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PRELIMINARY

GT-4 FLIGHT CREW DEBRIEFING TRANSCRIPT

PART I

Prepared By

Spacecraft Operations Branch

Flight Crew Support Division

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PREFACE

This preliminary transcript was made from voice tape recordings of the GT-4 flight crew debriefing conducted aboard the recovery ship, the USS Wasp, on June 9, 1965.

Although all the material contained in this transcript has been edited, the urgent need for the preliminary transcript by mission analysis personnel precluded a thorough editorial review prior to its publication. Errors in this transcript will be corrected as soon as possible and an official transcript will be published at a later date.

This document contains a transcript of the first part of the debriefing, during which the crew described the mission generally from an operational viewpoint. A preliminary transcript of the remainder of the debriefing will be published by June 23, 1965. It will cover systems operations, operational checks, visual sightings, experiments, pre-mission planning, mission control, and training.

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1.0 COUNTDOWN

1.1 Crew Insertion

White The only problem during insertion was that I fogged up again in my suit before we got the fans on. I think I'm just going to always fog up in that suit of mine. We turned the fans on quick, but with the visors closed it doesn't go out.

McDivitt We did have a problem with crew insertion on the Wet Mock and I think we had that probably pretty well taken care of. They put us on the suit loops and didn't turn the fans on. Normally you wait for a clearance from the Spacecraft Test Conductor before you throw any switches. Well, after we almost "died" of carbon dioxide poisoning during this test, we got this matter clarified. As soon as we got in the spacecraft and one of us was on the suit loop, we would go ahead and cut the switches on to put us on two fans. We did this during insertion in the Wet Mock. It really went well.

White We really went for a long time in Wet Mock. I was beginning to wonder if I was going to have to open my visor. I was really uncomfortable.

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McDivitt But everything worked out okay on this one.

White Yes.

McDivitt The timing was excellent, I thought. I didn't think we had any problem at all.

White No. I don't believe they missed a stroke on the insertion.

1.2 Communications

White I think the communications were pretty well worked out, Jim?

McDivitt Right. One thing, the last three minutes or four minutes, we got a little confused about who was talking to who. I was getting the Spacecraft Test Conductor, the Booster Test Conductor and the CAP COM at the same time.

White We got a split count, too, on **lift-off**.

McDivitt The first three or four minutes I was hearing the Booster Test Conductor. I heard what was going on on his loop, and I was listening to him get checks in from all of the guys. I really wasn't getting a clue as to what was going on. I was supposed to be getting the booster clues from the test conductor. I was supposed to find out when the engines were going to gimbal and when they

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were going to open the prevalves and stuff. I wasn't getting it from him. We were getting a lot of other information that made a lot of sense to the Booster Test Conductor, but not an awful lot to us. There were call-outs like, "Sequence 05003 complete." Well, this just didn't mean anything to us. On top of this we had the Spacecraft Test Conductor calling out the times, and superimposed on all of this was Al Shephard, the Cape CAP COM, calling out events that he was reading off that went on at certain specified times. He called out, "Stage 1 prevalves," and we could hear the fuel gushing downstairs and the whole booster rumbling. He called out, "Stage 2 prevalves," and you could hear the same thing all over again. I thought that was a lot more meaningful than the test conductor comments.

White I think that was wrong, the way they were doing it. I think we weren't supposed to be on any loop except CAP COM at that time.

McDivitt Well, I think what happened was that we got this thing over-coordinated. Al was going to give us all this information, but then as a result of GT-3, (Gus and John said they didn't get enough

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information about the boosters) they put this information on the test conductor's loop too. We had too many guys talking. I think if just CAPCOM talked from three minutes on down we would be all right.

White This is the way I thought it was going to happen, and then from three minutes on down it really got busy with the yak, yak, yak of everybody talking.

McDivitt I don't know whether we got off the Booster Test Conductor's loop or not, but at final countdown, Al gave me 2 minutes, 1 1/2, 1, 30, 20, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1. I got a similar count from the Spacecraft Test Conductor but it turned out that they were a second out of sequence on the countdown and Al was giving me 10 and our Spacecraft Test Conductor was giving me 9. So it went ten-nine, nine-eight, eight-seven. They were at the same time. All I knew was that we were getting close to engine ignition and then it started. So, we got a little over-communicated there. I think they kept us adequately informed on the hold. As a matter of fact, I'd say we got over-informed there at the end. We had too many guys keeping us informed and I think the pendulum

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swung from the GT-3 flight where nobody got informed of anything over to our flight where we got informed by three different people about the same event.

White On our flight, too, we were really more aware of the problem than those people were. We could sit right here and see the gantry come down and stop, that was really the only problem they had in the whole count.

McDivitt I don't think radio discipline is a problem. Each guy was disciplined on his own channel. They were conducting their tests on their own channel. But we were listening to three different communicators at the same time. We should have had only one. I think probably what we will need to do is to get to about T-3, and then just cut in the CAP COM.

White That was the way it was planned to be, I thought. That's the way Al planned it.

McDivitt That's correct. I think, because there had been some lack of information on GT-3, that it somehow had been written into the SFR so that we were also on the Booster Test Conductor's WOPS, so that we were also getting his countdown. I

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think CAP COM, alone, would have been sufficient. One further comment, I had to turn my VHF volume all the way up to hear anybody. I was at max. There we were sitting right on the pad, talking to a guy two miles away, and there I was with the volume full up. It didn't give me much confidence as to reception I was going to get when I was 200 miles away, or three or four or five hundred miles away. I thought that the volume control on the radio was inadequate.

White We were wondering what we were going to have when we got up a hundred miles.

McDivitt That's right. At max volume we didn't have enough and at minimum volume it didn't shut it off. We will cover this later.

1.3 Crew Participation and Countdown:

McDivitt I think it was just about right. I don't think we were over worked and I think we had enough to do to keep us busy.

White Actually, all we really made was a check of switches. There wasn't really too much else. Having the back-up crew run that midcount was the the right solution. I wouldn't have wanted to participate in anymore of the countdown than I

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did.

McDivitt That's an excellent point. The flight crew's participation should be the final count, not the midcount and precount. It doesn't tire the prime crew out doing a lot of chores that they don't really have to do. I think this is a good procedure.

1.4 Comfort

White Initially, the first 20 or 30 minutes, I was squirming around and I felt a little uncomfortable. But after I had been in for 30 or 40 minutes I didn't feel there was a real restriction on staying for several more hours. I would have been very disappointed if they had said, "Well you have been in there long enough and we will work on this gantry and try it again tomorrow." I would have been happy to stay there several more hours while they fixed the gantry instead of pulling me out.

After an hour and 40 minutes, which is the end of the normal countdown, I didn't feel uncomfortable. We sat in the simulator and were a lot more uncomfortable than this. I didn't feel uncomfortable. I had a chance to take a couple of little

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naps. I noticed Jim was napping too.

McDivitt Yes. I concur with Ed, although I don't want to get carried overboard. We shouldn't scrub due to crew fatigue.

White I think it is up to the crew. If the crew is uncomfortable they should come down. But I don't think he should say, "Okay, two hours and 30 minutes. You cut this off.", because it is an operational procedure.

McDivitt When I first got assigned to the crew I always felt one of the toughest things to do would be laying back for an hour and 40 minutes or so prior to launch. The time we spent in the simulator laying on our back, I thought to be a very uncomfortable position. As we went through all the training and testing at McDonald, and again at the Cape, my back got more callouses on it. I got used to laying with my feet over my head. At launch time I wasn't a bit tired from laying on my back.

White This is brought out in one of our last simulations, where we ran the whole four hour simulation and we forgot to have them tilt us up to 30 degrees. We just got used to running that way.

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McDivitt That's right, I just don't think we should scrub the flight because of fatigue. I don't think we should do that. We weren't approaching this point.

White We had a long way to go.

1.5 Environmental Control System

McDivitt I think we ought to get this water management panel squared away and everybody figure out what we are supposed to do with those switches. I don't think we should be arguing about where the switches are supposed to be on the launch pad. If I hadn't asked somebody where the waste management switches should be we would have probably launched with it in EVAPORATOR. I knew that it wasn't supposed to be in the evaporator. At one of the ten thousand briefings we got on it, we were told it shouldn't be there. We ought to get this kind of stuff squared away before launch day. Thirty minutes before lift-off we were arguing about where that switch was supposed to be.

White I wasn't confident that they knew where they wanted that switch to be.

McDivitt Well, I didn't think we should have it in the evaporator. So, I think that water panel could have cost as much as a weeks slip on our launch because

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they didn't know where to put those valves and it's only got three valves on it. It ought to be made much simpler than it is. I think they should get that squared away before the next flight. Ed and I knew where we wanted it. We wanted it off and the other two switches in NORMAL and leave it alone. That's what we flew with. That's the way it ought to be fixed.

White We can get canned, though, for not flying with it in the right position by the checklist. It didn't say that on the checklist. Every checklist we got was different.

McDivitt That's right! Each one was different. Finally we decided we were going to do it as we did and left it through out the whole flight. Everything worked fine. We had ECS briefings by a multitude of peoples from MAC including the guys who designed it. Everyone of them disagreed. It probably started out to be one of the simplest things in the whole spacecraft. By the time they got through confusing us with it, I got the feeling nobody knew what was supposed to happen to it. I consider this the most dangerous of all.

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White I was convinced of that, too, after the mix-up in putting all the water in the lithium hydroxide tanks.

McDivitt There would have been about a 30 minute four-day mission.

McDivitt The people that built the thing don't know how it is supposed to go. They had better decide this and let us know. I felt that George Roe at the Cape knew what was going on except the Cape personnel got the valves in the wrong position and almost lost the lithium hydroxide canister full of water with no water in the tanks. I'm not pointing a finger at George Roe. I think he's pretty knowledgeable about the system. Maybe somebody just wasn't following directions. But somebody ought to find out about the water management system and make it clear to everybody how it is supposed to be operated.

1.6 Sounds

McDivitt You can hear the prevalves, both first and second stages. The prevalves and the fluid gushing are very loud noises comparable to the engine gimbaling. I wasn't really aware that they were going to be that loud.

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White I got that feeling when I read Gus and John's debriefing.

McDivitt Did you? I didn't. I got the impression that it was going to be a much quieter noise.

White Well, the whole noise level of the engine gimbaling was louder than I thought it was going to be. It surprised me.

McDivitt Yes. Engine gimbaling was much louder than I heard before. We heard this during Wet Mock and during precount and at midcount. You can hear those engines gimbal around; they really shake the spacecraft. But, I really wasn't prepared for the big noise that the prevalves make, and such a long noise as that fuel gushed down to the bottom. I guess that was what it was.

I didn't like the sounds and vibrations we got when they raised and lowered the gantry.

White It shook the whole spacecraft.

McDivitt It shook the whole spacecraft--did you notice how it never came up straight? The spacecraft was supposed to line up kind of like this and then wham! I had visions of them knocking us off and laying us flat on the ground before we were launched.

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1.7 Vibrations

White Those are closely associated with the sounds.

McDivitt Yes. I think that the engine gimbaling makes a tremendous vibration in the spacecraft and pre-valves on opening and make a tremendous vibration. The gantry going back and forth vibrated the spacecraft. I don't think there is anything else, do you?

White No.

1.8 Visual

White Well, you can sure see the gantry lower and the white room disappear. That is about all you can see besides the sky.

McDivitt That's pretty impressive. That's when I sort of got excited, when the gantry went down. That's a new realm.

White I thought they were going to launch me.

McDivitt You're sitting there by yourself then, instead of all those people milling around.

I do want to make one other comment on this visual thing. We did Wet Mock about one or two o'clock in the afternoon. The sun was shining right in the window, almost straight down, such that the sun came across my visor from about just at the

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bridge of my nose on down. I had a tremendous amount of reflection inside the helmet, and I had a great amount of difficulty seeing the instrument panel. As a matter of fact, I'm not sure I could have seen the instrument panel at all. Those first few seconds there are extremely critical on launch. You have to be able to see those tank pressure gages. We ought to keep this in mind for those late afternoon launches.

White That is a problem, but the g loads are so small at this time you could almost forget about looking up.

McDivitt Did I fly like this for awhile during launch?

White I don't think so but you could have. The g load is so small.

McDivitt I'm not sure whether I did or not.

White This is what we had to do during Wet Mock. We had to put our hand up and cover the window to look down at our instruments to see them.

McDivitt I'm not sure I didn't launch that way.

White I wouldn't be surprised if you did.

McDivitt I don't think I launched that way, but as we tilted over and we got in the sun, I think I put my hand up for awhile.

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White Well, if the g's are so low that--

McDivitt When sun gets in your face you can't see the instrument panels because they are just too dark.

White The sun gets in your eyes. The point that Jim was making is towards a late-in-the-day launch, which we might have later in the program, there might be a bit of a problem of seeing the instruments during launch. Unless they put something up, which I really don't think you want to do. You are just going to have to put your arms up and shield the sun out and concentrate on your instruments or you won't see them. They are just gone.

There is probably a point even in an early morning trajectory as you start to pitch over where the sun will come right in your window and you won't be able to see your instruments unless you shield your eyes.

1.9 Crew Station Controls and Display

White I found the switches all where they were supposed to be and the cockpit all set up.

McDivitt So did I, except the comment I made on the water management system. They didn't have the control where it was supposed to be. At least, they had

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it in the place where everybody was arguing about whether or not it should be.

White

I certainly appreciated the work the backup crew did getting the cockpit all set up for us. Everything was ready to go when we stepped in. That's the way it should be.

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2.0 POWER FLIGHT

2.1 Lift-Off Cues

McDivitt CAP COM gave lift-off, about as good a cue as you can get.

White Wasn't any question either. Boy, you could feel the first little motions of the booster as it went up. It was really great!

McDivitt I think you could feel the acceleration at release. There wasn't a doubt in my mind that we were loose.

White That's right. I don't know if I could feel the bolts or hear them.

McDivitt As a matter of fact, it seemed to steady out a little bit. The vibrations seemed to decrease a little. Pretty impressive!

Not much vibration at lift-off. Very low.

White Very low. I got vibrations later on, though, didn't you?

McDivitt Yes.

Noise. There wasn't much noise, was there?

White No. There was less than I had expected.

McDivitt Noise wasn't a cue to lift-off. Noise was there

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if you were bolted down all day long. I don't think the noise changed a bit at lift-off.

White You could see the visual cues out the window. You were watching your gages, Jim.

McDivitt Were there clouds out there?

White No, but I could see it in the clear blue sky.

McDivitt Could you?

White Yes. I could see the motion.

McDivitt Okay. Well, I couldn't.

White I was looking out.

McDivitt I saw a little cloud go by and then I didn't see any more clouds at all.

White It was beautiful!

McDivitt The event timer started just like it should. Of course, that's the best display inside the spacecraft for lift-off. The event timer starts, and it did.

White We got both clocks started with the time hack. I had a watch hack on lift-off and the ... handle going. I knew when the engine ignited, within half a second accuracy. Three seconds later I was waiting for the lift-off and it came right at three seconds.

McDivitt We could tell ignition, too. We could hear the

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things go.

White I agree with you. I knew we weren't going to hold it when that lift-off went.

2.2 Roll Program

McDivitt Roll program came in at ten seconds just like it was supposed to. It was smooth, and it was just the way it was planned, on at ten seconds and went out at twenty seconds. Could you see it roll out the window?

White You can see everything out the window, I think.

McDivitt You can probably tell by the way the sun rays are moving, can't you?

White Yes, by change in lighting. The right seat has a better view. You have to watch the gauges so closely.

McDivitt I didn't even look out the window.

White I know you didn't.

2.3 Pitch Program

McDivitt Pitch program started just like it was supposed to, at twenty three seconds. Pitched over the proper amount, the pitch needles looked like they were hanging in there all the way.

White You could see the booster pitch definitely, and that was mainly due to a change in the lighting.

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2.4 Aerodynamics

McDivitt We were getting aerodynamic noise, which built up to max q. We got some pretty good vibrations at max q.

White That's where I had the most vibrations. It was just shaking like this.

McDivitt It was vibrating and noisy.

White That was the loudest noise we received the whole flight.

McDivitt Right after max q it got very quiet.

White This is where I had the most vibrations. There were more than I expected.

McDivitt Yes, me too. You can't simulate this in a simulator. You get more vibrations than you do noise. The only thing they have in the simulator is noise, they don't have vibrations. It was pretty loud and the spacecraft was actually shaking around a lot. It was really vibrating.

White Yes, it was. More than I expected.

McDivitt The whole thing was really going at it. Almost like a F-80 or a T-33 at about 0.8 Mach.

White Very good analogy.

2.5 Environmental Control System

White The cabin started venting shortly after lift-off

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and continued so until about 40 seconds and stabilized out at 5.5 and I made my call in. I think I might have called in on RECORD.

McDivitt You did.

White I switched and made the final call at about 1:10. I realized I called on RECORD and switched over.

McDivitt How high did it go? Did it go to 5.5?

White 5.5 and it stayed right there. And then I noticed later on it progressively leaked off until it got to 4.9 where it stayed. The suit? There really isn't anything to say about the suit.

McDivitt No, I don't have anything to say about the suit. It operated like it was supposed to.

2.6 Maximum q

McDivitt The noise built up gradually until we got to max q, then it just dropped off.

White The deterioration of the noise was almost instantaneous.

McDivitt Very quick. It wasn't instantaneous, but it was very quick.

White In fact, it startled me when we separated.

2.7 Windshear

McDivitt I didn't notice anything on the rate needles that had anything to do with the windshear I couldn't

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pick out windshear on them. How about you, Ed?

White No.

McDivitt Did you see any attitudes?

White No.

McDivitt No big divergences from windshear.

2.8 DCS Updates

White We got both of our DCS updates right on time--
1:45 and 2:25.

McDivitt No comment. Ed is in charge of DCS updates.

White I'm the button pusher. I do everything about
pushing the buttons.

McDivitt I can do this with this little stick.

White You can do it unless I have my knee over it.

2.9 Engine 1 Operation

McDivitt They operated the way they were supposed to as far as I could tell. The tank pressures stayed up fine on both Engine 1 and Engine 2. There was never any doubt in my mind that they were going to stay up there. There weren't any of those things like we saw in those simulations where they came on down pretty low on the gages when they were supposed to be at 18 or 15. There wasn't anything like that. They just stayed on up there.

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White Just where they were supposed to be.

McDivitt Yes. I followed them a couple of times and said they were staying up fine. They were way up. There wasn't any problem there.

2.10 Engine 2 Status

McDivitt Second stage pressure stayed right on up there very high. Just the way they were supposed to. There wasn't any problem there. They didn't decay all during the first stage.

2.11 Acceleration g's

McDivitt They weren't bad and I don't know where they went to on the g meter.

White Just like riding in an old saddle.

McDivitt That's right. It's very comfortable. Steady on-set.

White Not very long. Gee, we were below--

McDivitt Wait a second. This might be a good place to cover the pogo. I felt the pogo just prior to staging, from about 2:15 on to 2:30. I could feel pogo.

White How much were you getting?

McDivitt Very little. I could just feel it pull like this. Did you feel it at all?

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White No.

