors. They came in just as we had expected. Well, the crossrange error came in just as we expected.

6.1.12 Describe and comment on the appearance of the ionization sheath. Will it interfere with the use of the horizon for backup attitude controls?

Young — Take a look at the pictures of the GT-2 reentry. That's what it looked like, as far as describing the colors and what we saw.

Grissom — The only thing that would be different was when the reentry communications experiment was activated. Then we got a change in the sheath. Looked like steam or something like that, but you can see the horizon all the way through. It's not a great big firey ball that you can't see through. It's sort of a light yellowish - greenish color.

Young — It changes colors all the way down. It's exactly like the colors in the GT-2 film.

Grissom — Everytime I used the RCS thrusters during this time, we got a big change too.

6.1.13 Comment on the suitability of the out-the-window reference for attitude control during reentry.

Grissom — You could do it with no problem. I think you would fly a good reentry if you had good backup information. If we had used backup parameters, we would have been 30 or 40 miles shorter than what we were today.

6.1.14 Any additional comments or problem areas associated with the spacecraft systems during the reentry phase?

Grissom — No problems.

6.2 Reentry Procedures

6.2.1 Describe and comment on the procedures you used to control the attitude of the spacecraft from retrofire initiation through reentry.

Grissom — I used direct, both rings. Used the ball as prime reference, but cross-checked out the window. I had no problems with control.

Young — I was checking it out the window, too, and I didn't see anything wrong with it.

6.2.2 Comment on the reentry checklist provided. Suggestions for improvement.

Grissom — The reentry checklists – from that time on, you don't have time to get out a card and go through. That part has got to be simple. You've got to know it, or it's got to be out in big letters somewhere so you can see it. Fortunately, John and I both knew what we were supposed to do, and went ahead and did it.

Young — Another reason you can't is you are really interested in getting your backup reentry quantities from the ground. This eliminates thinking about doing a lot of other things.

Grissom — Yes, with the exception of arming the landing switch and getting rid of the retro pack.

Young — But that's not on any checklist that I have.

Grissom — Okay. The point is that in a dynamic situation you are not going to get out a checklist and read it. I'd suggest you don't have one, but rather memorize the procedures.

6.2.3 Describe and comment on the reentry technique you used. What would you recommend for future missions?

Grissom — I have already described the technique used. (See Sec. 6.1.2 and 6.2.1.)

Young — I recommend two-rings direct.

Grissom — You could do it alright on one-ring direct. I don't think it would be any problem. With two-rings direct, you tend to over-control a little bit, until you get the feel of it.

Young — If you got downrange steering where you had to roll around in a hurry, this would be a problem.

Grissom — Yes, you need it in case you have to roll and stop your roll. You need all the authority in there that you have to get the rates you want and then stop them. I recommend two-rings direct in future missions.

6.2.4 Did the ground supply all the necesary information for the reentry?

Grissom — Yes, we got all the information from the ground that we needed. I'm not sure it was correct right now, but we got it.

6.2.5 Describe the procedures used for the reentry communication experiment.

Young — I think it was started at 19:05:14. We started the reentry experiment and held the button down until just before the altimeter came off the peg; I don't remember shutting it off. That should be good enough for government work.

6.2.6 Any additional comments or problem areas associated with the procedures during the reentry phase?

Grissom — No problem that I can think of. The only thing we might mention is that sometime during the reentry, there must have been some sort of film on the outside of the window that burned off. That's all I recall. Actually, it wasn't a film. It looked like there might have been a film on the outside of the window, a little bit of fog or something, that didn't change. It was always there. It looked like it was a coating on the outside of the window – a clear coating, an optical coating. It suddenly burned off.

Young — It wasn't there after we hit the water. I looked for it.

Grissom — It burned off in a "V", with the apex of the "V" down. It started on the upper left portion and burned down and to the right. The apex was down about the right center of the window.

Young — Mine did the same thing. We were well through the ionization. In fact, it was just the last part of reentry.

Grissom — Just the last of reentry. Suddenly, it just crinkled all up.