McDivitt I could feel it. It wasn't uncomfortable enough where I had to lift my head or anything. I wasn't thinking about a pogo at all. It wasn't like I was trying to sit there and think about it. But as we were going along I could feel this vibration. And then it just crossed my mind, well there is pogo, and then we went on to staging. But it wasn't bad at all. The amplitude must have been--

White You were paying more attention to your clocks while I was watching the system gages and I wasn't really aware of the times that were going on. I had my eyes--

McDivitt It came around 2:15 or so and lasted to about 2:30. Maybe it was 2:10 or 2:05, but it wasn't bad.

White We had one area that I will get into later that I haven't told you about and that I didn't like.

McDivitt Oh. So, I think we hit the pogo and the g's.

2.12 BECO

McDivitt Engine shut down properly. The lights came on. Engine: 2 light went out and the Engine 1 lights went out. Just the way it was supposed to at BECO and staging. Two Stage 1 lights ON, Stage 2

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light OFF, Stage 1 lights OFF.

White At that time I realized that we were going to feel the pyros and stuff--feel the separation. It was a very distinct feeling when we separated. Of course, we immediately dropped in the thrust. There wasn't any question, we had a good separation, in my mind. This is just the way it was for all of our separations. Everytime we separated, it was very clear that was what had happened.

McDivitt Oh, yes, there wasn't any doubt about it when that first stage shut off--Voon!

2.13 Staging

McDivitt Staging was just as it should have been.

2.14 Engine 2 Ignition

McDivitt Engine 2 started right on up. Like I mentioned earlier, the light went out and the tank pressure went down just a tad, but it stayed way up there, about two or three times as high as was necessary for staging. It never really did decrease. It stayed up around 45 or 50 psi, and we need 20 for staging, so--

White I couldn't hear anything.

McDivitt Didn't you hear the engine?

White No. I was listening but it still was quiet.

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McDivitt I didn't really get much of a cue out of it at all, except the lights went out and I could feel a little bit of acceleration.

White The acceleration decreased. Another thing I didn't get--I got absolutely no pitch-up associated with the--the way the centrifuge does you at the end of an acceleration. I think that is associated with the cab on--

McDivitt Yes. I think that's the way they rotate those gimbals when you come on down. If they rotate them a certain way you can get that pitching-up--

White A very safe forward-type deceleration.

McDivitt I think that pitching up on the centrifuge is not a malfunction. It's just the programing that's hooked into the gimbals during the stop program. You've got to get them all going the same way so that you keep the vectors through you. During launch the vector is right through you. It's not varying around, but in the shut-down on the centrifuge those darn gimbals aren't always synchronized together. They get shifted back there and it gives you that peculiar sensation.

2.15 RGS Initiate

McDivitt Well, I was really watching closely but my rate

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needles just barely changed. We must not have had any errors at all.

White Yes, I got a full error.

McDivitt Did you have a full error?

White Yes, my pitch error went all the way down, and then it just steered slowly right back up. Remember you--

McDivitt You did call and tell me you had a saturated-- Did you call saturated, or did you say we had a big one?

White I called it saturated, I believe.

McDivitt That's right.

White I called a saturated error and then I called you that it was steering back to zero.

McDivitt Yes. I remember that you did call that.

White That's the way they showed this on the plot, that it would saturate there, and very quickly it seemed to gradually steer right back up.

McDivitt The steering rates that went in were on the order of less than half a degree/second.

White They were very low.

McDivitt Very, very low because I was on high scale. The needle just barely deviated at all at RGS

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initiate.

White It was beautiful steering.

McDivitt Nominal, nominal, nominal, except like that saturation on the error needle, but we have been briefed on that.

White That's right. That's something to be expected.

McDivitt When did it saturate?

White Right at staging. No, right at guidance initiate.

McDivitt Oh, okay. It saturated right there.

White Right there at guidance initiate, which is what you'd expect.

2.16 GO/NO GO

McDivitt They said they were GO and I said we were GO. There wasn't much problem. Ed and I had been checking back and forth on the systems. I knew they were all right.

2.17 Systems Status

White The systems were all pretty good. There was only one I didn't like and that was the stack readings on the main ammeters. One was reading about 28 and the other was reading about 14. But I felt that this was associated with bringing the batteries on. I went through and checked everything. Everything was reading properly. The control bus

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and main bus were all reading all right. I felt it was just a misbalance of loading. I talked to somebody previous to this time and it was explained to me that this could happen this way. I felt perhaps it was in the adapter batteries--- would feed through on one of the stacks causing one of them to take more than the other.

McDivitt Yes. You could have gotten into the knee of an adapter--

White This is what I had figured--that a couple of my adapter batteries were unbalanced, causing this to occur. I also had seen this on the simulator quite a few times.

McDivitt When did the unbalance start? When we got in they were-- As soon as we were on internal power?

White Right. And I didn't feel this was the time to talk about it. It was still under 30 amps, which was my point. So I didn't bring it up.

McDivitt You didn't want to worry me?

White I didn't want to worry you and I didn't want anybody on the ground to start hollering about it.

McDivitt You should have written me a note.

White I did feel that this was exactly what it was--

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that it was adapter batteries. That was the only abnormal type of indication we had in the systems. They were all real good.

Well, we had good communications with the ground during powered flight.

McDivitt We had pretty good communications. I called the "Roll Program", and nobody answered me. I said, "Well, to heck with it, maybe they just aren't getting through." Then I was just starting to call Roll Program complete when Gus called and said, "Did you get the Roll Program?" Now that was the only transmission I made that wasn't acknowledged.

White Yes, I heard you calling, too.

McDivitt So, if they lost communications it must have been right at the 10-seconds time, and it should have been for less than 10 seconds. It couldn't have been for more than 20 seconds. I heard the count-down to lift-off and I heard Gus call and ask me if I had the Roll Program started. This was a little bit less than 20 seconds-- around 18 or 19 seconds. That is the only period of time I didn't hear anybody I should have heard. So, if we lost communications, that was where it was.

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2.18 Acceleration

McDivitt Well we got up to 7 1/2 g's. The acceleration wasn't bad at all. I guess when you are really interested in what you are doing like on the boost or reentry, those g's don't mean anything. I don't like to ride the centrifuge. 7 1/2 g's is 7 1/2 g's on the centrifuge, but on the booster--

White My vision was crystal clear.

McDivitt Me, too. I wasn't even breathing hard. I wasn't huffing or puffing or anything. I was just laying there relaxed.

White Particularly on this one, The acceleration burn during powered flight and insertion was very light.

2.19 SECO

McDivitt SECO occurred as it should have on my clock. Ed thought it ~~was~~ about--what did you say it was?

White I thought it was a second or so early and it concerned me because that meant we were going to have to burn. So I was quite expecting to hear a big ΔV come up from the ground. There is no question on that SECO either. It shuts off and you get that linear straight deceleration.

McDivitt The thing that surprised me was that we weren't talking about it at all. We were just going as

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straight as an arrow when that thing shut off.

White There weren't any oscillations or roll.

2.20 Steering

McDivitt I was getting a sinusoidal oscillation on my rate needles, and I don't know now whether it was pitch and yaw. I called it out at the time, to you anyway, Ed.

White Right. And my attitude arrows were--

McDivitt Your attitude arrows were right on? Okay. But I was getting an oscillation, very small, about plus or minus a quarter degree in rates. Not so that the needle was actually moving back and forth across the dots. It was pretty obvious that it was. Now, I sort of felt that I could feel that movement a little bit, like this, but not annoyingly and certainly the stabilization was holding it close enough. But it wasn't that the rate needles were just constantly oscillating back and forth. It seems to me it was in pitch but I'm not really sure. A booster pitch,

White The attitude error needles were the only deviation we had at any time. Yaw was just about nominal all the time. We had the pitch deviation at guidance initiate. It went to full scale and steered right

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back in, and also right at the end we had, in pitch, a little bit of a pitch-down needle indication which increased to no more than about a degree at booster shutdown.

McDivitt You got about a degree, then, on shut down?

White Just about a degree.

McDivitt Yes. I kept glancing over to see how you were doing. They were always right near the center for me.

White Yeah. Right near the end they trailed down just a little bit. I'd be interested to see what the ground thought on this.

McDivitt Yes. You'll have to go over and look. I'm sure they have them.

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3.0 INSERTION

3.1 Post-SECO

McDivitt Yes. There was a Post-SECO. In the period between SECO and SECO + 20 seconds, I unstowed the maneuver controller. I don't know where our attitudes were. They were the same as they were at SECO, and it was about 20 degrees pitch-down, wasn't it? The rates during this period were on the order of less than a half a degree/second. We really had a period of from SECO to SECO + 30. So, during this time I actually fired the translations thrusters at least two times in one axis to kill off the rate in that axis, and I think it was probably the booster yaw or spacecraft pitch where I actually fired the thrusters once or twice to bring the rates back. It might have been the other way around. But, we didn't jettison the fairings then. I did unstow the maneuver controller and the attitude was the booster burn-out attitude and the rates were very low, less than a half a degree/second.

White I think we mentioned prior to this time the feeling that we came off a little half-

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cocked off the second stage.

3.2 SECO + 20 Seconds

McDivitt We were going to stay on the booster until SECO + 30 instead of SECO + 20. At 20 seconds the IVI's started displaying and I read them off as 20 forward, 11 right, and 5 down.

White Right.

McDivitt This was when we were still in the 90 degree bank position. Is that correct? Or was it after I had rolled right-side-up?

White It was after you had rolled right-side-up.

McDivitt Okay. Well, then the IVI's displayed when we were still on our side. It seems to me they were about 25 feet/second forward, and some other numbers, but anyway they were low enough where I felt we were certainly in orbit. At least the IGS was telling us we were in orbit. During this time, as I said earlier, I tried to damp the spacecraft rates, the spacecraft booster rates which were quite low. I checked to see that the OAMS Power Switch was in ATTITUDE and MANEUVER, and to see that Ed had switched over to DIRECT. I told him I was going to do some thrusting but I wasn't going to separate yet, so that when he

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heard the thrusters go off he wouldn't push the SPACECRAFT SEP. Then we did separate the spacecraft with the exact routine we practiced in the simulator. I said, "Thrusting, separate", and you punched the SEPARATE button and I guess you went to Rate Command. I thrusted straight ahead for about five seconds. This is where I think we came off crooked. This is the part Ed was mentioning before. We didn't seem to come off straight ahead. We seemed to be getting some sort of an oscillation that got us going in a different direction than what we had going on the booster.

White It seemed like one side of the separation plane came off with more force than the other.

McDivitt Yes. That's what it seemed like to me.

White It separated at a bit of an angle.

McDivitt That's right. We didn't separate fore and aft; we separated with a lot of rotation to this side.

White Yes.

McDivitt Air-ground communications were all right. We were talking to them and they were talking to us. I never had any problem there.

White Shortly thereafter they called up and told us we

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had a 153 by 57 orbit. So, they were talking to us. I don't think I ought to read off this stuff now, but they gave us the 2-1 data and all the nominal data we were supposed to get. It came out fine.

McDivitt Say again what the IVI's were while we rolled right-side-up.

White Right. At the position we decided on taking our IVI readings, which was heads up in a zero-zero attitude, you read off the IVI's to me as 20 forward, 11 right, and 5 down.

McDivitt Okay. Then I didn't bother nulling the pitch needle because we were really pressed for time to get around.

White No velocity correction was called up to us and since we had no velocity correction, and we were fairly busy at this time, I didn't even read out the 52 or 70. I wasn't particularly interested in them. It's a funny thing though--52 was punched in and had been read out and it showed 30. It had been punched in so it read out, you see, as soon as something came in the quantity. So, I did have a readout. I read out 30. I remember looking at that.

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3.3 Insertion Activities

McDivitt I thrust and got off the booster. Then I went ahead for just a short time, and then I started to turn around right away. During the turn-around, I jettisoned the fairings. They went off with a bang. I could see the fairing over the horizon scanner go, but I never did see the fairing off the nose go. I just assumed that it went. We were already in just a mass of debris up there, because when we separated from the booster there was stuff all over.

White All over. It really flew by to the side of the spacecraft.

McDivitt Yes. It was all over the place. As we were turning around it looked like we were going through a snow storm. There was stuff all over. Finally we got turned around, in about a minute and a half, and we could see the booster there.

White There's one thing I would certainly like to see somebody do--I'd have give my right arm to have had a camera when I turned around and saw the booster. I'd like to see somebody carry a camera in a semi-stowed position so he could immediately get it out and come around and take pictures of

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the booster. Either the camera, or better yet a 16 mm camera with a normal lens on it. Just tuck it to the side of your leg. If I had thought about it I think this is what I would have done-- just connected the camera, tucked it by my leg, and taken pictures of the booster at this time.

McDivitt

I think, Ed, this is probably one of those philosophical things. On the first orbit you've got to save to prepare to come back in case you have a bad spacecraft. You've got to be ready to reenter during the first orbit. This is the kind of bind we found ourselves in up there. During the first orbit we really had a lot to get ready for halfway through the second orbit, but on the other hand we had to be in good enough shape so we could reenter it at 2-1. Now, we didn't have anything to go wrong so there wasn't any problem, but I think when you first get into orbit you're in a problem. This kind of a thing, I think, is a problem you may have later on. You've got to be ready to eject at lift-off plus one second, and you don't want to be sitting there holding a camera or something like that. Both your hands are busy. But like you said we could stow it

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somewhere.

White I think you could. You could stow it beside you in the seat. I think we over-emphasize the necessity, particularly for ejection, of having to have everything stowed when you are only ejecting up to 12 000 feet and at very slow speeds. We certainly have a heck of a lot more working against us in our airplanes we're flying around.

McDivitt That's right. I agree with you. I'm just saying this philosophy of being completely prepared to reenter during that first orbit is in conflict with doing this kind of stuff in the first orbit, too.

White We ought to get some of this, though. I think we are missing things. I would have really--

McDivitt Yes, I think so. We could have really had some beautiful pictures of that booster when we were close to it.

White I also want to comment a little bit on the booster itself. I looked as closely as I could at the nozzle skirt and the aft end of the booster, and I saw no damage whatsoever.

McDivitt No, neither did I from our vantage point.

White As far as I could see the nozzle skirt was com-

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pletely intact. There was nothing wrong.

McDivitt Okay. Let's try to follow this insertion activities list here. I jettisoned the fairings, as I said, as soon as I started turning around. Then Ed went through the checklist for us. After I fired the fairings I turned off the BIA Switch and the retro rockets when he called. I was probably doing this before Ed called, wasn't I?

White We did things just like we had been doing them on the simulator. We don't just take a checklist and run down it item for item because there're things you have to be doing, and it just doesn't go in a sequence like that. I realized this was the way it was going to go, and I actually took a pencil and checked items off. If you did an item I checked it off, and if you didn't I left it unchecked and we got it later. You just can't expect to run down the checklist item for item because you're not ready to unstow your life vest or to get up out of your seat belt. You don't do that for some time. I think the logic on the checklist we have here is a very good sequence--.

McDivitt We reviewed that checklist 50 times. That's

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probably the fiftieth checklist we've got there, and I don't think it could have been arranged any better for the two of us.

White I knew Jim wasn't going to undo his seat belt harness and I knew I was going to have to because I had to do certain things that he didn't have to. The point that I'm making is that the checklist doesn't have to be accomplished item for item, completely done in numerical sequence.

McDivitt Okay. I think we'll revert back to the exact subject of 3.3 now. Safelying the switches. I safelyed the switches--the BIA Squib Switch and the four Retro Rocket Squibs Switches. I tested the sequential lights, but at a later time because I was involved in turning the spacecraft around. But I did test them. As far as stowage, I stowed my left arm restraint and my D-ring, but I did not put my safety pin in.

White I went through and put my arm rest down, put my safety pin in. That was one of the first things I did.

McDivitt I might comment that I never did put my safety pin in. I never put the safety pin in the D-ring. I felt the D-ring cover was adequate, and it was.

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White I know, you never have been particularly too hot on that.

McDivitt No.

White Then I went ahead and disconnected myself. I had a lot of things I had to squirm around and do. I left my life vest on as we had planned to do, then take them off leisurely at a different time. I did not find any reason to put the drogue pins in. I don't think they are satisfactory in any way. I don't think the pin itself is satisfactory, and I don't think the location or type of holes are satisfactory. I will elaborate on them a little further. We have had aircraft around for a long time and we have learned a lot about safety pins. We have come up with some pretty good designs on safety pins. We have a design on our drogue pin right now which is no more than the very first type of safety pin that I saw on an aircraft. I think that we are past the point where we should be starting right out at the beginning. We ought to put a properly designed safety pin in there that you can insert a little easier into the holes. I'm not going to try to design the pin but I think that it should have some type of shaft on it that

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you can use to stabilize the pin when you insert it. And when I say the holes through which you insert the pins are unsatisfactory, I'm referring to holes through a cylindrical shaft that is hollow inside so that you not only have to find the hole to put it in on one side, but you have to work it around and find the hole that it goes through on the other side. I don't believe that's satisfactory. I don't think the opening into the hole is supposed to be beveled and they weren't beveled on my seat and they weren't beveled on Jim's seat, either. I think a beveled hole is a hole that is bigger on the outside than it is on the inside. I don't believe there is much difference between the outside and the inside of the holes for the drogue pins. I had a difficult time putting my own in. I put Jim's pins in. It took me awhile, but I put them in. I never did get one of mine in satisfactorily at this time, so I think we should do something better with the drogue pins. In addition I couldn't even see the hole.

McDivitt You had an easier time putting my pin in than you had putting your own pin in.

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White That's correct. I could put yours in fairly easy.

McDivitt That's right. I think that when you turn towards the center of the spacecraft, you end up with more room than if you turned to the outside. You can't see a thing if you are turning toward the outside.

White This is probably covered later, but my hose lengths were not long enough to permit me to turn all the way around. I knew this when we went through Weight and Balance. I knew my hoses were not long enough but it was too late, as far as I was concerned, to change them at that time. But, I couldn't see the holes on my side to insert the drogue pin. I couldn't see the holes for your drogue pin either, but I could get a better view of them over there so I knew approximately where to put the pin. I think in all respects the drogue pins are not satisfactory. You just can't see them; the pins are incorrect, the holes are incorrect, and I think we can certainly do better with them.

McDivitt I think what Ed is saying is that it's lousy.

White That's right. In two letter words, it stinks! This is the way the batteries were reading out when I checked them at insertion. And this is what

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I had suspected they were doing when we launched-- why we had unbalanced stack readings. 1-A read 6 amps, 1-B read 10, 1-C read 11. This accounts for your high reading on Stack 1. 2-A was 6, 2-B was 6, and 2-C was 6. This was the way they were reading. I ran through a check on them when we were actually in the booster phase. So that is why I felt the reading wasn't bad. They were both reading about 23 1/2 or 24 volts. They looked pretty good.

I got my 2-1 update. I got the ΔV of 167, ΔT of 3+35, and GMT to retro command of 14 48 34. I have the other times too. The time to 400 000 was 2+18, as read up to me and the time to reverse bank angle was 8+47. This is what we wrote down.

This is one time I remember now when I was a little irritated, because they gave times to us in a manner in which I hadn't wanted them to. They were supposed to give elapsed time but they gave it to us in GMT time for our retro. We had asked them to give it to us in elapsed. They came right back up and gave it to us both ways. I remember writing it down twice, on the elapsed time of 01 32 35. I can see why they did it because it

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was two minutes past one hour 30 minutes, and I guess they weren't sure exactly what we wanted. So they gave it to us in GMT and elapsed time also. But that is the information we received, as far as our 2-1 area was concerned.

McDivitt I think Ed had better cover unstowage. I didn't unstow anything. I was just trying to stick with the booster at that time.

White The first thing I got into was my right-hand stowage compartment and I unstowed the blood pressure bulb. Then I started into the center section to get at the camera. The first thing I wanted to get out was the Hasselblad and the 16 mm. I was dying to get a picture of that booster. So, I unstowed the Hasselblad and got a good back on it and the 16 mm camera. I didn't unstow the urine nozzle as the flight plan had called. We both had decided we were going to use our launch-day urine bags as long as we could, and we had hoped to use them right through the EVA. As it turned out, we did. That was about all I unstowed at this time. I unstowed the cameras, the blood pressure bulb and also got out the film cartridges and the tape cartridges. I put them on the side

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of the foot well, where I planned to keep them,
so that we could keep a good tape cartridge
available.

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4.0 ORBITAL FLIGHT

McDivitt I think that the orbital flight should be broken down into some very distinct sequences. I think there are really three of these. The first one is about the first three or four orbits where we were trying to stay with the booster, where we did the EVA and where we finally got back in. The time that we finally got the spacecraft depressurized ends one phase of the mission. The next phase or sequence of the things that come along is really the second phase. This is the middle 50 orbits or so, where we did the experiments and where we did the flight plan in a highly modified manner. We did the flight plan we started out to do. And the last phase or series of sequences was the retro-preparation, retrofire and the reentry. The retro-preparation was actually another distinct phase of the mission. I think that we ought to divide it up into those three phases--the station-keeping and EVA as Stage 1, general orbit as Stage 2, and retro-preparation and reentry as Stage 3. So I think we should

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start in the orbital flight with the station-keeping on the booster. I think that we should just pluck that thing out and follow it through in its entirety, and then come back and pick up these things like the Thrusters, Control Mode Checks, Com Checks, and those things.

4.1 Station-Keeping

McDivitt The station-keeping with the booster--Well, as I said earlier on the insertion phase, I started turning around as soon as I completed the forward thrusting. I jettisoned the nose fairings after about 30 or 40 degrees of yaw. I rolled right-side-up and then I started yawing around to the left. We saw all kinds of debris floating around and we finally saw the booster back behind us. It was already in a peculiar attitude. As Ed mentioned, when we separated from the booster, it didn't really feel like we came off straight ahead. It seemed like we got knocked off to the side of the thing. The spacecraft-booster combination sort of bent in half at the separation plane. We yawed on around and saw the booster, and I thought it was around 400 feet back. Ed thought it was a little closer.

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White I would estimate it at between 200 and 250 feet.

McDivitt Okay. We were in pretty good shape right then and I applied about five or six seconds of thrusting that should have come out around 50 feet/second. I was in a hurry trying to get our separation velocity stopped, so I was thrusting. I had it in Rate Command. I pointed the spacecraft at the booster and started thrusting, and by the time I got the computer in the Catch-Up Mode and the Start Comp button on, I had already thrusted 2 or 30 feet/second out and I counted up another 3 feet/second on the IVI's. It looked like we were probably stopped, although I couldn't tell that quickly. I knew I had as much ΔV in there as I had at separation, and possibly a little more, because I tried to hold the separation ΔV down to no more than 5 feet/second. We watched it for just a short time and then it was obvious that we hadn't stopped our separation velocity--our relative velocity--so we were still separating. So, I applied about another 3 or 4 feet/second, which should have more than overcome the 4 or 5 feet/second I put in initially. It looked like we had stopped

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then. Our relative velocity looked like it went to zero. Here, I thought, we were out around 500 or 600 feet. Ed thought we were probably in closer than that.

White Yes. I thought we were in a little closer.

McDivitt I put in a total of around 9 feet/second in the first minute and a half after we turned around.

White I think we commented together on the speed with which the booster was going away from us. Right off the bat it looked like it was--it surprised me that it actually looked like it separated from us as fast as it really--

McDivitt It looked like it had a lot more velocity than the 4 or 5 feet/second I added at the separation. It looked to me, as an off-the-top-of-my-head-guess, that something in the spacecraft separation thing had really built up a lot of relative velocity between the booster and the spacecraft. I don't know why or how. Also, it looked like we weren't inplane anymore. It was actually out-of-plane so that we had an out-of-plane relative velocity that I took out. I pointed at the booster because, obviously, if

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you're separating away from something, whichever way you're going, if you point at the thing and if you thrust in that direction you are to take out your relative velocity in all planes. So, it looked like the thing was off to the left or to the south of our orbital track by a couple hundred feet and it was going down rapidly. Losing altitude. After I thrust this second time, I knew I had more than enough velocity, much more than I needed to kill off the 5 feet/second we'd added. I watched it and it looked like it wasn't going away from us anymore. It looked like our relative velocities had stopped. I wanted to get the platform aligned somewhat in case we did have to come down in the 2-1. We really hadn't had much chance to check over the spacecraft yet. So I quickly went to as close to zero-zero-zero as I could get. I used the zero yaw and the zero roll off the ball and I went to a pitch attitude that looked like it was about zero and tried to get the ball to align to zero-zero-zero. At that time the booster was mostly behind us--mostly back toward the Cape from us--back behind us with respect to our velocity back there. It was in the

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window and I could see it. Well, I started alining the platform and left it there for a couple of minutes. The booster started falling again, descending below us. It actually went out of my view in the window. At the time though our relative velocities were quite small, so I felt I could let it go for another 30 seconds or a minute and not have it get very far away from me. It looked like it was coming toward me again, but going below. So, I allowed myself about another minute and I pitched down and looked for it. It appeared that during that minute it had gone a lot farther down than I had expected it to go.

White Yes, I was surprised. Remember that it looked like the orbit was sure something different than we predicted.

McDivitt Yes. It looked to me like the booster and the spacecraft weren't in anything that even resembled the same orbit, at the rate it was descending. I don't know what the range rate was at that time. It looked like it was a lot more than a foot/second, though. I don't know what it was. I quickly pitched back up to zero-zero-zero and

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stayed there for about another ten or fifteen seconds and went to Orbit Rate. I knew I didn't have a good alinement on the platform but I knew I couldn't stay there any longer and have the booster anywhere near us. So, I flipped around and pitched right straight down and here's where the problems started. To get down to the booster in a long rendezvous type maneuver, what I should have done was to just stay horizontal and fire retrograde and take some total velocity out of the spacecraft. But, when you do this the booster continues to pull away from you for a while, and then eventually you are going to drop down below it. Then you are going to be in a lower-altitude orbit and you are going to pick up and catchup with the booster. Well, with the station-keeping we had to do and the fact that the darkness was only a matter of another few minutes--

White Boy it was fast!

McDivitt It wasn't any time at all. I didn't have time to play a rendezvous game with it. I had to overcome this relative velocity we had with sort of brute force, so I thrusted right at the booster again. I got going down and I used about 5

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feet/second there. Here's where the numbers get a little vague. I thrust down at it and I watched it go for awhile. I thought sure we'd start closing on it again. We weren't closing, so I thrust down on it again. I must have done this probably three or four times. I can't say exactly.

White I don't remember, precisely, how many times you thrust. I was keeping my eyes on the booster.

McDivitt And it was a lot tougher to see when it was down with the ground as a background, I thought, than with the sky as a background. During this period of time its rotational velocity picked up considerably, and during this time Ed checked it and got eight seconds for a complete revolution.

White A complete revolution. Yes. This was an estimate.

McDivitt This meant that in the first three minutes after we were in orbit the thing had gone up to a rotational rate of 40 to 50 degrees/second. It seemed to stabilize at that rate. Its rotational rates stabilized but I don't believe its rotational mode ever stabilized. It didn't rotate in a plane as I thought a log body like that would rotate. It seemed to oscillate in just a random tumbling

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fashion. It was all over. It looked to me like it was rotating in three axes in a completely unprogrammed manner. It might have been that the roll nozzle was flopping around and the fuel was turning it around in different directions. And as a matter of fact, at this time we should go back and draw a picture of what the fuel looked like and what was coming out of the nozzle. The booster was tumbling and you could see the fuel squirting out of the roll nozzle in a big fan like this. I had the impression that if the booster were perfectly stationary, the fuel would have been coming out of the nozzle in a great big cone the way you would expect it to, but because the booster was tumbling so rapidly it was coming out in a long, twisted--like a horn of plenty. It was very obvious; you could see it, and there wasn't any doubt about the fact that there was a lot of fuel coming out. Whether this was contributing some thrust to it or not I don't know.

White

I want to comment on something that was quite an experience for me. When I called out to you, I was looking down at what I thought, since it was pitch black, was the sky. I could see little

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sparkles everywhere. And it looked like almost a starlit sky, but it just didn't quite look right to me; it looked like an artificial starlit sky. It looked like some of these star displays they have created for us. And I looked over at Jim and asked him if he was seeing this and about the same time I noticed that he had nothing but daylight out his window. This was the first time that I had the daylight-dark experience of one guy looking into pitch black night and the other guy looking into a complete daylight window over there. Jim remarked rather disgustingly to me, "We are pointed straight at the ground!" About the same time I realized I was looking out at the fire flies everybody had seen, but probably in a much more profuse quantity than had ever been seen before, because we were getting all this fuel that was vaporizing into many, many particles from the booster and a little bit of a contribution from the spacecraft also.

McDivitt And we were thrusting, too. I'm sure we had all that junk on it from our launch.

White That's right. And the whole area out in front of my view was just entirely taken up with these

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little particles, and this was at sunset. As the flight progressed, each time we had a particle or a group of particles such as a urine dump right at sunset or sunrise, the sun would pick these particles up and they would act just like little magnifying glasses and make very bright spots. This is exactly what happened. Did you ever see that then? I think you were more in the daylight side.

McDivitt No. I was on the daylight side. I didn't see what you were talking about.

White It was really something. The whole sky within my view was covered with these little particles-- thousands of them. There was obviously a great deal of that stuff in the air all around.

McDivitt As soon as we got turned around I could see that the lights were flashing on the booster, and Ed saw them, too. It was pretty apparent. I called out right away to the ground that the lights were working. I don't know if they understood what I was talking about or not. I also called out shortly after we came off the booster and we saw it, that it didn't look like we were going to be able to touch it because of the high rotational

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rates that we already had. We were into darkness by the time that we got turned around, and I had thrusted just two or three times at the booster. We were still quite far above it--I would guess now on the order of 2000 feet or more and it was still dropping away from us rapidly; I had already used about 25 or 30 feet/second to get toward the booster. I knew I had to catch it during the night time because when we came out of the darkness on the next pass, we had to be next to it, because we were supposed to take some photos of it around that time. So I thrusted some more right at the booster trying to just overcome orbital mechanics with brute force. It was too late to start playing fancy games with the orbital mechanics. Finally, I got us down to what I considered a good position, and this was prior to Carnarvon, I believe. Remember when we finally got it on the horizon?

White It looked like it had finally stopped.

McDivitt The relative velocity had finally stopped. And let me now make a general comment about what I thought of the lights on it. We had two lights on the booster that flashed and they were diametrically

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opposed on the center of the booster. And when the booster was in such a manner that I could see both of the lights, I could tell relative rates and I had an idea of how far away I was. Did you find this to be true too, Ed, or not?

White Well, I can't honestly say I was looking at it with that feeling.

McDivitt Okay. Well, what I am saying is that it was difficult--

White I want to hear what you are going to say. I'm not sure what you're saying yet.

McDivitt It was difficult to tell how far I was away from it, at best, but when I had the booster in such a position that I could see both lights at the same time, I could tell by the distance between the lights whether I was close or far.

White Okay. I agree with that.

McDivitt And when I could see these lights flashing over a period of time, I could tell whether the distance between them was getting larger or smaller so that I knew if I was closing or not. Unfortunately, because the booster was tumbling in this screwy manner, I couldn't maneuver around the booster because it was tumbling so fast; I was just trying

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to get close to it and not even maneuver--not to pick specific positions. All I wanted to do was just get close enough so I wouldn't lose it. When I could see these two lights, I had a pretty good impression of whether I was closing or opening; for a long part of the early part of the mission in the night time it looked like we were holding our own, and then we finally started closing with it. I finally worked it down where we were at the same level. All this time I had been above the booster. I worked down until I was at the same altitude with it; at least it was on the horizon. I felt that by then I had gotten the thing under control and we stood a pretty good chance of still coming out on the daylight side with the booster. I can't tell you what the range was. It looked to me like I had worked the range back down (it had been opening up as we went into darkness)--to 2000 or 3000 feet again--probably around 2000 feet. It might even have been as low as 1000 feet. It could have been lower than that. At one time I got the impression that we were quite close to it.

White Yes. You were wondering whether you should retrograde away from it.

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McDivitt It looked to me like we could have gotten as close as 200 feet. It was extremely difficult to tell how close we were. What's your guess, Ed? Just pick a number.

White I wouldn't say that close. I'd say you're more in the ball park in the neighborhood of 700 to 1000 feet.

McDivitt Okay.

White You could be magnitudes off.

McDivitt Before we got to Carnarvon, I remember, we were in reasonably good shape, because I had finally gotten down to the booster. I felt if I could just keep it down near the booster we would be all right. Then it looked to me like we were closing rather rapidly. So I thought we were going to get next to it and then we were going to be all right. The reason I felt this was because I could see the two lights. It must have been rotating in such a manner that I could see the two lights. Almost every fifth or tenth time they blinked I could see them. I could see two of them. So I knew by the distance that we were in quite close and everything looked pretty good then. And then for a long, long, long period of time after that I never

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saw two lights again. I don't know if you did or not. I kept looking and there was a single light and a single light and a single light, and I didn't know where I was with respect to the booster. And then I started getting the impression without really seeing the double lights, I guess, that it was going away very rapidly. Maybe I did see two lights and I just don't remember it now.

White My impression was that the light was getting fainter.

McDivitt I think that must have been it. I think that must have been it. But all of a sudden I got the impression that it was leaving me at a rapid rate. It wasn't that easy to see. During the few times that the booster was up against the sky background it was easy to see, but when it was down against a ground background, it was very difficult to see. I think it was just before we got to Carnarvon that I felt we were in good shape. And then as we passed Carnarvon, I remember calling I could see the lights of the city. Well, during this period of time all of a sudden I thought it was starting to pull away again. So I started thrusting at it again. And I never really got the

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double blink of the lights for a long, long, long time. And finally I thought I could see them blinking again, and they were almost a single light this time since they were so far away. And this occurred over a very short period of time. Ten minutes? Five minutes?

White Yes.

McDivitt Is that right? Whatever you think, Ed.

White Yes. I fully agree with you.

McDivitt So then I said to Ed, "I think we are losing it." So I started thrusting at it again. All of a sudden it was apparent that the thing wasn't as close as it had been. So we started thrusting at it.

White In fact, that was one time you said we had lost it, didn't you?

McDivitt I said I think we have lost it. I had it in sight. I didn't say that I had lost sight of it.

White I thought you meant you had lost sight of it.

McDivitt No. I still had it all the time.

White But it wasn't getting any bigger.

McDivitt I didn't have any idea in the world where we were. And I still couldn't really tell. Finally, we could see the sky starting to get a little gray

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and I thought at least we were going to get to see where the thing was. And all of a sudden the booster came out just like that, and you could see it. The lights disappeared and there was the booster. It was '2 or 3 miles away, I'll bet.

White You asked me there and I estimated 1 1/2 miles.

McDivitt So, it had gotten that far away in such a short time, and it was down. I think what really gave me the clue that we were losing it again was that I had it on the horizon and it had started going down below us.

White Right. It looked like it was about 30 degrees below --

McDivitt It started going down again. And I could see it was coming down below the horizon, so I knew that I wasn't right with it. But I wasn't really sure how far away I was so I did thrust a couple of times--a foot/second or so--to make sure I always had a closing velocity with it. And finally I got the thing down. It was down so that when it came out it wasn't directly below me; it was out in front of me and down again. And like Ed said, I guess it was down about 30 degrees.

White That's what I'd estimate.

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McDivitt When it came out of the night and we saw it out there in the daylight--

White Right. I'd estimate 30 degrees down.

McDivitt It was above the horizon, just barely. Or was it above the horizon?

White No, it was below the horizon.

I'd say it wasn't more than ten or twelve degrees below the earth horizon, but below our local horizon. It was in the neighborhood of 30 degrees. If you looked out level to what you would call level--but you know the horizon tilts away from you, so--.

McDivitt So here again we were faced with the same kind of problem--to catch up with the booster. What I should have done was to retrofire right then to drop down, get a lower orbit, and come back up. But we had to get to the booster right then or we weren't going to get to it, because we had the mission to take photographs of it across the States. So I thought if I could close with it at 10 or 15 feet/second we could at least overcome our problem. So I aimed behind it, so to speak, and down, and I thrust that way trying to get enough closing velocity down and another one that

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would bring us up to it at the same time; but most of the thrusting I did was down. Then we just didn't gain on it. I started thrusting retrograde with my top thruster, but I was thrusting more back and downward. I just absolutely could not get down to the booster. It kept pulling away and pulling away until by the time we got to Hawaii.

White You were putting a lot of ΔV in there and we just weren't doing anything. We just weren't making any headway.

McDivitt It continued to pull away from us and it was falling farther and farther below us until finally--

White You put in about 40 feet/second to do something with it and it hadn't changed a speck.

McDivitt By the time we got to Hawaii I told them I thought we were having difficulty doing it. Anyway, I had decided by that time that if we were going to do the mission at all, the only thing we could do would be to leave the booster. The fuel was down to around 75 per cent on my gage and the gage kept going up and down, so it wasn't a heck of a lot of help. I had burned around 85 or

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90 feet/second. I had numbers in all three of the windows, and of course since I was changing attitudes and thrusting in different directions those numbers were going all over the place. So I made up my mind then that it looked like a hopeless task and that we had better stop this stuff or we were going to lose all the fuel for the whole mission. We probably wouldn't be able to catch it, and we wouldn't be able to do what we were going to do. I think the only thing we could have done to save the whole thing would have been for us just to go forward on the local horizontal and retrograde a large amount on the order of 20 to 30 feet/second, fall down below the thing and catch it an orbit or so later and actually perform rendezvous with it. But because the flight plan was such that we had to get all the EVA done in the first three orbits, and because Chris and I had talked this over and decided the EVA was the more important of the two things, I felt that the best thing to do would be to abandon trying to catch up with the booster.

White

Let me interject something else, too. See if you had the same feeling. I had the feeling that the

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booster orbit had changed so much with respect to our orbit that if we really went down after it, it might jeopardize our lifetime.

McDivitt Honestly, I was concerned about that too, because, remember, I called and asked what the heck our orbit was right then. The booster looked like it was going down at such a rapid rate. By the time we got to the States I would guess it was 5 miles below us at least.