6.3 Reentry Training

6.3.1 Did any unexpected or unplanned spacecraft operational problems develop during the reentry that had not been covered in your training?

Grissom — No, I don't think so.

6.3.2 What changes or additions to training for the reentry would you recommend?

Grissom — It would be nice if you had an out-the-window display for training.

Young — I think they ought to seriously consider doing away with the egress kit, so the guy sitting in the seat can see the horizon the whole time out the window. You want to be looking straight at that 8-ball and out the window, so you can see the whole thing during reentry. During zero g, you can prop yourself up and see 16° nose down out the window in any place you want to.

6.3.3 Comment on the actual reentry in relation to those simulated on the following:

a. Mission simulator

b. Centrifuge

c. Part task trainer

Grissom — The mission simulator is the only place we've practiced reentries that are closed loop. We never saw one like this.

Young The first valid reentry we ever saw was during the flight.

Grissom Right, and we're not sure how valid that was right now. But they do need to do more work on reentries in the simulator to get them realistic. It is one of the areas where we were short in training.

6.3.4 Did the absence of out-the-window displays for the mission simulator cause any problems during the reentry?

Grissom No.

7.0 DESCENT AND LANDING

7.1 Descent and Landing Systems

7.1.1 Comment on the ECS performance during descent and landing.

Young — Well, we didn't go on O_2 high rate until after landing.

Grissom — The only reason we went on O_2 high rate then was because we had fumes in the cockpit.

Young — That's right. I'm sure we did the right thing then. We lost all the cooling capability we had in the regular system. We were comfortable, not being particularly overheated until after we hit the water. The cabin pressure came down right on time, and it was reading zero when we opened the inlet snorkle at 27 to 28 000 feet. That's what it's supposed to do. You couldn't ask for any better ECS performance. We were comfortable until we hit the water. I think the suit inlet temperature was 74° when we hit the water.

7.1.2 What indicated altitude did the 40 k barostat light illuminate?

Grissom — I don't remember. I wasn't looking at the altimeter as we descended through 40 k. We had just gone slightly below that and the 40 k light was on. It wasn't on at 50 000 feet so it probably came on close to 40 k. I will make the comment that I didn't have a lot of confidence in the altimeter. As we went to altitude on launch the thing jiggled around and did some funny things. The simulator runs up to 100 000 feet and suddenly stops. Well, this thing quit indicating on launch, at about 80 000 feet, and it stayed there the rest of the flight. Another thing that I noticed in orbit that concerned me a little bit was the rate of descent indicator indicating 60 or 70 ft/sec down all the time.

Young — I didn't look at that vertical speed indicator after that chute opened.

Grissom — I did.

Young What was it reading?

Grissom 30 ft/sec.

7.1.3 Comment on drogue deployment and the spacecraft motions before, during, and after drogue deployment.

Young That's a good chute, really good!

Grissom I was concerned on the way down. I didn't really trust the altimeter. At the time, my needle on the computer stopped guiding – this is when the computer says it's 80 000 feet – is about the time the altimeter became active. It started running down. It was doing all kinds of funny things. We were still going sonic at the time. By the time we got to 50 000 feet it had slowed down and was indicating a steady descent. So, when we hit 50 k I punched the drogue chute, and it came out. We stabilized and turned off the RCS jets, but it took them a while to stop firing. After they stopped firing, the oscillations started to build up again. We turned them back on. I told John to open the RCS motor valves again, and I went to rate command on the RCS. It damped out the oscillations quickly, and I told John to turn off the valves again. Sure enough, the oscillation diverged slightly again. I'm not sure that drogue chute is a good thing. We were stabilized until we put the drogue chute out.

I think the thing to do is leave the RCS on in rate command when on the drogue chute.

Young I don't really think we can get fumes in the inlet snorkle. Did you see the inlet door blow off?

Grissom No, I didn't see that door blow off, and I knew I wouldn't.

Young Yes, I didn't think you would. I think you could open the inlet snorkle and leave it on rate command with the RCS until passing about 20 000, and then close the motor-operated shut-off valves.

Grissom After those valves were shut off, there was still some flame from the thrusters for quite sometime.