White My impression was even more. I thought maybe it wasn't more at the time but it was going more. I felt that if we really got back with the booster we might have a pretty good orbit, but we would be down in the neighborhood of 130 and this wasn't the altitude we wanted to be, for the six-day lifetime that we wanted.

McDivitt The other thing that bothered me was that we were going toward perigee where we should have been coming back together. And we weren't. We were pulling away so fast that it wasn't even funny. Frankly, I just couldn't figure out what kind of orbit the booster was in. It looked to me like, if we were having trouble, the place where we should have been the farthest from it was at Car-

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narvon. Apogee should have been farthest apart. Our perigee should have been closest together. It was almost opposite. We were with it at Camarvon, but we were way far away from it and getting farther away from it as we crossed the United States, or Mexico, or wherever we came. I wasn't looking out at the scenery; I was looking at the booster. It was extremely difficult to track across the water and as we got to the land it was almost an impossibility to track it. Here the distance is extremely difficult to judge. It could have been anywhere from 5 to 15 miles directly below us at this time. If I had a range rate I could have told where I was all the time and with range rate I would have been able to rendezvous with it from a mile. I could have done the things I knew had to be done, rather than try to do it forcefully. I sort of feel the big problem was that we were so optimistic for those first three orbits that it is almost unbelievable. It became apparent when we tried to do the EVA that we couldn't do it in the time allotted. But anyway, I had decided by the time we had gone by Hawaii, or wherever it was after we had been in the

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daylight for ten minutes or so, that it was hopeless, and I told that to Ed. I told him I thought we had lost the booster for good. I don't mean I didn't see it but that we weren't going to get back down to it. He agreed with me.

White Yes.

McDivitt I think I could have gotten to the booster in a dignified, normal, slow, easy manner if we didn't have the constraint on us of being next to the booster in the first daylight pass over the States, and taking pictures, prepare for the EVA, and be ready to emerge from the spacecraft an hour after we came out of the daylight on our first pass, which was about two hours into the flight. I just felt that if I had had more time, I could have gone ahead and done some of this without using brute force to overcome the difference between the booster and myself. I could have gone into a lower orbit and chased it that way. I could have just gone horizontal and retrofired and fallen away from the thing initially and caught back up with it later on, but it was getting so far away from us to start with that to purposely put yourself farther away from it so that you could catch

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up later on was not the thing to do. We had to be all done at a certain time. We had to be with the booster when we came back into daylight. That was it; that was the thing. We had to be with the booster, because we had to take those pictures. Then we had to be with the booster again an hour and a half after that so that we could do the EVA right next to it. And with those kinds of time constraints you don't have time to perform a rendezvous. You've got to get with it right then, but we just couldn't get with it right then.

White You know another thing too; I'm darned glad we didn't use any 10 feet/second initially to separate with. I think we could have used something in the terms of 1 or 2, feet/second and that would have been fine. Don't you?

McDivitt I cut it short. I only burned about 5 seconds, and I stopped.

White You have been doing that in all your simulations so I knew you were going to do that. You can even cut it less. It was amazing to me the separation you get immediately.

McDivitt It almost seemed like we had a posigrade rocket on the spacecraft and a retrograde rocket on the

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booster, the way we separated. Well, anyway, we told Guaymas that we had to get resolution immediately if they wanted us to continue to chase the booster because we had used a lot of fuel and we weren't getting any closer and it was still pulling away from us. If they wanted to go for it they had to make up their minds and we would really go after it. But I didn't think it was wise. They confirmed this and said, "Knock it off!" For closing rates at rendezvous, I think you could handle 20, 30, 40 feet/second if you are coming at it, not if you are going away from it. You see we never got a chance to do a rendezvous. We never rendezvoused with it. The best thing we ever did was to get close enough to it where I could at least say I was at the same altitude with it for a change. It was the first time I had gotten back to the same altitude since we left it at insertion. You just can't equate it. You don't do an optical rendezvous with the booster below you. You try to put it above you so you have the stars and the sky background. It was below us. You couldn't do any line of sight nulling because there wasn't anything to null the

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line of sight with. On the other hand I found that if the sun was on the window you couldn't see beyond the nose of the spacecraft. This satellite that I saw over around Hawaii--I saw the thing and we were closing on it. We might have had a better rendezvous with it than with our own booster. We were closing on it and I was concerned enough that I checked to see where the a.c. Power Switch was to see if I had maneuver capability at the time. The sun came across the window and I lost it just like that. It might have been 5 miles out. I don't know. It might have been then. It might have been 50 miles out, but I had the impression in the 30 or 40 seconds I saw it that it was quite close because I could make out the shape of it. Shoot! The sun came across the window and that was the last thing I saw out the window. I never saw another thing out the window until we were gone and until the sun finally came off the window. So, if you are doing an optical rendezvous and you've got the sun on the window, I don't know what you'd do.

White

And if you have as dirty windows as we had-- our windows had a white film of material on the

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outside , which made it very difficult to see out when the sun's rays reflected on these particles that were on the outside of the windshield.

McDivitt To just summarize this thing, I think that we came off the booster with a fully unknown relative velocity which was much greater than what we anticipated, and it didn't seem to be an inplane relative velocity. It didn't seem to be an inplane local horizontal relative velocity. It was out-of-plane and it looked like the booster headed down, with respect to us because it started separating from us so rapidly. It also had less total velocity. I think that this was the first surprise. It started tumbling and immediately the rates built up in just a very few minutes to something very high--40 to 50 degrees/second-- but it never got any higher, at least the best we could tell. When we last saw it over Mexico or over southern United States it was still tumbling at about the same rate, I guess around 40 or 50 degrees/second. I felt that I got down to it all right and I was in reasonably good shape prior to Carnarvon, and from that time on until we came out of the darkness I lost it. And I think I lost it

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because looking at a single light at night doesn't give you any depth perception at all. You just don't know where the booster is. I think that summarizes it. Ed, you want to add anything? You weren't watching it as much as I was, but you saw enough of it to know exactly what was going on.

White

Well, you see I wasn't able to put the pieces quite together because I was either looking out, and I couldn't see when you were thrusting, or I was looking in and watching you when you were thrusting and listening and not looking out. I tried to interject my thoughts as we went along and I agree with what you said. I don't believe I want to add anything else.

McDivitt

Now that we've covered the tracking and the losing of the booster, I think we ought to go back to the very beginning at insertion and we will go through the checks that we went through as we proceeded along and the things that Ed and I were both doing aside from tracking the booster, the things that we were either doing to prepare to come back in at area 2-1 or to stay in orbit and proceed with the EVA as we had planned. In looking over the flight plan that we had and the briefing guide on

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page six, I have already covered the things on platform alinement. I did not have time to aline the platform. I tried to get it to somewhere near the local horizontal so that in case we had to do a retrofire I'd be able to do the retrofire. I brought the spacecraft up to a pitch attitude that I hoped was zero, but I never got the spacecraft alined to see that it was zero. So we really went into this thing without my ever having seen a zero pitch attitude on the spacecraft. Obviously I didn't get a chance to see the 30 degree pitch down on the retrofire attitude. I didn't really have time to look out the window and do a single thing that would have prepared us to reenter at 2-1 because we were so busy keeping track of--

White

You know another thing I'd say also is that we were eternally optimistic. We felt we were going to aline the platform and watch the booster at the same time.

McDivitt

As a matter of fact, while I was trying to get the alinement it became apparent to me that I could not aline it. I even thrusted vertically--

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McDivitt I was in a horizontal position and I thrust down using my top thrusters, so that I would try to keep the booster in my view. Thrusting, chasing the booster, and alining the platform all at the same time--those are the kinds of things you have to do. So, I never did get the platform alined. I did not have time. I got it somewhere near local horizontal. If I was within plus or minus 5 degrees in the axis, I think I did a reasonably good job. The Thruster Control Mode Checks that took place at 15 minutes I didn't do as such. I would just throw it into a different mode and thrust. I just did it with a catch-as-catch-can. I did check out the different modes.

White Everything seemed to be working. You weren't getting any thrusters that weren't firing, and your modes all seemed to me to be working properly.

McDivitt It looked pretty good.

White I had one comment on the Communications System Check. Remember we lost good communications with No. 1 UHF and we switched to No. 2 and seemed to have good communications with it

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from then on? Now this wasn't representative that we lost UHF No. 1 because we used both of the sets at different times throughout the mission later on. But at this particular time, UHF 1 didn't give us good reception and we switched.

McDivitt I thought communications through the first day of the flight were atrocious. They were terrible. Finally we switched to the Reentry Stub Antenna and that seemed to fix the problem. Didn't you think so? But you know we went back to reentry antenna over Carnarvon one time. We got just as good reception off of it that time as we did any other time.

White I remember when you were making your Communications Check. That was when I was asleep. You were checking the two and you ended up with the reentry antenna.

McDivitt Yes, later on in the flight, as I said, at the end of the first day or so.

White We seemed to get better communications.

McDivitt Communications were better. As a matter of fact, I was a little concerned that the communications were so lousy that we might have

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to come back in, because we were really losing communications. We were trying HF and all kinds of things. Information just wasn't getting up to us.

White That was after EVA.

McDivitt Right. Communications just weren't getting up to us.

White I figured we didn't have any communications with the ground during EVA.

McDivitt No, we didn't. Our VOX blocked them out.

White I know it.

McDivitt But the Communications Systems Check that was supposed to be performed at 15 minutes-- we sort of already accomplished the thing, because we'd used UHF No. 1 and No. 2.

White I made the check with them.

McDivitt Did you make the check? -- that's right you made the check but we didn't use the HF because we weren't going to put the antenna out until after EVA. We didn't do anything with the urine bags except keep them right where they were.

White At this time we didn't pressure check both suits, because we did this later.

McDivitt We didn't align the platform, as I mentioned.

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The Control Mode Check was a catch-as-catch-can. You did unstow, the equipment that we were supposed to unstow. The blood pressure bulb, the Hasselblad camera and its packs, and a 16 mm camera. During this time when I was chasing the booster, I did manage to get to reach back behind my seat and pull out the bracket for the 16 mm camera. You tracked the booster while I smoothed the thing out.

White That's right.

McDivitt We didn't get out the urine nozzle. How about the utility cord? Did you get out that fancy utility cord, the three-axis utility cord?

White Yes, I knew where it was. I didn't give it to you because you didn't need it.

McDivitt No, I didn't need it. That's right. As Ed said, we did not pressure check our suits at 30 minutes like we were supposed to.

McDivitt There's this little thing here that says measure all ΔV 's. All I did was put the computer in Catch-Up, hit the Start Comp button, and just let the numbers fall where they would. At the time that we stopped chasing the booster around, I had about 60 feet/ second in one window,

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30 in another, and 30 in another. I never really came to a position to try to null all these things out to see what the total ΔV was. I was putting in the thrust with mostly the aft thrusters and the down-firing top thruster. I don't think I used the left and right thruster, at all. I don't think I used the bottom thruster at all. There was no difficulty controlling any of them. I used the forward-firing thrusters once or twice to try to slow down, to take out total velocity.

McDivitt Then there was the Accelerometer Bias Check which was another one of those things. I don't know how I let it get into the flight plan.

White We both joked about that one, huh, Mac? We were really going to get an Accelerometer Check when we were trying to track the booster.

McDivitt I was putting ΔV 's on the IVI's at a rate of a foot per minute at least. We ended up with over a foot per minute, I think, over that period of time. We couldn't have checked anybody's accelerometer bias, so I just didn't even fool around with it. We were supposed to take a blood pressure. Did you take that blood

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pressure, Ed?

White Yes.

McDivitt You did take the blood pressure.

White I think I did. I had it out. I don't know whether they asked for it or not.

McDivitt Okay.

White I don't remember on that.

McDivitt Okay. We got the Quantity Read off. I guess we got a time hack somewhere in there.

White They called up I believe. I remember them calling the Quantity Read-Off, and I turned it OFF.

McDivitt That's right.

McDivitt Then it says at one hour we were supposed to unstow and assemble the maneuvering unit in its 16 mm mount. I don't think we had that stuff out by then, did we?

White No.

McDivitt You see, this whole flight plan was based on me being able to track the booster without using any thrust, and essentially having the spacecraft stationary near the booster, without any maneuvering at all, where the station-keeping was a matter of just looking out at the thing and controlling your attitude with pulse.

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We thought that if the booster was stationary we could get in close to it. We could essentially fly a formation by it with more attitude control than translation control, which left me then free to help Ed assemble all this stuff for the EVA. Well, it turned out that I didn't dare take my eyes off the booster for half a second. So all the things that we were supposed to do together up until the time we finally said goodbye to the booster, Ed had to accomplish himself. I was completely unable to help him. The only thing I managed to do was to unstow the 16 mm camera bracket and put the 16 mm camera on.

White I couldn't quite get at that one.

McDivitt No. I could hardly get to it. So we were probably behind at the hour mark. Right?

White Yes.

McDivitt Not by an awful lot.

White I knew we had a problem with the booster, and I was more concerned with our problem with the booster than getting the gun and stuff out then. I felt that they were both tied together and once we lost the booster we didn't have a

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sweat time-wise on making our EVA. So, I was trying to be of what assistance I could to Jim on watching the booster during these first critical periods.

McDivitt Yes. It wasn't unappreciated because this booster was becoming a speck on the horizon, and if you blinked your eyes you could very well lose the darn thing.

White When we were out that second day, I think you said one time you did lose it for a minute.

McDivitt That's right.

White I was lucky enough to still be seeing it, until you started picking it up again.

McDivitt That's right. So, I'm saying it really took two pairs of eyes constantly looking at that booster to keep it in sight. It's just one of those things that just took so much time that we hadn't planned on. It was almost unbelievable.

McDivitt In our flight plan from an hour to an hour and twenty minutes we don't really show anything. Although, here again, we were busy with the booster. So, when we got around to closing with the booster, there wasn't any closing. We finally got clearance over the United States to stop

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fooling with the booster. I think this was an extremely wise decision.

McDivitt I got to Guaymas and I said the booster was pulling away from us. We'd already used about 100 ΔV to stay with it, and I recommended that we just give up on it. We had to get a decision immediately because I couldn't stay with it and not use fuel at the same time. They came back from Texas. I talked to Guaymas and got their confirmation from Texas, which was only a matter of a couple of minutes, saying leave the booster. That was about the only thing they could say.

4.2 Extravehicular Activity

White And this was the time I went after the gun.

McDivitt Okay. At that time we reverted from station-keeping, which we were both attempting to do to EVA preparation, which we both had to do. That's when Ed went after the gun, and we started our preparation. We weren't really far behind at this time. All we had to do was get the gun out and get the maneuvering unit. The cameras were already out. You had the Zeiss too, didn't you?

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White Yes. The Zeiss came out with the Hasselblad, from that same package as the movie camera. And the storage certainly was a lot easier. What do you think?

McDivitt That's right.

White Particularly getting it out that center thing. You can just zip them out of there with no problem at all.

McDivitt So, at about 1:30 we started to assemble the gun. If you look at the checklist, you see that we probably got the gun assembled in nothing flat.

White It's no problem to assemble the gun.

McDivitt We started our egress preparations essentially on time. As a matter of fact, I think we even got started a little earlier.

White Then, we weren't worrying about anything else.

McDivitt Then, we weren't worrying about staying with the booster. We probably started it about 1:35 or 1:40. Over the States we started our egress preparation. We went to our other checklist.

White You were over Ascension, calling off the checklist.

McDivitt I started reading the checklist off to Ed and

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we went through it. He unstowed everything. Why don't you tell them what you did there, Ed? I just read the checklist off to you, and you went ahead and did it.

White Okay. I had to get back into the right-hand box, and I unstowed the items there. The first time I went back in there, I took the first items out, and I did not unstow the full box. I remember I told you, "It's all coming out, Jim. I'm going to bring them all out on the lanyard." Remember?

McDivitt Right.

White We'd take them off piece by piece if we need it. At that time I pulled the whole lanyard out and the cockpit was full of little bags. I was quite happy that they had prevailed upon me to put a lanyard on all this equipment. I had thought at one time that it would be more desirable not to put a lanyard on. We'd been working a lot in our simulations without the lanyard and it seemed pretty easy. But looking at it now, I highly recommend that everybody keep that stuff on a lanyard.

McDivitt We would have really had a mess if we'd had all

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those things floating around. It was bad enough as it was.

White Yes, eight or ten of those little bags, and I was glad they were all tied on to one string. I could control them in that manner. They were quite simple to unsnap. I thought the snap attachment made it pretty easy to unstow, and selectively pick out the items that I wanted. I unstowed the pouches that I needed, and then we got ready to take the long umbilical out. I had a little difficulty. It took me about three tries to get it out. It's fairly big package to come through a small hole. It was a good thing that we had taken the velcro off of the batch, because there was no tendency for anything to hang up as we removed it. On the third try I got it out.

McDivitt I thought you did an extremely good job getting the bag out. You got it out a lot quicker than I'd ever seen you do it in the Crew Procedures Trainer in Houston or in the simulator at the Cape.

White You didn't know it. It took me three tries.

McDivitt Well, maybe it did, but it sure looked like it

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came out a lot easier. I thought you got it out in a big hurry. I didn't notice that it took you three tries. I saw you start, and then just a short time later, it was out.

White Well, it did come out pretty easy, and I think the storage was satisfactory, but I'd certainly recommend that nothing be on the outside to keep it from coming out. It's a real tough--

McDivitt Yes, we need the velcro off of there. We're pretty well sure of that.

White The rest of the equipment- the "Y" connectors, the bag that contained the "Y" connectors, and the attachments for the chest pack, I handed to you. I think you were keeping track of most of those things until the time I needed them.

McDivitt Yes, I was.

White The storage of the ventilation module from the floor came off pretty easily. That's when I started going ahead and putting it all on. You read the checklist off to me. I had gone ahead and done a few things anyhow. As you read them off I checked them off to be sure that I had done them all. I think we had

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everything out without much problem at all. I think it took us longer actually to put it all together.

McDivitt That's right. It did. We started going through the checklist here and putting the things on and we started getting more and more rushed. We were supposed to start the Egress Preparation Checklist at about 1:44. We probably started it at about 1:30 or so. We started it about 10 minutes early, roughly, maybe five to 10 minutes early. We were supposed to be ready to start the depressurization at 2:30 over Camarvon.

White I think I could have gone through and looked everything all up, but I felt that we should go through fairly close to the procedure we had set up on the checklist.

McDivitt That's right.

White I think this slowed us down.

McDivitt Well, we set the procedure up so that when we finished with it, it would be right. I think this helter-skelter thing that we were being forced into was for the birds. So as we got farther along, it became apparent to me that

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the thing to do would be to stop.

White Right.

McDivitt Go ahead with the assembly of the stuff. Why don't you comment on that?

White I've commented in my Self Debriefing about the equipment and the assembly of it. I thought there was no difficulty at all in connecting the "Y" connectors, the hoses, and the chest pack. I thought the connection of the chest pack to my harness was a good one. With the velcro I could move it in and out whenever I wanted to so that I could make my connections on the inlet side of the ECS hoses. It went along pretty smoothly, as a matter of fact. I think as we progressed along in it though, we felt that we had everything done. I didn't really feel that we had everything done in a thorough manner. And I think you had that same feeling.

McDivitt That's right. When we got to Kano or Tananarive --I think it was Tananarive--I called whoever I was talking to and said that we were running late and I thought that we would probably not do the EVA on this particular rev. I knew that

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we had another rev on which we could do it. It looked to me like we had all the stuff hooked up, but we hadn't really had a chance to check it. I also noticed, Ed, that you were getting awfully hot. You were starting to perspire a lot. I didn't like the way you looked to start this whole thing off. So I told them over Tananarive--I believe it was Tananarive--that we would go ahead and continue on, and I would let them know whether or not we were going to depressurize at the next station. We went on ahead and it looked to me like you were all hooked up and about ready to go except for one thing.

White We forgot the thermal gloves. I did not have my thermal gloves on.

McDivitt You did not have the thermal gloves on, which is sort of insignificant, but we hadn't really had a chance to check over the equipment to make sure that it was in the right spot.

White Well, we talked and you said, "What do you think?" We talked it over and I had the same feeling. I thought it sure would be smart if we had about 20 minutes to just sit here real still

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before we go out.

McDivitt I think we were in a situation where it would probably have gone all right. We had completed about 80 percent of what we really should have had done as far as the checking went, and I just didn't feel that we were in the right shape. Ed didn't think we were, and besides, I could see Ed. He couldn't see himself. Ed looked awfully hot, and he looked like he was getting a little pooped out from playing around with that big suit. I thought that the best thing for his sake, and I knew he wouldn't admit it, was to let him rest up for another orbit.

White I agree that was the best judgment.

McDivitt So, when we got to Carnarvon--I guess it was Carnarvon--I called them and said we were not going to come out on that orbit.

White It was Carnarvon. It was just before we depressurized.

McDivitt So, we postponed it until the next orbit. As a matter of fact, after that we just sat there. We didn't do a thing for about 10 minutes. I let Ed cool off a little bit. We were on two-

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fan operation at the time. We just sat there and we were cooled off. We went around for about twenty minutes then.

White Okay. Then as we went back around, I asked you to go through the checklist again, and we went through item by item this time.

McDivitt That's right. I might add that we went right back to the beginning checklist, the Egress Preparation Checklist. We started at the top one, and we did every step on it again. We verified every step to make sure we hadn't left anything out.

White We actually went in and checked this time. Another thing we hadn't really positively checked was the position of all the locks on all of the hose inlets and outlets. This time we actually checked all those locked. All of them were locked in, but it was a good thing to do, I believe.

McDivitt You want to make sure. We did do our Suit Integrity Check before we started all this stuff.

White That's right. We started before we actually went to the unstowing of the stuff from the right-hand aft food box. We went to the Suit

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Integrity Check.

McDivitt Well, I don't know where it is, but we did it when we were supposed to do it.

McDivitt We did the Suit Integrity check before we started the Egress Preparation Checklist. That's when we did it, over the States.

White I think we did that just about the time you decided to give up on the booster. We did the Suit Integrity Check. Both suits checked out all right. It went up to 8.5 and it leaked down to about 8.3 or something like that.

McDivitt Same thing with mine. It went up to 8.5 and leaked down just a little bit. Not enough to be concerned about.

White No. Oh, one thing that we did do on that extra orbit that we went around-- I disconnected the depress system and we went back on the--

McDivitt Oh, yes. We never even got on the depress system, did we?

White Yes, I believe we were, but then we turned it off. We were already to depressurize and then we went back on the spacecraft's ECS system, full, and went through and reverified the whole checklist again. The only things that I would

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say we hadn't done to my satisfaction the first time was to check the inlet and outlet positions of the locks, and I didn't have my thermal gloves on. It turned out I didn't need them.

McDivitt Also, during this period of time I alined the platform, which was completely misalined. It was probably alined within a couple degrees, but as we went around in Orbit Rate it got farther and farther out of tolerance. So, I managed to aline the platform. Here again, I might comment on the fact that our initial flight plan was so optimistic that it was almost unbelievable. The both of us worked full time on doing nothing except preparing for EVA, and we didn't quite get the job done. I can't believe that we could have possibly flown formation with the booster and taken pictures of it and all the other things that we had scheduled, and still prepared for this thing and even come close to completing it.

White Well, the way we would have had to do it, would have been without a checklist. I would have had to just go ahead and hook everything up. I think we could have done it satisfactorily in

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this manner, but it wouldn't have been the way we would have wanted it.

McDivitt Yes, that's right. I don't think that's the way it should be done. It was just too bad that we had a time limit on it, but when we did get rid of the booster, or the booster no longer became a part of the flight plan, then the time limit vanished. We found out that we really needed that extra orbit, or probably could have used another 20 minutes.

White Yes. We went back. And I remember as we came over Carnarvon, we had about a 15 minute chat back and forth—kind of a rest period. We were all hooked up at that time, and that's the time we went on the repress flow, ready for the depressurization. I think they gave us a GO then for our EVA.

McDivitt That's right. We depressurized the cabin and got down to 2 psi to check our blood pressure. We tried to put our blood pressure plugs in the blood pressure plug port and found out that we didn't have any blood pressure plugs on either suits. This was quite a surprise. An unpleasant one, I might add. Well, we decided

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that from our past experience and our knowledge of the suit that even if we did spring a leak in the blood pressure cuff the size hole that we had in the suit would not be catastrophic, and we decided to go ahead with the EVA.

White It was within the capability of the system we were using.

McDivitt At Carnarvon we not only got the go-ahead to start the depressurization, we also got the go-ahead to open up the hatch, the go-ahead that we weren't supposed to get until Hawaii. So, we went ahead and did that.

White Yes. I'm kind of curious of the whole time. We were out nearly an orbit, I think. We didn't get it closed back again till we got back around to Carnarvon.

McDivitt We were in a whole orbit depressurized.

White Yes, I don't think people quite realize that.

McDivitt We'll remind them. As we got to the hatch opening thing, we had our first difficulties with the hatch. The gain gear, I guess you want to call it--actually I call it the ratchet--didn't want to engage into the UNLOCK position.

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We fooled with it a few times and it finally engaged in the **UNLOCK** position, and Ed was able to go ahead and start.

White The first indication of trouble was when I unstowed the handle to open the hatch. The handle freely moved up and down with no tension on it at all. I knew right away where the trouble was. It was up in that little spring on the gain pawl. So, I went up and manipulated it back and forth in hopes that I could break the lubrication loose in the spring to get it to work. We must have spent several minutes with the hatch. I thought perhaps it might have been stuck in the manner that the hatch got stuck in the **Wet Lock**, where it just was stuck. You could ratchet it open, but the hatch itself wouldn't open. It was pretty apparent the trouble was in the gain pawl. I jimmied it back and forth, and then I decided to go ahead and try the technique of actuating it in sequence with the hatch handle. If you actually replaced the operation of the spring with mechanically moving the gain pawl up and down, you can do the same work that the spring does.

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McDivitt Your fingers sort of take the place of the spring and drive this little pawl home.

White This is the first time we actually tried this in a suit. It requires you to press up with your left arm to get at the gain pawl, and at the same time hold yourself down. And I think later on this was a source of some of our problems which I brought out now so that we can find out later on. I felt it start to engage, and start to ratchet the lugs out. Jim also verified that they were coming open. I backed them off, and I remember Jim saying "Ooop! Not so fast!", and at that time it popped. The hatch actually popped open, jumped open about 3 or 4 inches.

McDivitt I was expecting the hatch to come open with a bang. Although we had the cabin to vent and it had bled on down to where there was nothing indicated on the Cabin Pressure Gage, we still really had the repress valve on. He was bleeding right into the spacecraft. We never got down to a vacuum and even though we had a cabin pressure of only a tenth of a psi, we spread it over the entire area of that hatch,

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and that puts a pretty good size force on it. I had a real tight hold on the hatch closing device, and when it popped open I was able to snub it.

White It didn't really open with much force, did it?

McDivitt Well, it did. It opened with a fair amount. It popped and I couldn't stop it the first inch or so. Then, of course, as soon as it opened that much pressure bled off. I just sort of snubbed the thing to keep it from flying all the way open. Now if I hadn't been holding onto it, I don't think it would have gone open more than two or three feet.

White This is another point too. There's more force on the hatch actuator than I thought. I didn't just flip the door open with my hand. I had to actually forcibly push it open, similar to the force with which I opened the hatch laying on my back under one "g". That's about the force that I had to put on the hatch to open it.

McDivitt This extra force that we are talking about is due to the O-rings they put in the pyros that are used for jettisoning the hatch. This is something that they put in just before the

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flight. Something that we'd gone out to the spacecraft to feel. We knew just about what the force was, but it was pretty high.

White: Okay. At this time I had certain things that I had to accomplish. I had to mount the camera on the back of the adapter, and mount the umbilical guard on the edge of the door. I elected, as I had planned, to go ahead and mount the camera first and then the umbilical guard. I mounted the camera and it went on without too much difficulty. The three little lugs on the bottom are a good mounting scheme. I think I would make a little easier engaging device for working out in a hard suit. I had familiarity with it, and it did lock up there all right. The umbilical guard for the umbilical on the side of the door took me a little longer to mount. Back to opening the hatch--I had the thermal gloves on when we were opening the hatch, and because of the fine work I had to do with the little gain and the drive lugs up there, I had to remove the thermal gloves so that I could actually actuate those small levers. I couldn't do them with any precision

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with my gloved hand. So, I took the thermal gloves off at this time and I handed them to Jim. When I got back out I didn't notice any temperature extremes. I felt quite confident that there wouldn't be any heat since we just came out of the dark side, so I decided to do the actual work in putting this equipment on with my plain pressure suit gloves. I had much more feel with them. Let me get back now to the umbilical guard on the door. It went on pretty well. It took me a little longer and it took me four or five tries to get the little pin into the hole that actually snubbed the guard down on the door. I did something then that I hadn't planned to do. The bag had floated up and out of the spacecraft and now it was above the point where the hose was going through the umbilical guard. I had planned to keep it down inside. I left it there for two reasons: (1) I figured it was there already and I would have had to take the umbilical cord off again and scooted it back down, and (2) I also felt that Jim might have had a better view if it wasn't sitting right in front of him on the hose coming

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up from the repress valve. I elected to go ahead and leave the bag there. I then reported to Jim that I had everything all mounted and was ready to go. I had planned to take a short series of pictures. Since we had gotten out early, I had a little extra time at this time, so I went ahead and turned the outside EVA camera on. I took a short sequence of pictures that actually gives the egress up out of the seat. I kind of went back down and came out again so they would get an actual picture of it, and then I turned the camera off again. I mounted the camera and I turned it on while it was on the mount. I took a short sequence when I asked Jim to hand me my left thermal glove, which he did. I put the thermal glove on while the camera was running. I turned back around. I wanted to be sure the camera was off, so I took it off the mount and I turned the camera off and actually visually took a look to see if the switch was off.

McDivitt: Did you knock it off one time? I thought you said the camera fell off.

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White By golly, I did. So I must of mounted it four times. That's right, I knocked it off one time during this time when I was out there. I got the picture of the egress, and then I asked you to hand me the gun. At this time the camera wasn't running. I had the glove on my left hand, and I went ahead and took the gun and made sure that it was ready to go. I had the camera on at that time and the valve was on. I checked the valve to be sure it was on and I was essentially ready to go. I don't know how long this took, but it took me longer than I thought. We had had early egress and it wasn't too much before I got the GO that I was ready to leave the spacecraft.

McDivitt I'm not sure whether we got that GO from Hawaii or Guaymas. I sort of suspect that we got that GO from Hawaii, not Guaymas as we had originally planned.

White Well, it sure seemed short from the time I was mounting all that stuff out there to the time you told me go.

McDivitt That's right. I'm sure we were talking to Hawaii, and they said you're clear to proceed

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with EVA.

White And that's when I went. I bet we went out at Hawaii.

McDivitt I think we went out at Hawaii.

White I delayed from the time you gave just a minute, long enough to actuate the camera on the outside. This was kind of interesting. When I actuated that camera, I had my gun tied to my arm with the tether. It floated freely to my right. I turned back around and turned the switch ON on the camera, and listened and made sure the thing was running. I know it was running, and put it down. I think you'll see this on the film. I wanted to be sure it was running when I mounted it back there. I actually took it off and turned it on, and I remember it jiggling up and down when I was trying to stick it on there. It ought to be a funny looking film. And it might even show the gun floating beside me as I was mounting it. That's when you said, "Slow down. You're getting awfully hot." I was working pretty hard to get that on. I mounted the camera again and this is where I tried to actually maneuver right out

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of the spacecraft. I knew right away as soon as I got up—I felt even before -- that the technique of holding on to the bar in the spacecraft and sticking a finger in the RCS thruster wasn't going to work. I mentioned that to Jim before -- that I didn't think I would be able to do it.

McDivitt I think that you and I both knew how you were going to do, and everybody else was planning for us how we were going to do it, but without any real experience in it. People who didn't know a lot about it were planning this sequence and it wasn't the way it should have been.

White I couldn't have done that. I didn't have three hands. I couldn't hold the gun and put a finger in the RCS nozzle, and hold the handle at the same time. I thought it would be more desirable anyhow to actually depart the spacecraft with no velocity, other than that imparted by the gun. This is exactly what I did. I thought that I was free of the spacecraft, and I fired the gun. I realized that my legs were still dragging a little bit on the side of the seat, so I pulled myself out until I could see that my feet were actually out of the

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spacecraft. I think you called me and said I was out of the spacecraft.

McDivitt I called and told you that you were clear.
That's right.

White And that's when I started firing the gun and actually propelled myself under the influence of the gun. I don't believe I gave any input into the spacecraft when I left that time, did I?

McDivitt No, you left as clear as a whistle.

White Later on, I gave you some pretty big ones.

McDivitt You were really bouncing around then.

White Now at the time, I left entirely under the influence of the gun and it carried me right straight out, a little higher than I wanted to go. I wanted to maneuver over to your side, but I maneuvered out of the spacecraft and forward and perhaps a little higher than I wanted to be. When I got out to what I estimate as probably one-half or two-thirds the way out on the tether, I was out past the nose of the spacecraft. I started a yaw to the left with the gun and that's when I reported that the gun really worked quite well. I believe that I

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stopped that yaw, and I started translating back toward the spacecraft. It was either on this translation or the one following this that I got into a bit of a combination of a pitch roll and the yaw together. I felt that I could have corrected it, but I knew that it would have taken more fuel than I had wanted to expend with the gun, so I gave a little tug on the tether and came back in. This is the first experience I had with tether dynamics and it brought me right back to where I did not want to be. It brought me right back on the top of the spacecraft, by the adapter section. Jim was calling me and said that I was out of his sight. I told him that I was all right, that I was up above the spacecraft, I looked down and I could see attitude thrusters firing, little white puffs out of each one. I wasn't very close. They looked just like what Chamberlain's report told us. It looked just like about a foot and a half or maybe 2 feet of plume from the spacecraft and certainly didn't look ominous to me at all. In fact it looked kind of like the spacecraft was really alive and working down

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there. I knew Jim was doing his job holding attitude for me.

McDevitt Let me comment on the attitude-holding right now. Initially we started out in blunt-end-forward, banked to the left about 30 degrees or so. This happened to be the attitude we were in. We wanted to be blunt-end-forward for the sun, and they told me it didn't make any difference what attitude that we were in when we opened up the hatch. We had originally planned on opening the hatch toward the ground. I was called by some station that said it didn't make any difference what attitude I was in when I opened the hatch. We opened the hatch. We opened it in that particular attitude, and I held the attitude for the first portion of the time that Ed was out. When you had the gun you managed to stay reasonably well out in front. I held the spacecraft essentially stationary with respect to the local horizontal. After you ran out of fuel in the gun you were on top of the spacecraft all of the time. I felt that unless you really had to have the thing stabilized, to maintain your sense of balance or

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Whatever you want to call it, I wouldn't fire the thrusters.

White You asked that already when I was out.

McDivitt Yes. I asked you if you needed it and you said no. So, then I felt it would be better not to fire the thrusters, because you were drifting back up over the cockpit. I could see that you were going up over us. I couldn't see back behind me, but I could see by the motions that you had when you went by me that you were going to continue on. I felt that it would be a lot safer if we just let the spacecraft drift unless it got into very high rates. I fired the jets a couple of times just to knock off the rates. I let it start drifting when you got on the tether so that you wouldn't get back there on top of one of those thrusters when I fired them. From about the time you ran out of fuel until you got back in I didn't do much attitude controlling. I did some. Everytime the rates got up pretty high, I'd knock them off. You were able to maneuver around the spacecraft when the spacecraft itself had rates of say plus or minus 2 degrees/second in a

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couple of the axes at the same time. Here again before the flight we discussed the axis system. Ed selected the spacecraft as his axis system. It didn't appear that he was having a bit of trouble with it. He was maneuvering with respect to it, regardless of what the earth, sun, moon, and stars were doing. It was pretty obvious to me that was exactly what he was doing.

White Well, when I came back the first time to the spacecraft with the gun--I had used the tether to bring me back--I did go back up on the adapter area. This is the first time it had happened. I said, "All right. I'm coming back out again." This is one of the most impressive uses of the gun that I had. I started back out with that gun, and I decided that I would fire a pretty good burst too. I started back out with that gun, and I literally flew with the gun right down along the edge of the spacecraft, right out to the front of the nose, and out past the end of the nose. I then actually stopped myself with the gun. That was easier than I thought. I must have been fairly

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fortunate, because I must have fired it right through my CG. I stopped out there and, if my memory serves me right, this is where I tried a couple of yaw maneuvers. I tried a couple of yaw and a couple of pitch maneuvers, and then I started firing the gun to come back in. I think this was the time that the gun ran out. And I was actually able to stop myself with it out there that second time too. The longest firing time that I put on the gun was the one that I used to start over the doors up by the adapter section. I started back out then. I probably fired it for a one second burst or something like that. I used small burst all the time. You could put a little burst in and the response was tremendous. You could start a slow yaw or a slow pitch. It seemed to be a rather efficient way to operate. I would have liked to have had a three foot bottle out there-- the bigger the better. It was quite easy to control. I feel that with the gun there would be no difficulty in maneuvering back to the aft end of the spacecraft, and this was exactly what I did later on, just on the tether. I got

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all the way back. So, I ran out of air with the gun and I reported this to Jim. I didn't attempt to take any pictures while I was actually maneuvering with the gun. The technique that I used with the gun was the technique that we developed on the air-bearing platform. I kept my left hand out to the side, and the gun as close to my center of gravity as I could. I think that the training I had on the air-bearing tables was very representative, especially in yaw and pitch. I felt quite confident with the gun in yaw and pitch, but I felt a little less confident in roll. I felt that I would have to use too much of my fuel. I felt that it would be a little more difficult to control and I didn't want to use my fuel to take out my roll combination with the yaw. We divided our plan so that I would have a part of it on the maneuver and a part of it on the tether. I don't know how far along we were when the gun ran out.

McDivitt Right on schedule when the gun ran out. We planned four minutes for the gun portion of it. We were just about on schedule.