Grissom Then it stopped and we didn't see anything else. When we hit the water and went under I got rid of the chute, and we came up. We got all kinds of yellow fumes out of those nozzles. It was all over the place and we had smoke, or fumes, in the cockpit at the time. I closed the snorkle but it was hazy inside. That's when we went on O_2 high rate. You could still smell it pretty strong. It gradually cleared up.

7.1.4 Did you have any problem with the deactivation of the RCS after drogue deploy?

Grissom I could still see fire coming out a long time after the motor valves were shut off.

7.1.5 Did you notice any propellant fumes from the RCS after closing the propellant valves?

Grissom No propellant fumes, just fire.

7.1.6 Was the emergency drogue switch used?

Grissom No.

7.1.7 Did the altimeter operate properly during descent?

Grissom I think we discussed that earlier. (See sec. 7.1.2 and 7.1.3.)

7.1.8 Comment on snorkel operation.

Young It operated properly. The pressure was zero all the way to the deck.

7.1.9 Did the cabin pressure build up properly?

Young Yes. I was watching the cabin pressure indicator as an altitude indicator. Going through about 60 000, it's a better gage than the altimeter.

7.1.10 What indicated altitude did the 10.6 k barostat light illuminate?

Grissom The 10.6 k barostat operated almost exactly with the altimeter. I pressed the chute off at 10.6 k indicated, and the light came on at exactly that time.

7.1.11 Could you detect R and R section separation? Visually? Audibly?

Grissom — You could see all the pieces all the way, audibly and visually. I could see the R and R can coming down, right along with us.

7.1.12 Comment on main chute deployment.

Grissom — Beautiful! Just as we expected. Came out in reefed condition, dereefed, and then came out full. One section breathed in about one time and came out and stabilized. Stayed there. There were no folds in the chute that I could see. No tears, no rips, no cords broken; everything was just perfect. There wasn't a thing wrong with that chute.

7.1.13 Comment on single-point release.

Grissom — Single-point release was the biggest surprise of the whole flight. When I hit that single-point release, landing-attitude button, I thought all hell had broken loose. For a minute, I thought maybe the whole chute had broken loose.

Young — I thought it had fallen off.

Grissom — Threw us both forward and broke my faceplate. I surely was glad to look back up and see the chute up there.

Young — When the single point releases, it allows the spacecraft nose to fall to 45°. Just fall, that's what it did.

Grissom — It's like driving along at 20 or 30 miles an hour and running into a brick wall. It really snaps you forward! I probably wouldn't have broken my faceplate, if it hadn't been for the reticle knob below the window.

Young — I am sure I hit just as hard as Gus did.

Grissom — You know we talked about the reticle knob a long time ago and felt there was no way of getting rammed up against there. We didn't worry about it.

Young True.

Grissom In fact, if my faceplate hadn't been closed, I'd probably have it right through my head. The faceplate just slowed my acceleration enough to stop me. It was an abrupt change. You don't notice it on a film like GT-2.

7.1.14 Were there any problems encountered with the lack of communications from main chute deploy to single-point release?

Grissom No, that's not a very long period of time.

7.1.15 Did the parachute jettison operate correctly?

Grissom Yes. I'll make one comment here. We went into the water and a second or so later I expected to be back up on top. But, there was still water on both windshields. I had to jettison the chute, which was obviously dragging us through the water, nose down. I jettisoned the chute, and we immediately popped right up. I don't think we need to be in any great big rush to jettison the chute.

Young No leaks in the spacecraft whatsoever. I checked the bottom of the ECS door, and I never saw any water.

7.1.16 Did the rate of descent indicator operate correctly during descent? What did it read?

Grissom Rate of descent indicator operated properly. I took a look at it right after the main chute deployed, and it was reading 30 ft/sec. I didn't pay much attention to it the rest of the way down.

7.1.17 Were you able to determine when landing was about to occur? If so, how?

Grissom No. When the altimeter read about 600 feet, I told John to get ready to land. He said, "What shall I do?" It's true, there's nothing you can do. It's not a very bad jolt when you hit the water.