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White I bet we used a little more than four, because I think we came out earlier than we thought.

McDivitt No, I started the event timer to time it.

White Well, this is where my control difficulty began. As soon as my gun ran out I wasn't able to control myself the way I could with the gun. With that gun, I could decide to go to a part of a spacecraft and very confidently go. I think right now that I wish that I had given Jim the gun and taken the camera off. Now I was working on taking some pictures and working on the tether dynamics. I immediately realized what was wrong. I realized that our tether was mounted on a plane oblique to the angle in which I wanted to translate. I remember from our air-bearing work that every-time you got at an angle from the perpendicular where your tether was mounted, it gave you a nice arcing trajectory back in the opposite direction. You're actually like a weight on the end of a string. If you push out in one direction, and you're at an angle from the perpendicular, when you reach the end of a tether, it neatly sends you in a long arc back

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in the opposite direction. Each time this arc carried me right back to the top of the adapter, to the top of the spacecraft, in fact toward the adapter section. One time I was so close to the thrusters back there that I called Jim. I said, "Don't fire anymore.", because I was right on the thrusters. I was even closer than that foot and a half which I had noted to be the length of the thruster plumes, and I didn't want to sit on a firing thruster.

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White We were discussing the EVA and I was saying that I spent approximately 70 percent of my time, it seemed, trying to get out of the area back above the spacecraft in the adapter area.

McDivitt Yes, you intended to go toward the position that was directly over the cockpit. You always arced passed it because you were coming from the front.

White This was exactly right because that's exactly where my tether was connected. Chris had been very emphatic that he wanted me to stay out of this area, and I had agreed to stay out of there. I tell you, I was doing my level best to keep out but the tether dynamics just put me back there all the time.

McDivitt Let me interject something here. When we were talking about the control modes and how we were going to control the spacecraft, we decided on the Pulse Mode rather than the Horizon Scan Mode, or anything like that. The Horizon Scan Mode would leave me free to use both hands to take pictures of you and that way I wouldn't have had to control the spacecraft. But since it

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was an automatic mode and it fired whenever it felt like firing. It didn't give us any flexibility, and this is why I felt that the best mode to be in was Pulse, in case you did get back there.

White That's exactly what happened.

McDivitt I didn't have to worry about the thruster going off in your face. I didn't want the thrusters to fire and they didn't fire because I didn't touch them. It was a wise choice.

White I think this was good. When you look at it from a picture-taking viewpoint, it gave a wider spectrum of pictures. You got different views of the earth and the horizon. I'm glad we weren't held to a specific mode.

McDivitt I think that the picture we did take or the attitude that we started out, which is shown in the newspaper, is just about right.

McDivitt I guess we banked over to the right, I don't know.

White That must have been just as I came out.

McDivitt I don't remember, but it had enough of the ground in the background so that it was certainly

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worthwhile.

White On one of my passes back to the adapter area I got so far back that I was about 3 or 4 feet from the adapter separation plane, perpendicular to it. It was rather jagged. There did appear to be some sharp edges but it really didn't look very imposing to me. I took a picture of it. That's one picture that I believe was good and should come out.

McDivitt The trouble is it was probably set on infinity and you were up about 5 feet.

White No, I set the camera to about 15 feet or so. It might be a little fuzzy because it was too close.

White No, I didn't see the far side of the adapter. It didn't go all the way around. I think I could have pushed off and gotten back that far.

McDivitt No. Better to stay away from it.

White Well, I felt that if I got going I could have swung all the way around and had my umbilical right on the edge, without anything to hold on to or any gun to control myself. This didn't seem like it was at all safe and I had told Chris that I wouldn't go behind the craft. So I didn't go back there.

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McDivitt That must have been just about the time I told you to come back in.

White No, I would estimate this was about two-thirds of the way and about this time I was after pictures. I knew this was a part of the flight plan that I had, in my mind, fulfilled satisfactorily. So I tried to get some pictures and this is where I really imparted some velocities, trying to get away from the spacecraft into a position so I could take a picture. I went out to the end of my tether cord quite a few times doing this. I seemed like every time I would be completely 180 degrees to the spacecraft. I'd have beautiful views of the ground but I couldn't see the spacecraft. It was a definite mistake to mount the camera on the gun. That made it very difficult to use the camera. I had to point not only the camera but the gun with the long thrusters mounted out on the little arms. I'd want to take a picture of an object like the spacecraft, and there were too many loose items to get tangled up in and block the camera. I know my tie-down strap was floating loose. I had left that out intentionally so that I could

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get it later on anytime I had to pull my helmet down. Occasionally when I got in close to the spacecraft, the bag and strings associated with the bag were tangling up around the vicinity of the gun and the camera. And it seemed like the umbilical was right in front of the camera all the time. So, I think the pictures will verify that I was flicking my right arm quite a bit in the latter part of the flight, trying to clear things out from in front of it to get a picture. Whenever I was in a position to get a picture it seemed like I was facing away from the spacecraft. I took a couple of shots in desperation and I think I might have gotten a piece of the spacecraft. But I never got the picture that I was after. I wanted to get a picture of Jim sitting in that spacecraft, through the open hatch, with the whole spacecraft. I know that I didn't get that. In fact, as time went on I realized that I wasn't going to get much of a picture. I was trying everything I knew to get out there and get stabilized so that I could turn around and get a good picture. I just couldn't do this. This was at the time when I was looking

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a little into the tether dynamics, and I actually kicked off from the spacecraft pretty hard. I remember Jim saying, "Hey, you're imparting 2 degrees/second rotational velocity to the spacecraft when you depart." I was pushing the spacecraft quite vigorously. I wanted to push off at an angle of about 30 to 40 degrees to the surface of the spacecraft. And anytime I pushed off from the surface of the spacecraft, my main velocity was perpendicular to the surface. It shot me straight out perpendicular to where the tether was attached. Again, this wasn't in the position that Jim could take a picture of me, and it wasn't too good a position for myself. I usually ended up facing away from the spacecraft.

McDivitt Let me interject something here. In desperation I took the Hasselblad camera and stuck it over out through Ed's open hatch, and asked him if he could see the camera and if he could tell me which way to point it. He couldn't see the camera so he never really did tell me which way to point it.

White No. This was the time that you said, "Hey, get in front of my window." It just so happened that

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I was right up close to the spacecraft and that's when I came over. Do you remember me coming over and actually looking about a foot from your window, Jim?

McDivitt Yes.

White Looking right at you.

McDivitt Yes, I think that was the time the movie camera wasn't going and I was fooling around with it, trying to make sure that it was running.

White Oh, that would have been a very interesting picture.

McDivitt I'm not sure it was going, Ed, because, as you know, we had so much trouble making the left hand one run. We had that trouble throughout the remainder of the flight. You pushed a switch over and it seemed to run sometimes, but sometimes it wouldn't. I kept worrying about whether or not it was running so, I would grab a hold of it to see if I could feel it clicking over. I switched the ON-OFF switch on a couple of times to make sure I could tell the change in the feel of it. I'm afraid this time is one of the times that I didn't have the camera going, because I was trying to make sure that it was

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going. I'm not positive. I hope I got the picture but I'm not sure about it.

White That was the time that I came right in, and I couldn't have been more than a foot from your window, looking in. I could actually see you sitting there.

McDivitt That's probably when you put a mark on my window.

White I think the way I did that--I could actually see you in there and I pushed away with my hands a little bit. I think this was the time that either my arm or my shoulder contacted the upper part of your window and you called me a "dirty dog" because I had messed your window up. You know, as you look back in retrospect, I wish you'd handed me a kleenex and I wish I'd cleaned up the outside of those two windows. I think we could have done it.

McDivitt Yes. We'd have never gotten to the kleenex at that time, but I think we might have done something about it.

White I think I might have but we might have smeared them so irreparably that it might have--.

McDivitt That's right. When you looked at that window of mine from the inside while the sun was shining

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it looked like it was a black paint smear, such as if you'd take a piece of white linoleum and a black rubber soled shoe and made a mark on the linoleum. It had that kind of consistency. It was absolutely opaque. Just as black as it could be.

White Yes, I could tell. When I hit it I could see from the outside that it turned white.

McDivitt It turned black from the inside.

White From the outside it was white.

McDivitt From the inside it was black. When I got the thing turned around a different way with the sun on it, it was perfectly clear as if you had taken the coating off, and what I was seeing was through a perfectly clear surface. So, I don't know really whether the thing was black, that you placed something on the window that would make it black, or whether you'd taken something off that was very white, very thin.

White I smeared the film that was on your window. I'm quite confident that is what happened.

McDivitt I looked at our spacecraft windows after they got it onboard, and I could still see that little hunk of window. It looks to me like what

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you did was remove a layer off the window, rather than put something on it. You took something off it. Except I can't possibly imagine why it was so black and opaque with the sun shining on it at certain angles.

White

I'd like to comment on the ease of operation outside on a tether. If you've ever tried to hang on the outside of a water tower, or about an 8-foot diameter tree, you can visualize the problem I had out there. The decision to leave the hatch open was probably one of the very best that we made. I had nothing outside the spacecraft to stabilize myself on. There just isn't anything to hold onto. I think Jim will remember one time when I tried to hook my fingers in the RCS thrusters. I think Jim could see because--.

McDivitt

I could see.

White

I was right out in front of Jim's window. This gave me really nothing particularly to hold onto. It didn't stabilize me at all. I had nothing really to hold onto, and so if you have ever tried to grasp an 8-foot diameter tree and shinny up it, you know the kind of feeling that I had

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outside there. There just wasn't anything for me to hold onto. One thing though that I'll say very emphatically-- there wasn't any tendency to recontact the spacecraft in anything but very gentle contacts. I made some quite interesting contacts. I made one that I recall on the bottomside of the right door in which I had kind of rolled around. I actually contacted the bottom of the spacecraft with my back and the back of my head. I was faced away from the spacecraft and I just drifted right up against it and just very lightly contacted it. I rebounded off. As long as the pushoffs are slow there just isn't any tendency to get in an uncontrollable attitude.

McDivitt It seemed Ed did hit it pretty hard at one time. I think that was after he pushed off violently; he went out and it seemed he came back and bashed it pretty hard. I remember a pretty solid thump. It seemed it was over the right hand hatch or just right behind--.

White I know a couple of times I kicked off with my feet, and I think I know the time you are talking about. I came in with my foot. It wasn't so much the contact with myself--.

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McDivitt What did you do? Contact and pushoff?

White I contacted and pushed with my foot.

McDivitt I heard a big thump and I think I called you at this time to take it easy.

White I believe that was on the front end of the R & R Section on my side where you couldn't see me.

McDivitt It was a position that I couldn't see.

White One of the pictures that I saw last night in the movies, I think, was made at that time. I was coming in fairly rapidly and I wanted to get back out, so I kicked off again with my foot fairly hard. It was a very good kick. I felt that I certainly could have controlled myself without the gun out there if I had just some type of very insignificant hand-holds or something that I could have held on to. I believe that I could have gone on back to the adapters with a minimum of several hand-holds to go back there, going from one to the other. I was actually looking for some type of hand-holds out there. I remember that the only one that I saw was the stub antenna on the nose of the spacecraft. I could see the ceramic covering over it, I believe it was ceramic, or some kind of covering over it.

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McDivitt Yes, it's white.

White I felt that this wasn't quite the thing to grab onto, this was at the time when I wanted to get out at about 10 or 12 feet directly in front of the spacecraft. I certainly had the urge to hang onto the antenna and push myself out. But I didn't and there really wasn't anything to hold onto. You really need something to stabilize yourself. I worked around the open hatch.

McDivitt Let me ask you a question? How about putting the hand-hold inside of the nose cone? A fairing is up there for launch, just the fairing. We could mount a hand-hold right inside.

White I think we could have really made some money if we had had an attachment for the tether out there right on the nose of the spacecraft.

McDivitt Strung the tether out there and then attached there?

White Right. Have a second attach point and put it right out there. It would give you something to hold onto out there.

McDivitt Yes.

White There wasn't anything to hold onto on the R & R Section.

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McDivitt I know it.

White It had smooth corners and the only thing I could have grabbed was the antenna, and I didn't want to grasp that. We thought one time of holding on out there and thrusting, but--.

McDivitt There isn't anything to hold onto. I think you probably could have gotten a hold on the antenna and held onto it without hurting it. I examined it pretty closely before the launch, and it looked pretty sturdy.

White I thought this was something we needed and I didn't want to fool with it.

McDivitt As it turned out we really needed that antenna because that was the antenna that we used the whole flight--that stub antenna in the nose.

White Yes.

McDivitt When we opened up the spacecraft the hatch came open with a bang. The air that we had inside was obviously of greater pressure than that outside, and we had a great outflow of things including a piece of foam that we had used to pack our maneuvering gun in it's box. It was the first thing that we put in orbit. But then throughout the time that Ed was out, he wanted the door wide

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open. It was pretty obvious that the flow was from the spacecraft to the outside because part-way through his maneuvers his glove floated out and floated away from the spacecraft with a reasonably good relative velocity. The entire time he was out, even after we had the hatch open for 20 to 25 minutes, we were still getting particles floating out through the hatch. It was the flow. The streamlines were very obvious. It was from inside the spacecraft to the outside. I guess the spacecraft was out-gassing at a sufficient rate to cause a reasonably large pressure differential from inside to outside, and it was certainly relieving itself. I noticed this even as we were trying to get the hatch closed. There was still a flow from inside to outside.

White Okay. I think that pretty well covers most of the things that we actually did while I was out there.

McDivitt Now, as for getting back in--.

White Yes, let's go all the way back through and come back in. The time really did go fast! I had watches with me, but I didn't look at them.

McDivitt I was watching the time. I noticed my watch

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around 4 minutes and 6 minutes and 8 minutes.

And then you got involved in floating around as we were trying to get that last picture.

White The time really flew!

McDivitt You kept getting behind me all the time and I became distracted from the time we were on VOX, completely blocking out the ground. Our VOX must have been triggered constantly, because whenever we were on it they couldn't transmit to us.

White That's where the time got away from me.

McDivitt That's right, and it was 15 minutes and 40 seconds when I looked at my clock. So, I thought that I had better go to the ground. I said to the ground, "Do you have any message for us?" because I knew it was time to get back in. And they just said, "Yes. Get back in!"

White Right. I remember hearing Gus say, "Yes, get him back in!"

McDivitt This is what all the fuss was about. They might have been transmitting to us to get back in but we were on VOX and couldn't hear a thing.

White I did a few things after this time that I wasn't doing to deliberately stay out. But I was deliberately trying to do one last thing. I was

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trying to get that last picture. And this was one of a couple of times that I kicked off the spacecraft really hard, to get out to the end of the tether. And I wasn't successful in getting the position so that I could get a picture. I felt this was the one part of the mission that I hadn't completed. Everything else was successful and I wanted very badly to get that picture from outside. I spent a moment or so doing this. This was also the period of time in which I called down to Jim and said, "I'm actually walking on top of the spacecraft." I took the tether held onto it, and used it as a device to pull me down to the spacecraft. I walked from about where the angle starts to break between the nose section and the cabin section. I walked from there probably about two-thirds of the way up the cabin, and it was really quite strenuous. Could you see me walking along, Jim?

McDivitt No, I couldn't see but I could feel the thumping on the outside.

White That's when I got to laughing so hard. This was when Jim was saying to come in.

McDivitt Yes, I think this is when I got a little stern.

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and said, "Get in here!"

White When I was walking on the top and was laughing, Jim probably didn't think I thought he was serious. But it was a very funny sensation. Now as far as delaying, there were certain things that I had to do before I came in. And there wasn't anything in the world that was going to hurry me up in doing them. We had just agreed that we'd do things in a slow manner and this is the way we'd do it.

McDivitt Let me talk about the time here. It is implied in the papers that Ed didn't really want to come back in, and didn't. I think one of the things is that we didn't hear. We didn't have any transmissions from the ground after he stepped outside until I went off VOX at 15:40. They said, "Come back in.", and I told him to come back in. I think that he probably delayed about a minute or two minutes.

White I think so, trying to get the pictures.

McDivitt And at that time I got a little irritated and hollered at Ed, too. Then he started back in.

White But when I came back I had things to do.

McDivitt Yes. I know it. That's what I'm trying to say

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to get this thing in its proper perspective.

White Yes.

McDivitt We were 3 minutes 40 seconds late getting started back in because we just lost track of the time. I couldn't see Ed any longer. I was trying to keep track of what he was doing without being able to see, and I lost track of time. Then I think he delayed probably a minute or a minute and a half before he started back in.

White That's right.

McDivitt So, those are the two delays. We'd agreed on that he'd start back in after 12 minutes. From then on all the time was spent just trying to get back in.

White I had certain things to do. I had to disassemble the camera that was on the spacecraft. I did this very slowly. I had to disconnect the electrical connection to it and hand the camera back in to Jim. Then I had to go out and disconnect the umbilical, and this really went pretty well. The little tether that I had them put on the ring, a pull ring, to disconnect the pin worked pretty well. I disconnected the umbilical and discarded the umbilical cord.

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McDivitt That was the last thing Ed put into orbit.

White Right. I put that in orbit. Earlier, it was really quite a sensation to see the glove floating off. I asked Jim a few minutes before about the glove, or Jim had asked me, "Hey, do you want this other glove?" About a minute later, I saw it go floating out of the hatch.

McDivitt All I can say, Ed, was about a half hour later I was sure thankful that we had gotten rid of something. We had so much other junk that we didn't want.

White I saw the glove come floating out of the right-hand hatch, and it was a perfectly clear picture of the glove as it floated out. It floated out over my right shoulder and out--it looked like it was on a definite trajectory going somewhere. I don't know where it was going. It floated very smartly out of the spacecraft and out into space.

McDivitt I think this had a lot to do with that out-gassing. There was a definite stream--.

White Yes. It was following the streamline right out of the spacecraft.

McDivitt It went out perpendicular to the spacecraft,

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whichever direction that is.

White Back to getting back in the spacecraft--I had the one thermal glove on the one hand, my left hand. I always wanted my right hand to be free to operate that gun and the camera. The way the camera was mounted on there, I had to use both hands -- one hand to actually stabilize it with the gun and the other hand to reach over. Again, I think dynamics played a little bit of a role there. Everytime I brought my hand in from a position out on my left, it tended to turn me a little bit, which is exactly what we found happened on the air-bearing tables. I think that the camera should have been velcroed to my body somewhere and used independently of the gun.

McDivitt Yes. I got that same impression. I got the impression that what you really should have done was--.

White Dropped the gun.

McDivitt Unhooked the camera out there floating around and just thrown the gun away. I don't think you ever should have tried to bring it back.

White Well, what I should have done was fold the gun and handed it to you.

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McDivitt That would have just taken longer. It would have taken precious seconds out of the very few that we had anyway. I think you should have just unhooked it and thrown the gun away.

White This was probably the thing that I was most irritated with not completing. I didn't feel the pictures were satisfactory with the camera outside. But I think the reason was that my camera was not in a position so I could use it adequately. But coming back in was the last thing. As a matter-of-fact, before I dismounted the movie camera and dismounted the umbilical, I folded the gun.

White I took the lanyard off with the camera on it, and handed Jim the gun and the camera.