7.1.18 Comment on the communications throughout the descent and landing period.

Grissom — Communications were good on descent. We were talking to the Cape.

Young — You talked to the Cape when you passed through 100 000, as the altimeter came off the peg.

Grissom — Oh, yes, I know. I told them my drogue chute was out and Gordo said, "Yeah, it sure looks good, doesn't it?"

7.1.19 Were you able to determine your horizontal speed at impact? How?

Young — That's a good one. No!

Grissom — No!

7.1.20 What was the spacecraft attitude upon contact with the water?

Grissom — We couldn't see the horizon, so we had no feel for it. It looked like we were in the proper attitude.

Young — Yes, 45° nose up.

Grissom — I could tell we were swinging around quite a bit on the chute, because, occasionally, I'd see the pilot chute somewhere.

Young — You could see the background against the clouds.

Grissom — Yes, and you could tell we were swinging. I had no idea what the attitude was when we hit.

7.1.21 Describe spacecraft motions at landing. Did the spacecraft submerge? How long did the spacecraft take to stabilize?

Grissom — Well, on landing, the spacecraft submerged all right. I've already described this. (See sec. 7.1.15.) I didn't jettison the chute for 3 or 4 seconds, so we were held under by the chute towing us in the water. Yes, it looked like it was nosed down.

Young — Yes. 25° to 30° down.

Grissom Probably, the edge of the chute was on the water being blown, and we were still at a 45° angle.

Young Well, it dug in. There wasn't a lot of water over the top of us.

Grissom No, we were very close to the top. I suspect the top of the water was right about the top of the windshields, because I think I recall seeing little burbles.

Young Yes, I saw some.

Grissom So, we weren't really deep in the water. But, as soon as we hit parachute-jettison, she popped up in the water and stabilized immediately - just within seconds.

7.1.22 Did the landing loads cause any discomfort? Do you feel that your restraint harness was adequately tight?

Grissom No.

Young No.

Grissom And yes.

Young Yes. No and yes on that.

7.1.23 Did anything in the spacecraft break loose upon landing?

Grissom Not that I know of.

7.1.24 What was the stabilized attitude of the spacecraft immediately after stabilizing?

Grissom The hardest shock is the single point release, not landing. The spacecraft floated almost exactly as Static Article 5 in the Gulf. Water wasn't washing up nearly as far on my window as it was there. I did have the feeling we weren't rolled quite as far to the right as we had been in the Gulf.

Young I did too, because my window was further out of the water.

Grissom — That's right. I think we were pulling at a more normal attitude rather than the 12° list we had out there. The pitch attitude was just about what we had seen before, and the waves weren't washing up on the spacecraft hatch at all.

Young — The period of the waves was a lot greater.

7.1.25 Did you notice any water in the spacecraft after landing?

Grissom — No water in the spacecraft.

7.1.26 Any additional comments or problem areas associated with the descent and landing phase?

Grissom — No additional comments.

Young — No.

7.2 Descent and Landing Procedures

7.2.1 Describe and comment on the procedures you used for drogue deployment.

Grissom — The procedure for drogue deployment was to reach over and push the button. My altimeter was used as a cue. I didn't have very much faith in it, but, evidently, it was working pretty good.

Young — I had the cabin pressure indicator and my absolute pressure gage, and I was checking both of them. I think those are good instruments to check – also, the color of the sky.

Grissom — Yes.

Young — And the time for drogue chute deployment was being called out to us at that point.

Grissom — As a matter of fact, they called the time of drogue chute deployment to us almost exactly on time. The time was up when they called us, and we punched it off just then.

Young — They gave it to us in Greenwich mean time.

Grissom I was just trying to figure what in the heck time it was, and John said, "It is that time now, and we're going through 50 k." So I punched it off. They ought to give it to us in elapsed time because we're looking right at it.

Young That is a critical operation.

7.2.2 Describe and comment on the procedures you used from drogue deployment until main chute deployment.

Grissom I've already discussed what we did there – how we turned the RCS off and then back on. (See sec. 7.1.3.)

7.2.3 Comment on the procedures you used for main chute deployment and single-point release.

Grissom After we got a full main chute, we waited a good 6 to 10 seconds before we went to single-point release.

7.2.4 Describe and comment on the procedures you used from single-point release until landing.

Grissom I stowed my D-ring and started to turn off some of the gear and circuit breakers onboard. I turned off just about everything that wasn't connected with the communications system in some way. I watched the altimeter and waited. I talked to recovery forces and that sort of thing.

Young I went through the post-main checklist about two times. There's no need to have a pre-main checklist. If a guy doesn't know what he's doing coming down from 100 000 feet, he had better not be flying.

7.2.5 Describe and comment on the procedures you used during and following landing.

Grissom The only word we had about our IP was from the Intrepid. We had our computer which said we were 60 miles short. We had no confidence that it was right. The only other word we had on our position was from the Intrepid. They gave us a call and said we were 5 miles off their bow. We didn't bother taking off helmets or suits or anything. The next transmission we received was that they were 55 miles away. I took off my harness and

pulled the suit down around my knees. I didn't have the wrench to get the com lead out. I couldn't take it down any further and still have communications.

Young Well, it was my fault. I didn't know they put that wrench back in the aft food box, or we would have gotten the wrench out and probably taken the com lead off right away. They tied the wrench to the door on the aft food box. When they took the door off, the wrench came with it. I didn't know it was there.

Grissom Is that how you got your's off?

Young Yes.

Grissom I cut my leads. Anyway, I took mine off, and then John took his off. I used his helmet to plug in through his harness while he was taking his off. The scuba divers already had the collar on by this time. It was about 30 minutes before we took our suits off.

Young Much too long.

Grissom Too long. We should have started immediately.

Young You want to get those suits off!

Grissom I vomited about this time. We were both getting pretty warm. The collar was on, and no water was coming up any place, so then I opened the left hatch. Actually, one of the scuba divers outside opened it. I started to do it. That hatch handle! I couldn't make it work! I pulled and heaved on the handle, but I never did get the thing opened. Maybe I wasn't pulling hard enough. I checked three times to make sure I had those two little levers in the unlocked position. Well, the other thing that concerned me was the scuba diver on top of the hatch. I didn't know if he had already gotten a wrench in there and done something to those dogs. I didn't want to break it and be stuck in the capsule. Since he was up there fooling around, I put the handle back in the neutral position and let him go ahead and unlock it, rather than break something. When he started to open it from the outside, I decided that since

they closed the thing from the outside, we'll just let him open it from there. Joe Alvarez told me the forces are higher with that new seal in. That may have been it. I may not have been pulling hard enough. They put a new hatch seal in and the forces on the handle went up from 35 to 45 pounds.

7.2.6 Did you receive all of the impact and recovery information you required?

Grissom Yes, I guess I received all the information that was available. As soon as they knew where we were, and how far we were, and how long it would take to get to us, they passed it to us. We'd been in the spacecraft for about 40 minutes, and I heard there was going to be another hour and 35 or 40 minutes before the Intrepid would be there. That's when I made the decision to get out and go back by helo.

Young That was a good decision, too, because it kept me from getting seasick.

Grissom The waves were long period, and there weren't any white caps. They were more like swells than waves.

Young Yes. I didn't think it was as bad as out in the gulf.

Grissom It wasn't real choppy.

Young When the period is long like that, you can care less how high the waves are. As long as the spacecraft stays pretty nice in the water, you don't care about a little heave.

Grissom The only thing I was concerned about was not getting the vomit in the bag and getting it all over the cockpit. I thought it was going to make John sick, too.

Young I wasn't worried about that.

Grissom I was. I didn't want to get it all over that suit.

Young You should have seen me unstow that right food box.

Grissom I noticed you got it out to me pretty fast.

7.2.7 Did you contact the recovery units during descent?

Grissom Yes, we were talking to the Intrepid. We were talking to Big Box and to the helos.

Young All communications were on UHF.