McDivitt And I stuck it down between my legs.

White That was the first thing that I handed in. Then I handed in the 16 mm camera, and then I threw away the umbilical. This was where the fun started. I found it was a lot more difficult coming back in than I had remembered in the zero-g training. It seemed like I was contacting both sides of the hatch at the same time, much firmer than I had in the zero-g airplane.

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McDivitt You mean you were hitting the hatch on one side and the hatch opening on the other side.

White Coming back in, I was contacting the side of the spacecraft on both sides.

McDivitt Yes, that's right.

McDivitt You weren't really hitting the hatch on both sides, you were hitting the hatch opening on both sides.

White Yes. I was coming down through there. I felt a much firmer attachment wedging in there than I'd remembered from the zero-g training. I think this might be associated with the extra 7/10 or 8/10 pound of pressurization on the suit. I just might have been a little fatter. I did notice that the suit was a little harder. I felt this type of suit before during my pre-work, so this wasn't a surprise to me at all. But I did feel like I was a little fatter getting in and wedged a little tighter.

McDivitt I really don't think Ed was any fatter. I think that link in the suit holds the suit to whatever volume it's going to go to. And I don't think a couple psi are going--.

White Well, I felt like I was hitting a little more as

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i came in.

McDivitt Yes, I think what happened was he was stiffer, and he wasn't bending his legs and his arms any.

White You mean with the harder suit I was stiffer?

McDivitt Harder. And your arms were stiffer and you weren't bending them around as much. It looked a lot more rigid.

White This might have been.

McDivitt Not semi-rigid--Ed was rigid.

White All right. This might have been.

McDivitt And that looked to me like it might have been the problem.

White This might have been part of the recontact on the side of the spacecraft that I noticed. But as I came back in, I noticed that I had to work a little harder, and I hoped the tape was running because I think we had a very good commentary. We were both talking very clearly back and forth to each other during this time and I was telling Jim that I was going to come in slow because it was a little tougher than I had thought. We were talking back and forth about being slow and taking it easy.

McDivitt I actually helped push Ed down in there. I don't

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know whether he felt it or not in that suit.

White No, I couldn't.

McDivitt I reached over and I steered his legs down in, and I sort of got him settled in the seat a little better than what he was getting himself.

White Yes. Right. I was kind of free wheeling my feet up there.

McDivitt Yes. It looked to me like Ed was holding on to the top of the open part of the hatch and just swiveling around that part. It looked like he didn't have enough mobility and strength in his arms to actually twist his body down against the force of the suit into the seat.

White After awhile, I reached my left arm underneath, the same technique we had used in the zero-g training, and actually I had my hands all over the circuit breakers.

McDivitt Yes. Ed was a real hazard to the switches.

White Yes, and I pulled myself down in and that's when I really started coming in--when I got hold of the underneath side of that circuit breaker panel and pulled myself in. That's when my first real progress was made toward actually getting down in.

McDivitt Because, while I could steer Ed from where I was

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I really didn't have the strength to pull him in.
McDivitt It was 90 degrees to the way that he really wanted to be pulling. I could steer. I did do a little bit of pushing, but not a heck of a lot. I wasn't really contributing much to the effort there except--.

White You were guiding me down into the footwells.

McDivitt Yes. That was about it.

White But once I got my hands up underneath the instrument panel, I was back pretty well in familiar grounds--the work that we'd done five dozen times in the zero-g airplane, and I knew the technique pretty well.

McDivitt 10 000 times! White does check pretty well.

White I really did it a lot. Maybe the suit was stiffer, or maybe I was fatter, but I wasn't going in quite as easy as I had before--getting into the initial position to pull myself down into the seat. So it took me a little longer. If you recall, I had to go back out again one time. I got back down and started to wedge myself down and I got two fat cramps at the bottoms of my thighs in both legs, where the muscles started to ball up a little.

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McDivitt Oh? Did you get it in your thighs or calves?

White Both of the muscles in the back of my thighs balled up in a ball and I thought, "Well, I have to go back out and let them straighten up." So, I straightened my legs out.

McDivitt We had that problem before in the zero-g airplane.

White This is the time Jim said, "Hey while you're up, why don't you throw the visor out?" I hesitated a minute because I thought, "Well, you son-of-a-buck, you might have problems here. You might have to be spending an orbit or so trying to get in."

McDivitt No, as a matter of fact, I don't think that is when you did throw it out. I think you threw it out when you came back down and you started to close the hatch. You were having trouble. It wouldn't close, and you said, "I'm going to have to take this visor off so that I can see these things." And I said, "Listen, if we get this thing closed we're not going to open it again. Throw the visor away."

White That's right. That was when I got the cramps, went back up again and then I came back down

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again, and said, "Hey, I can't see them. I'm going to have to take the visor off."

McDivitt No, it was a little bit later than that. You had all ready started to try to close it and you were having difficulty closing it.

White Okay. Let's get the sequence out. We came down in. I got up to straighten my legs a little bit, went back up, then I came back down--.

McDivitt --with all your equipment on--.

White I hadn't held the handle yet, had I?

McDivitt No. You hadn't done a thing with it.

White So I got back down into position--.

McDivitt --with all your equipment on and pulled the hatch down.

White The hatch was down far enough to close at this time.

McDivitt I thought it was.

White I did, too. I felt it was down far enough. I can tell by looking right straight down at the edge--.

McDivitt Yes. I can tell by looking up underneath the right-hand side to see where the dogs are.

White Okay. So I thought the hatch was down far enough to close at that time. I reached up and

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got the handle, but I don't know what I said to you.

McDivitt You didn't say anything. I don't know whether you said anything to me or not, but you didn't have to say anything to me. I saw you move that handle and I saw how easy it was going and I saw that the dogs weren't moving.

White I think I said something. I don't remember what I said. But I said something and you knew right away what had happened.

McDivitt You didn't say a word. I was watching the dogs and that lever and I knew what the trouble was.

White Right. So I guess that's when I said, "I'm going to have to take the visor off because I can't see." And then we went back up and Jim said, "Well, we're not going to open the hatch again. Why don't you throw the visor out." I hesitated for a minute to throw it out because I thought that we might have a problem.

McDivitt Actually, we had a little more difficulty than we had explained. We fooled around for a minute or two or maybe even three or four with the handle. It was pretty apparent to us that we weren't going to get the hatch closed with nor-

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mal straight-forward techniques, and that we were going to have to start going to other things.

While we say that we came down and moved the handle once or twice, it was over about a three or four minute period, at least.

White

The normal method of closing the hatch is for me to come down and wedge myself down, hold onto the little canvas handle up there, and actually apply a downward force on the hatch to help close it. Then with my right hand I use the hatch handle to ratchet the hatch down. This is normally our technique we would always use, and never in the past, has Jim had to help me with the hatch closing device. This wasn't the case this time. As soon as I had gotten up there to operate the gain lever, I couldn't operate the canvas handle anymore. I couldn't apply any torque or pull there because--.

McDivitt

Not only that, but you were actually pushing yourself up off the seat. And I'm not sure that even the first time that we had the hatch closed far enough. It looked like it was closed far enough. As a matter of fact, later on when we got it down to that position it looked like it

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was closed fine. It really wasn't closed far enough because you never did get those dogs out until we--.

White No, the dogs came out, Jim, the first time I got torque on it. Those dogs started out, then it closed.

McDivitt Did they? Okay.

White Yes. I think we had it down far enough.

McDivitt It looked to me like we did, and I couldn't understand why they weren't coming out. I knew that the ratchet wasn't engaged, but I got the impression that it was from watching your hand when you came down one time. You had the ratchet engaged and the little tit pin that sticks in the door that doesn't allow things to come closed wasn't there.

White No, the ratchet wasn't engaged. There was nothing on the handle at all. It was free, completely free. The situation hadn't changed at all. Another thing I'd like to point out now, too, was the chest pack was in the way of bringing the handle down to a full-crank position. And I wanted definitely to do this because you can interrupt the sequence of the dogs if you don't

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fully stroke the handle each time.

White We went back up so that I could actually see and observe the levers. This was the time Jim said to throw the visor out because we probably wouldn't open the hatch again, once we get it closed. And this seemed like very good sound advice to me. The only thing I was a little questionable about was that at this time I had the inkling in my mind that we might spend quite a bit of time getting this hatch closed, and I might want the visor when I was back out again. But I thought the judgment to throw the visor out was best and I threw it out--opened the door about a foot and a half and threw the visor out. The next time we came back down, I was still having the little bit of problem with the cramps, but not nearly the problem I was having with the gain lever.

McDivitt One superseded the other.

White That's right. One problem became of much higher magnitude than the other. So this was the time that we started working. I knew what I had to do. I knew I had to work the gain lever in sequence with the handle again, just like we had when we

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opened it. We both had an inkling that this was going to happen when we opened it the first time. But this posed the problem of when I reached up with my left arm to work the gain lever. It takes a great deal of force. This isn't the direction that the suit is designed to reach in. And it takes a great deal of force to lift your arms up in the vicinity of your helmet to operate something there. In so doing it pulled me back up out of the seat. And I think this is the time that Jim noticed that I was up higher than I had ever been before, and he actually felt that my helmet was up against the hatch. I tend to agree that I was up in that position.

McDivitt Yes. I actually pulled Ed down in the seat by pulling on the--.

White I think so.

McDivitt I did it in steps. I'd pull down and Ed would come down. Then I'd pull some more, he'd come down some more.

White I was actually pushing up with my left hand and my helmet was wedged right up against the hatch. I had a little bit of area in which they actually see the dogs that I was working with up there.

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McDivitt You could see them though?

White Yes, I could see them. At least I could see what positions they were in. I could see the little lever operating under the spring--where I was actually operating the spring on the gain lever. This is where I think we got some very good teamwork, because it was necessary that Jim pull down in conjunction with the time that I pulled down on the closing handle and operated the gain lever. I just hope that the tape worked because I can remember I was in there. Jim was talking to me, and then when it came to the point when we really had to make the big pull I felt a little torque on the handle. I knew that we had it at that time if we could only get the hatch down close enough so that the dogs would engage. And I can remember giving the old--I think I was yelling HEAVE! HEAVE! Is that what I was yelling?

McDivitt I think so.

White And it was in perfect timing, because I could see Jim or I could see the hatch come down each time that I was yelling HEAVE! I think it was probably the most--.

McDivitt The most interesting moment of the flight.

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White Yes. It was the most interesting moment of the flight, but I think it was probably the most, if you want to say, dramatic. I don't know the right word. But it was probably the most dramatic moment of my life. About those 30 seconds we spent right there. The dogs started latching. I could feel them going in, and then I could feel them come over dead-center. Jim called out that the dogs were in.

McDivitt I knew that once we got them moving we'd be all right.

White Yes, once they started coming in. As long as we got those dogs to engage, with the little lever that permitted them to come out and lock, I knew that we had it hacked.

McDivitt Yes. So did I. Even if we would have had to reenter with the hatch in that position, we'd have been all right. I don't think that the heat leaks were that tremendous.

White I knew we could continue and dog it on in all the way. It seems like whenever you know you're right on something, you want to be darn sure that they fix it. This was going through my mind then. And I remembered that I felt I was

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right in that the bar and the attachment on that bar and lanyard were not strong enough. I remembered that and I knew how hard you were pulling on that thing. I think, if nothing else, they ought to be sure. How many times did we break that attachment at the bar?

McDivitt We broke the attachment about three or four times on the zero-g airplane. Everytime they kept telling us it wasn't made out of the right kind of stuff and the stuff we were going to have in the spacecraft would be the right material. Well, it didn't break in the spacecraft. Just coincidentally, or maybe because we both had doubts about the strength of that particular piece. The same thing crossed through my mind. I was thinking that the success or failure of this hatch closure depends on whether this hatch closing device stays hooked onto that spacecraft and doesn't break off.

White We would have been flat out of luck!

McDivitt We would have been in deep trouble! I'm not sure we wouldn't have been able to get the hatch closed, because we had put that canvas strap on there and I might have been able to pull you

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down that way. But I had about all the pull I had in me on that last--

White I know you did.

McDivitt --on that last thing and I had a lot of mechanical advantage over it. When we went to that canvas strap we would have had to go with no mechanical advantage. As a matter of fact, a mechanical disadvantage.

White This is one thing that didn't fail, but I recommend that it be made stronger.

McDivitt Stronger anyway!

White I think so.

McDivitt For nothing else than a psychological purpose.

White Right. I'd like to take the spacecraft now and see if I could break it, because I had the feeling that I never had been confident that that attachment nor the bar nor the lanyard were strong enough.

McDivitt When I say I was really pulling as strong as I could, I really had some pull left in me, but I guess what I should have said is that I was pulling about as hard as I dared pull at the time. I guess I could have pulled another few pounds, but I hated to apply more than was needed on

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there because of the lack of confidence in the strength of it.

White Everything I had was in it over there. I was pulling down with my legs as hard as I could and operating. I was pulling on the handle. I remember one time you said, "Hey don't pull on that handle so hard! You're going to break it!"

McDivitt I was cautioning you to take it easy, which you don't usually have to do.

White This was when we were yelling HEAVE! I was heaving on the handle as I was pulling it down each time. It felt like to me that the handle was giving. But I didn't give a darn! If it broke, it was going to break. So one of the points we learned out of this was we'd like to see the bar and lanyard strengthened.

White Let me say one thing about the decision to go ahead and open up the hatch. If we hadn't done so much work together with this hatch and run through just about every problem that we could possibly have had, I would have decided to leave the hatch closed and skip the FWA when we first started having trouble with it. We had encountered just every conceivable problem that we could possibly

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have with that hatch. If it failed we'd know exactly what it was.

McDivitt That's right. I personally had disassembled this cylinder and piston and spring combination up at McDonald prior to the altitude chamber, so I knew exactly what it was made of. I am sure the problem was that the dry lubrication coagulated, or whatever a dry lube does, and was causing the piston to stick. I knew how we could do this thing. Carl Stone and I had dismantled it and put it back together, cleaned it out, put it back together, relubricated it, put it back together, and it operated fine. I figured out how to make the thing work with it not working properly by using your finger as the spring.

White That's the exact technique we had used.

McDivitt If we hadn't had the training together that we had, and had not encountered all these problems before, I know darn well I would have decided not to open the hatch.

White Maybe we wound overdramatic about the effort we made getting me back in, and I'll honestly say it's one of the biggest efforts I ever made in my life, but I don't think we were all done then.

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McDivitt There were a lot of things we could do.

White We could have gone around several orbits working on closing the hatch. That wasn't the last time we were going to get a chance to close it. So, there were things left if we understood, and other procedures we could have used to go ahead and close it. When we got it closed back in, I was completely soaked wasn't I?

McDivitt Yes. You were really bushed.

White Sweat was just pouring down. In fact, I could hardly see. It was in my eyes.

McDivitt So I told you, "Just sit there and I'll get a repress. Don't even move for 30 minutes."

I just left the repress valve where it was. I closed the vent valve and we had a lot of instructions from the ground to close the water seal and a whole bunch of other things that didn't make any sense to me. I knew that the spacecraft was repressurizing. I watched. There wasn't anything else that we had to do right then, and we were both bushed, especially Ed. He was perspiring so that I could hardly see him inside the fact plate. So, I just said, "You sit there and I'll sit here and we'll just coast around.

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When we get the thing repressurized, we'll start doing something." That was exactly what we did. I did finally extend the HF antenna and try to call somebody on HF and let them know that we were back in safely and that the thing was repressurizing. I didn't get any response until we got to Carnarvon, which was about three minutes later. I called and told them that we were repressurizing and had the hatch closed.

White You know, that was some pretty good gage reading that we saw when we got the first 1/2 psi.

McDivitt The first 1/2 psi. Ha! Ha!

White That was really a big one. Since we've described the whole operation we'd like to go back now and specifically point out the pieces of equipment that we used and our opinions of them, a few features that came out loud and clear to us in operation, general conclusions on EVA as an operation, and what we have to do to make it an operational procedure. So the first thing I'll do is go down through the equipment. As an overall comment on the equipment, I would say I felt very confident the equipment would do the job. And without question the equipment performed

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as it was advertised. It performed just exactly as it had been designed. There wasn't one thing on them as far as the VCM, the umbilical, the gloves, the gun, and the visor that didn't perform just exactly as it had been designed. I'll take them all one piece at a time, and discuss them a little. I'll start right with the visor. The visor was a rather controversial piece of equipment from the beginning. And I, for one, doubted a little bit the necessity for quite the protection that we were providing, although I had helped right from the beginning in the design with some of our ideas on the visor. It turned out though, and I commented on this during the time that I was out, that I was very happy to have the visor, I was able to look directly into the sunlight. I did so in installing the camera on the back of the adapter. I felt that the vision out of the visor, was about as it would be on a normal sunny day. This is because it is so bright up there in space. I felt as if my vision was what I would consider normal. I was looking at the different parts of the spacecraft and down at the ground, and

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the view that I received at this time was what I would expect on a normal sunny day. I was certainly glad to have the visor and I left it down throughout EVA. I think on a later flight we might recommend going ahead and lifting the visor and observing any changes we might see in visual acuity when looking down at the ground. the ground vision through the visor really didn't seem to me to be degraded at all. Evidently just the intensity, and not what I was seeing, was cut down.

McDivitt Let me comment a little bit on that visor. I didn't have a visor and the bright sunlight that was in the cockpit didn't seem to bother me. I imagine that the visor turned out just like a pair of sunglasses. You go outside on a normal day and wear a pair of sunglasses. If you don't have them, you're squinting. But if you start out without them you tend to get accustomed to it. I think I was accustomed to what light there was coming through the spacecraft, admittedly much less than that outside. Ed was accustomed to the sun visor and it turned out just like two people with and without

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sunglasses. They both could have adapted. I didn't look into the bright sun straight ahead.

White Well, the first time I looked into the bright sun, the first thought I had was, "Boy! Am I glad I've got this visor on!"

McDivitt I know you mentioned it on the radio.

White --because I was looking right straight into the sun. I had to look into it to attach the camera onto the adapter section. I don't normally wear sunglasses. As you know, Jim, I have never worn sunglasses very much, and I didn't notice it from then on, through the time I was out. I had no impulse whatever to lift my visor. My vision was as clear as I could have expected it to be without the visor. There are a few design points in the visor that we could make better and I'll briefly go into them right now. When you are seated in the spacecraft one visor slips up underneath the other and back along the back of your helmet, so that instead of resting on your helmet on the headrest you're resting the visor on the headrest. You certainly don't want to do that. The visor should be restrained in some manner from slipping up along the back of the

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helmet. Also, my visor was quite difficult for me to raise and lower. Once it was down it fit quite snugly, for which I was happy. But it was difficult for me to raise and lower. It was actually a two-handed operation, which is one of the reasons why I didn't raise it outside; although, I had no impulse to raise it when I was outside. I think that we might be able to design them to be raised up and down more easily.

McDivitt Let me make a comment on that visor. I never did see any need for the little lexion visor.