Grissom I don't know if we ever got anyone on HF, because at one time, people were calling us when I was on HF on both transmitters, and I'd call and call and nobody answered. I think I received the Cape one time on HF. The other thing that happened, was after they got the collar around the spacecraft, and the scuba divers got up there, the antenna was whipping back and forth. I tried to retract the thing and it wouldn't retract. It wasn't damaged then. It looked like it was standing up straight, although it was whipping some.

Young When I got out of the spacecraft, I fell against it and bent it a little, but not much.

Grissom Well, I don't think it was bent before that. Nobody touched it before that. I was looking out where I could see it. I would have seen it if they had. The rubber collar that goes up to keep the water out was up around it good. It didn't work its way down, and it was in good shape. But, I don't know why it wouldn't retract. Maybe they had a good reason for us not extending it in orbit.

7.2.8 Any additional comments or problem areas associated with the procedures during the descent and landing phase?

Grissom No.

7.3 Descent and Landing Training

7.3.1 Did any unexpected or unplanned spacecraft operational problems develop during descent and landing that had not been covered in your mission training?

Grissom Yes, that single-point release. We didn't expect that. I don't see any point in training for it. You're just going to get your head bashed against the window, and you might as well be prepared for it.

Young I don't know if tightening the shoulder harness would do you any good because you're too close to the window to keep your head off.

Grissom Yes, your head is going to snap forward!

Young Mine was as tight as I could get it.

Grissom I don't know. I probably wouldn't have broken my faceplate if that reticle knob had not been there. But there's a good possibility you're going to break the faceplate.

Young I didn't have one on my side, and I hit that windshield hard, too. I was glad I had some padding in that hat.

Grissom So am I.

7.3.2 What changes or addition to training for the descent and landing would you recommend?

Grissom I don't have any recommendations.

Young No.

8.0 RECOVERY

8.1 Recovery Systems

8.1.1 Comment on the ECS performance from landing until egress or recovery.

Young — Well, it did just what it was supposed to. I went O_2 high rate after the fumes.

Grissom — I want to mention that we could smell that stuff in there.

Young — It may have been burned metal that we were smelling.

Grissom — Yes, I think it was. We were getting some steam and a burned smell off that metal out there - not fumes. All the fumes that we saw, were blowing away from us. It looked like a gray smoke inside and I wondered, for a minute, if we had something on fire inside.

Young — Yes, it did.

Grissom — It gradually thinned out, so we were just getting some smoke or steam off of the hot parts of the spacecraft. The walls of the spacecraft remained cool all the time.

Young — They were cool the entire time.

Grissom — We never had any problems that way.

Young — We were on O_2 high rate and suit fan number 2 was running just as it's supposed to.

8.1.2 Could you verify the operation of the spacecraft flashing light?

Grissom — No, when I got out of the spacecraft, I never looked to see if it was flashing.

8.1.3 Comment on the spacecraft communications from landing until egress or recovery.

Grissom — Communications were generally pretty good. There were times when I'd call and nobody would answer.

Young — I agree with you. I don't remember talking to anybody on HF, because none of their transmissions sounded like HF.

8.1.4 Were you aware of your recovery situation from landing until recovery?

Grissom — Yes, we were kept pretty well aware. I think we were as aware as anybody. As soon as they got information, it was funneled to us.

8.1.5 How did the spacecraft orient itself relative to wind and swells, that is, rotated so many degrees left and right of blunt end or small end into the wind?

Young — It oriented itself right into the swells.

Grissom — The blunt end was into the wind because the sea marker was drifting away from us. We could tell we were lined up pretty well, and, of course, we had one of those scuba divers sitting out there right on the nose in that stuff all the time. He was on my side. I guess John couldn't see him. And, as I said before, we were rotated almost upright. I don't think we were canted to the right at all.

Young — No, I didn't notice at all.

Grissom — And the blunt end was into the wind.

8.1.6 How did the spacecraft orient itself relative to the wind and swells after collar installation?

Grissom — Blunt end into the wind.

8.1.7 Do you think egress could have safely been accomplished without the flotation collar?

Grissom — Yes, I think it could have, but that flotation collar sure makes you feel good out there.

Young — Yes, I think so, too.

Grissom — I think I could have opened the hatch before the collar got on there, but I surely didn't want to do it, and I didn't.

8.1.8 How did the spacecraft compare with the boilerplate flotation?

Grissom The pitch attitude of the spacecraft was about the same as Static Article 5 but we were rolled in a more vertical position than Static Article 5.

8.1.9 Describe spacecraft flotation attitude before and after collar installation.

Grissom After the collar was on, we were a lot more stable than before. You don't get any roll at all. We were getting very little roll, anyway. But it seems to follow the waves a little more, and you get less pitch with the collar on.

8.1.10 Did you notice any fuel and oxidizer fumes?

Grissom We noticed the yellow fumes. As we came up out of the water, there was a lot of popping and blurping and yellow smoke all over the place. Great batches of it. I was sure glad we were oriented with our tail into the wind.

Young And I tell you, if we hadn't been, we would have had to seal ourselves in that thing.

Grissom As a matter of fact, that's a pretty good reason to let that chute drag you for a little bit. That gets your blunt end into the wind and when you come up, if you've got any of that stuff, it's going to blow it away from you.

Young Yes, I think that's a good point. The way that thing digs in, that's the only way it could drag you.

Grissom It's bound to drag you that way.

8.1.11 Were there any problems with the HF and UHF antennas?

Grissom No problems, except the HF antenna wouldn't retract when I wanted it to. Extended fine.

8.1.12 If the survival radio was used, describe performance.

Grissom No, it was not used.

8.1.13 If survival gear was used, describe performance.

Grissom I inflated my Mae West as I got out of the spacecraft.

Young Me, too.

Grissom I started to take the liferaft out of the survival kit, but John pointed out three or four rafts outside so I got in one of those. I did break my backboard loose.

Young I had a hard time getting by Gus's backboard. Everytime I got up in the cockpit, the backboard would fall on me.

8.1.14 Any additional comments or problem areas associated with the spacecraft systems during the recovery phase?

Grissom I don't believe I have any thing else to add.

Young No.

8.2 Recovery Procedures

8.2.1 Describe the procedures you used from landing until recovery.

Grissom We've gone through this at least once before, so I don't think we need to go through it again. (See sec. 7.2.5.)

8.2.2 Were the egress and recovery procedures clearly understood and defined between yourselves and the recovery forces?.

Grissom Yes, I think they were. I don't know of any time when we misunderstood each other.

Young I agree.

8.2.3 If water egress was accomplished, describe.

Grissom Well, I got into the raft. The helo brought the horse collar over to me. I put it underneath my arms, and they hoisted me aboard. It was normal.

Young That's what happened to me.

8.2.4 How long could you have stayed in the spacecraft after landing?

Grissom Well, with those hatches open, I guess we could have just stayed there indefinitely.

Young Yes.

Grissom We sat in there in our underwear.

Young Yes, but it's a mighty poor boat. You might as well look forward to getting seasick, if you stay there for any length of time.

Grissom I don't think we would have gotten seasick if the hatches had been open.

Young Well, I tell you, I was minutes away from getting seasick. You just don't know how close I came.

Grissom Well, I think if you're going to have to stay there much more than an hour, and you have a helo there, you may just as well go ahead and be picked up.

Young I think so, too. That's no boat.

Grissom I wouldn't want to get out without that collar on. I would hesitate to get out. I'd stay in there and suffer.

Young You're right. I agree with that.

Grissom That's what you're going to do with those hatches closed. You're going to suffer.

8.2.5 Describe the hatch opening.

Grissom The scuba diver from the outside opened it. I'm not sure I could have opened it with my hatch handles. It sure felt like it was firmly locked. (See sec. 7.2.5.)

Young As soon as you hit that water, the first thing to do is climb out of that suit.

Grissom In fact, we had already made up our minds to do that. We didn't because we thought they were so

close. The trouble is, it's work taking off that suit in a confined space. You don't have any place to put it. We didn't have that wrench. Getting out of and back into that harness is a job. I think that's what has to be done.

Young — You're going to sweat a lot more with it on than with it off.

Grissom — Yes, if you wait, you're going to build up a workload, and then it's going to be harder to do. The best thing to do is, as soon as you hit the water, get stabilized and start peeling the suit off.

Young — Yes, I think so. I didn't shut all the things off like I should have when I left there. It seems to me I didn't shut the batteries off. It's just normal to secure things when you get out of there. We shut down all the switches we could think of that needed to be shut down. The point is, when you really start feeling sick you don't care if you shut those things down or not. And that's the way I was. I really didn't care.

8.2.6 Any additional comments or problem areas associated with the procedures during the recovery phase?

Grissom — No.

8.3 Recovery Training

8.3.1 Did any unexpected or unplanned spacecraft operational problems develop during recovery that have not been covered in your preflight training?

Grissom — No.

8.3.2 What changes or additions to training for recovery would you recommend?

Grissom — I don't think I have any recommendations.

Young — No.

8.4 General Training

8.4.1 Do you have any recommendations on the preflight training activities as to sequence, time before flight, benefits of the following:

a. Mission simulator

Grissom — The mission simulator should be used frequently, and right up till the launch day. You can't start too soon and you can't use it too long. We had adequate time on the trainer. I would like to have had more reentry training just before I flew. I really wasn't confident that I had seen all the cases. But the mission simulator is the best trainer we have. It looks exactly like a spacecraft, and when we got inside that spacecraft on launch day, for all you could tell, you were just sitting right in the trainer.

b. Launch and network simulations

Grissom — The launch sims are most valuable to us. As far as the network sims are concerned, we didn't get a lot out of them. We learned how the range would operate. I think the thing we would like to have practiced more was reentry sims.

Young — Reentry sims would be valuable training both for us and for the network, to enable them to get the data. They have to do this thing in real-time before blackout. It's a tough task for them.

c. Centrifuge

Grissom — I don't feel very strongly about a centrifuge. It's the only place you can go through the launch g's. I'm not sure you need it.

Young — No, I don't either.

d. Planetarium

Grissom — Maybe I didn't spend enough time at the planetarium, but I didn't get enough good information from it. I think it's a low priority item.

Young Yes, I think it's a low priority item, but I think you should know all the stars on your orbital path. You can orient yourself in any sky if you know the stars. You can orient yourself north, south, east, or west pretty accurately, if you know the pattern. The first thing we saw was the Southern Cross and the Alpha Beta Centauri. I knew right where we were on the orbital path.

Grissom Yes, Orion's Belt was very comforting to me when we were having alinement problems.

e. Egress and recovery

Grissom We had ample recovery and egress training.

Young It sure taught us what we needed to know.

f. Systems briefings

Grissom We worked with those systems so long that I didn't feel a real strong requirement for the systems briefings. They were good. They point out a few areas that we had either forgotten, or didn't know about. They should be operationally oriented. It depends on how well you know the systems beforehand, but I think it's a good idea to have systems briefings just prior to extensive simulator training so you understand exactly what's going in there. I think you can do it with schematics. In fact, you're probably better off doing it with schematics, because you can draw on them, work on them, and you've got up-to-date ones.

Young Yes, systems boards cost a lot of money to up-date.

g. Flight plan reviews

Grissom Flight plan reviews are necessary.

h. Spacecraft tests

Grissom Spacecraft tests are absolutely essential. You have to be involved. You have to know what's going on. This is where you get the confidence to go fly.

i. Flying

Grissom You never get enough flying. We should have more and higher performance airplanes.

j. Launch abort simulator (LTV)

Grissom The launch abort simulation at LTV was good but I think a good deal of it could be done in the mission simulator. Their vibrations and noises are extreme.

9.0 CONCLUDING STATEMENTS

Are there any concluding remarks?

Young — I think the best training is when you crank the Mission Simulator up with a net and start doing launches and launch aborts.

Grissom — That's the best. That's the best launch training you can get. There you're working with everyone you're going to be working with during flight.

Young — That's the secret. We found working with the net that we could do things faster onboard, and, on the otherhand, they could help us in areas that we hadn't been aware of before.