White That's exactly the point I was going to get to next. I think that one single visor made as close to the helmet liner as possible, providing the maximum amount of headroom and a minimum amount of interference, is what we actually need. I don't believe we need that lexion outer visor. As they pointed out to us, it doesn't really protect, because it bows in and it doesn't really give you the protection that it should be affording. I would recommend one visor, one sun visor only. It'll be simpler to operate.

McDivitt I think so, too.

White Okay. The Ventilation Control Module, I can say

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without qualification, worked exactly as it was planned to work. There was not one complaint that I had with it. It provided me with the proper flow. The flow was less than with the normal ECS suit system, but it was adequate to keep me cool and ventilated, except for two times during the flight. Those times were when I attached the camera right before departing the spacecraft and reentering the spacecraft. But I think it performed without fault.

White

The umbilical was another item that I thought performed its part of the flight quite well. I had no complaints about it. I did tend to get it tangled up with the bag and the strings that were attached to the bag during EVA.

White

I am very thankful that we decided to design the gloves in the manner in which we did, the two-piece glove that was easily donned or doffed under pressurized conditions. As it turned out, I took them on and off twice while pressurized. I was quite happy that we had them designed in this manner. As it turned out, the heat on the side of the spacecraft, or the cold on the side of the spacecraft when we came out of the dark

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side, were not noticeable to the touch at all. I didn't use a right hand thermal glove at any time during the flight. I took it off when I was opening the hatch and, as I pointed out earlier, it floated off during the EVA operation. I didn't have opportunity to use it again if I had wanted to. Coming back in we had difficulty closing the hatch, and I, at this time, removed my left hand glove and used the plain pressure suit gloves for this operation. The pressure suit gloves were comfortable. In fact, there were no sensations of either hot or cold through my gloves.

White

The gun, I think, was an outstanding point in the flight, a highlight of the flight. It worked just as we had felt it would work and it was, I felt, simple to operate. The training that I had on the air-bearing platform provided me adequate orientation in the use of the space gun. I think that now that we have a little more time to prepare ourselves for the next time we use this gun, training with it on zero-g flights would be appropriate. I don't believe we will have any trouble using it in the zero-g aircraft.

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White One mistake that we made on our EVA equipment was the mounting of the Contarex camera. This camera should have been attached by velcro to me, so that I could use it independently of the gun. It would have been easier for me to use and I would have had a much higher probability of getting satisfactory pictures with it. It was a case of lumping too much together--putting the gun and the camera together.

White The attachment of the VCM to the harness was a good type of attachment. It was easy to disconnect the two velcro attachments and move the chest pack in and out. I had to do this both when I opened the spacecraft hatch, so it would clear the hatch handle, and I had to move it out of the way when I closed the spacecraft and pumped the hatch handle.

White Now we can get into some conclusions. While I was out, I decided to put a piece of velcro strip on the side of the adapter to see if later on we might use this as a method for attaching items on the outside of the spacecraft, if the velcro was still there and if it was in good shape. I think the velcro could be made into a very useful item for

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a type of tether. I think you might even be able to do something along the line of just having some female velcro on the gloves and pieces of the male velcro at points along the adapter. This might provide us at least some attachments so that we could maneuver ourselves back to the adapter section. This would be about the simplest kind of handle that we could use. I do believe that we need some type of handles on the outside of the spacecraft. Jim suggested one on the nose and in the cover on the R & R section up there. I think this is an area that we certainly have a possibility of using. I certainly would have found it useful. I would still be a little hesitant, though, of breaking the antenna. You would want to be sure that this wouldn't be broken during EVA. I think the feeling I had out there, again, was like holding onto an 8-foot tree. There wasn't anything to hold onto. You definitely need some kind of hand-holds. The decision to leave the hatch open was one of the best decisions that we made. It provided me with a center of operations for my work. I was able to stabilize my-

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self by holding onto the hatch. It was also surprising to me how much force it took to open the hatch the first time against the preload and the actuators, due to the seals. One other very good decision was to have me wear the heavy suit and Jim the light suit. I think this was one of the things that made our operation easier. It certainly made my getting back in the spacecraft and Jim's assistance in closing the hatch much easier for him. Also, I was handing him things in and out. He was performing quite a bit of coordination in the operation with pieces of equipment that were going in and out of the spacecraft, and I believe that by being in that light suit he was able to do this much easier than if he had been in a heavy suit.

McDivitt I might make a comment on that suit, too. When we opened up the hatch we were in a vacuum. I noticed that the temperature of the suit dropped slightly so that the suit was a little bit cooler inside. I was wondering if I was going to get too cold through the suit, but the rest of the time we were out the the temperature never changed. I don't remember looking at the suit

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inlet temperature, but the suit itself stayed reasonably warm. I had sun in the cockpit and I had the cockpit open without the sun in it for a relatively long period of time, four or five minutes at a time. This didn't seem to affect my temperature inside the suit.

White I think you felt the temperature more than I did.

McDivitt I felt the temperature go down, rather than up.

White I felt that also while outside. I would say it was very comfortable figure. I figure that I was probably at 68 degrees temperature out there inside the suit, which was cooler than I had been anytime during the flight. It wasn't a cold feeling, just a very natural comfortable temperature.

McDivitt Suit inlet temperature was running about 55 degrees during most of the flight. It got down around 52, so it probably might have even been cooler than your 68.

White Well, it was cooler inside the suit when I was outside the spacecraft than at any other time during the flight. It wasn't uncomfortably cool there at all.

White I think that we can go on with some conclusions.

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Some conclusions that I had were:

1. I didn't notice any extremely hot temperatures on the outside of the spacecraft. I also didn't contact surfaces for any period of time to transfer much in the way of a heat load to any part of my suit including the gloves.
2. There's a definite requirement for some type of hand holds outside the spacecraft.
3. We should think a little more on where we want to operate during EVA and where to attach the tether. The tether was not attached at a point that would provide me the capability to operate in the area that I wanted to.

McDivitt You couldn't get to the nose. It provided great operation for directly above.

White Straight above.

McDivitt I just don't know how you would get the thing out there. You would have to run it along the spacecraft, then attach it somewhere at the front.

White It would preclude operations in other areas. You would either have to accept where we are going to operate or--.

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McDivitt You could have multiple attachment points around the spacecraft.

White Of course, now, if you have a gun with a good air source, I wouldn't particularly care where it was attached. I think you could go ahead and, maneuver to any point you want if you have a gun. Again, when you're pushing off of surfaces, you tend to go perpendicular to the surface from which you push off. I found when I pushed as hard as I wanted to I'd still tend to go straight up above that hatch instead of out toward the front. I think this is a fairly obvious conclusion, but it proved out. Everytime I pushed off I went straight up instead of at an angle to the surface where I wanted to go.

McDivitt Something that you should bear in mind is that you were pushing off from the front which tended to make the front go down as you went out.

White Yes. Everything was working against getting where I wanted to go. Everything I did tended to put me up.

McDivitt When you started you went in a straight line forward and tended to push the spacecraft down.

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I think, initially, where I was holding the attitude, you didn't have that much trouble. Of course, you weren't pushing as hard either, because you had the gun.

White No, I wasn't.

McDivitt Later on, when we started free drifting, you were back behind me where I couldn't see.

White Did you feel me stomping around back on the adapter and hitting the adapter.

McDivitt Well, I felt you hitting things back behind me and once you went behind the line that was directly overhead the spacecraft. I couldn't see you through your open hatch.

White I never really had a good contact with the adapter back there.

McDivitt Just as well. We wouldn't want to disturb those radiator tubes too much.

White No. Well, now that we're back, we'll have some conclusions on the adapter area. I made it a point right from the beginning to take a look at the thermal lines, the thermal paint on the adapter. It looked like it was in good shape. It was all there. There was discoloration around the attitude thrusters, particularly,

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from the thrusting. The color of the thrusting is just like the RCS thrusting--nice and clear plume. It looked like from outside, though, that I could see a lot more of the plume than I could when I was sitting inside the spacecraft looking out at the RCS thrusters firing. Again, the camera was not attached in an opportune manner to operate.

McDivitt Which camera? The camera on the spacecraft?

White I'm really after that camera on the gun. That one wasn't attached good.

The camera on the spacecraft was okay. It was a little difficult to attach because of the attachment on the bottom of it. You can't have it at any angle to make it engage. It has to be perfectly flat with the mounting plate on the bottom. A big conclusion that I came to--and I'll see how you feel about this one, Jim--I feel that storage in the back of the adapter section was certainly a very high priority for later missions. I feel that we can adequately store equipment in the adapter area, particularly larger pieces of equipment that we don't have room for in the crew station or pieces we don't

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have particular use for in the early part of the flight. If we can lick the problems in opening and closing of the hatch, we can store equipment in the back of the adapter section as a routine operation.

McDivitt That's right. I think the extravehicular activities have proved to other people what we all ready knew a long time ago--that EVA is quite simple. I think the thing we've got to iron out is the hatch opening and closing. This is really our problem. I don't think you or I will ever have any doubt about the extravehicular activity. That was, I thought, going to be pretty straightforward. It looked like to me it was pretty straightforward.

White I felt that I could operate equipment out there. I could assemble equipment. I could put pins in, pull pins out, and screw things in. I did all these things during the flight. I turned the gun on, and I put in the pin to operate the umbilical guide. I attached the camera. I don't think you could do these operations very effectively with big heavy gloves on. Although my gloves operated satisfactorily, I think that for

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assembly of items you want to have--you ought to look into the glove area a little more thoroughly and try to get a piece of a glove with some type of a surface that will give us some heat protection and gives us a high sensitivity of feel through it. The big conclusions, the final conclusions, that I'd like to draw are that EVA can be made a normal routine operation if the following modifications are made to the spacecraft:

1. The highest priority is that the spring back there on the gain lug has convicted itself and I don't believe that that's a good design. There should be some way that either the lubrication is made foolproof or the spring made stronger.

McDivitt I think what we really want to say here is that the locking mechanism is inadequate as it is, completely inadequate. Until it is fixed, I think we should take it easy.

White That's right. I think we almost had a bad experience with that gain thing. We knew about it ahead of time. We thought we had it fixed, but it's not fixed. I think it convicted itself and it's

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guilty and it has to be fixed.

2. I recommend that at least the egress kit on the right of the crew compartment be removed to provide more room in the spacecraft. I see no reason for it being in there. I think it would be worth the effort and the additional money to provide the extra room in the spacecraft. So, my second recommendation on EVA is to remove the egress kit, at least from the right-hand side, to provide more head room.

McDivitt Yes, that's good. I might add that it's a good thing that we had that egress kit modified to the minimum height, because without that we would have been in deep trouble.

White That's right.

White Yes. You and I had been telling each other that that was the biggest thing we did on our whole nine months prior to the flight--to get that thing cut down. I think it sure paid for itself on our flight.

3. My third item is to make the bar and lanyard completely foolproof in strength. That was a device that provided us with the added force

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we needed to close the hatch, just as we sat there and said we might need during the SAR of the spacecraft in St. Louis. I think the attachments of the bar and the cable to the spacecraft should probably be at least doubled in strength, so there just isn't any question in the pilots' minds or the engineers' minds. I guess the engineers were convinced that you didn't have Jim and I convinced that those two attachment points--.

McDivitt We've seen it break too many times, I think.

White We've broken the bar and we've broken that attachment point. I had actually physically twisted the attachment right off the spacecraft up in the zero-g airplane. I certainly wouldn't have put my full strength into it if I knew my life depended on that attachment. It should be made absolutely foolproof.

McDivitt Well, that was the point I was trying to make earlier when I said I was pulling as hard as I could. Then I said that I really wasn't pulling as hard as I was capable of.

White You didn't have confidence in that attachment.

McDivitt I didn't really think that I should pull on it

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any harder.

White No. I think that should be the third recommendation and it should be corrected.

McDivitt I think we could spare a couple of extra pounds of weight there, just for the pilots' peace of mind.

White That's right. Take the time it takes to put a new attachment on there. They told us they didn't want to do it because they'd have to re-rig it. I think they'd better re-rig it and take the time to put a good attachment on there.

4. The final thing really doesn't fit in with the first three recommendations, but I would sure like to have the opportunity to use that gun again with about a 10-times supply of oxygen in a great big canister. I think that maybe this is one of the items we could carry in the back of the adapter. We could use a small supply to provide the means to go back there to get a great big canister. Then we'd have a unit that we could actually do some maneuvering with.

McDivitt That's right. I think that, in essence, we proved the usefulness of a self-stabilized or a

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man-stabilized maneuvering unit--

White Yes.

McDivitt --rather than one that is gyro-stabilized with automatic stability features. I think that although you didn't burn up a lot of fuel, you certainly proved the feasibility of this type of maneuvering unit.

White We had an awfully small amount. We just had the 6 feet/second--

White We proved, in my mind, that I had the capability to go from Point A to Point B with that maneuvering unit.

McDivitt Let me ask you this question, and be honest about it. Would you detach your tether and go without it? Don't be too optimistic, because other people's lives may depend on it.

White I think that we probably have not done enough investigation to do that at this time, but I feel we are progressing toward the point. We made the first, say 50 percent, of the step toward being able to detach the tether and go. I don't believe that I would detach the tether and go with that 6 feet/second--.

McDivitt Oh, no. I didn't mean that. I mean with that

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type of a unit.

White If I had some more ΔV in a unit like that I think that I would be willing to detach myself on the next flight, right now, from the spacecraft and go. That's combined with two things, you see. You have two things working for you. You have the capability to maneuver yourself, and if you should get out of control the spacecraft still has the capability to come over and get close enough so that you could get yourself back in control and get in the spacecraft.

White I think that 40 or 50 feet/second would be a minimum. I had 6 and I'd like to see, probably, a capability of about 10 times that. That may be a little--.

McDivitt It's difficult. I would think it would be difficult to fix a number on it until you fixed the job.

White Yes.

McDivitt If you wanted to go to something that was 10 feet away and come back, you'd probably get by with 20 feet/second.

White If I wanted to get out of the spacecraft and go along to the back of the adapter and get in the

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adapter without being attached to the spacecraft, I'd only need two or three times the amount. I'd be happy to go with that.

McDivitt There are some problems in the capability to align one's self onto an object. I think chasing the booster around points this out. You say you'd be willing to go away because the spacecraft can come and get you. Admittedly it can, but keeping in mind the difficulty we had with the booster. I don't really anticipate us ever getting into the situation like that because you'd never get so far away that you're in different orbits, like we were with the booster--.

White What I visualize is a 25 to 50 foot operation where you're going out to investigate either another spacecraft or another satellite up there, or making a transfer similar to the type of transfer that we visualize as a backup mode for Apollo. I think with the gun I had, if the LEM and the Command Module were there, I'd be satisfied to depart the Command Module and maneuver over to the LEM situated 10 to 20 feet away from the Command Module. I feel I could do that at the present time. I don't think it would be a very smart

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thing at the present time to go maneuvering off 200 to 300 feet away from the spacecraft with this type of device. I think this device is designed and has its greatest usefulness in close operation around the spacecraft.

McDivitt That's right. There is no need to maneuver off about 400 or 500 feet away because if you want to go that far, use the spacecraft. This gun is for a close working job.

White I think it's a valuable tool in this manner.

McDivitt Okay. That's the same conclusion I came to. We'd be willing to do it at close range.

White I'd be willing to do it right now. I might not go tell somebody else to go do it, but I'd be willing, with the training that I had with it, to transfer 15 or 20 feet without a tether. But, I think we should spend some more time with the gun.

McDivitt I think so, too.

White I also think it would be of value to go in the zero-g airplane with it.

McDivitt Yes, I think so, too.

White I think the work that we might do in the zero-g airplane doesn't necessarily have to be done in

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full regalia, with all the pressure suits in a pressurized condition. I think we can go up there and learn a lot about the gun without pressure suits on, in a plain flying suit type operation. Perhaps polish the training off with a little work in pressurized suits. If you work in the zero-g airplane with a pressurized suit it's pretty awkward.

White In pitch and yaw I felt I could maintain effectively zero rates. I don't know how it looked to you Jim, but it looked like I could establish a rate and take the rate out without too much trouble. The yaw is the lowest moment of them all. Pitch was very easy, just to pitch the thing up and down. I'm still a little suspicious of roll. That's the area that I would like to look into a little more. I think that you could get yourself into a kind of balled up situation with pitch, roll, and yaw all coupled up. It might take a little bit of fuel to get yourself straightened back out again. But just in translating from Point A to Point B, you could care less if you rolled, as long as you kept pitch and yaw straight. And that's why I say I think you can

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translate and correct pitch and yaw very successfully and effectively forget about roll, just as we do in our reentries or our retros.

White

The question is: Was there any problem with the gun of maintaining a fairly well stabilized attitude and still get my translation input? I did this actually three different times and this was what I had done when I was coming back to the spacecraft the last time. I had to put in both pitch and yaw and had taken them out and I was coming back. I was going to fire my last thrust toward the spacecraft. I got a little burst. I could feel a little burst and then it petered out. But you can put a translation in. I was also surprised that I was able to stop at the time I tried to stop it out there about one half or two-thirds of the way out on the end of the lanyard. It seemed to stop pretty well. It was either the gun or the lanyard dampening me. It didn't dampen me in roll, so I think it was the gun that actually did it.

McDivitt

I think that this previous bunch of words just spoken covers a lot of detail, of the first three or four orbits of our flight, and it covers

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that first phase of mission sequences that I first mentioned. I think the next thing we should do is go through the interim orbits, about 50 or 55, or however many there were, where we set about to save up enough fuel to do something constructive, to check on our orbit to see what it was, to see how we were decaying, what our lifetime expectancy would be, and perform the experiments that we'd initially set out to do on our flight plan. Although, it's not going to be of much use to go through it in a chronological order, I suppose that is probably the best way. As I just finished saying, we're not going to get an awful lot out of going through the flight plan sequentially, but we'll do it quickly and then we'll come back and discuss each experiment or operation, check as entity in itself, and we'll discuss the systems as an entity, too. We'll do this, generally, in elapsed time.

McDivitt Going back to the EVA for just one moment. I'd like to say that the use of the manual heaters on ECS O₂ bottle was about two five-minute periods separated by about 10 minutes. We really didn't need an awful lot of manual heater when we

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were doing the extravehicular activity.

4.3 Other Orbital Operations

McDivitt Let's see. One thing that we did was to turn off the ES Sensor at 6:35. You have notes along here?

White I got all the Sensor stuff down, I think, pretty well.

McDivitt Okay. I have the ES Sensor and the Bio-Med Recorder No. 1 going off at 6:35.

McDivitt At about 7 hours elapsed time, I checked the OAMS fuel remaining. We had about 62 percent indicated, 2100 psi, and 88 degrees temperature. We kept getting our GO and NO GO checks as per flight plan. At about 7:30 Ed went to sleep.

McDivitt We didn't do any lifetime adjust maneuvers. I turned the spectrometer-magnetometer on. This was while Ed was asleep. Extended the boom, got the ES Sensor on, and we left the spectrometer-magnetometer on for three passes through the South Atlantic Anomaly. I couldn't really see any increase in the ammeter when we extended the thing. We went through a number of extension cycles throughout the flight to make sure that we got the thing out. At no time during the flight did we ever see a rise in the ammeter when

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we extended it. The way it operates is, it has three positions: EXTEND, OFF, and RETRACT. It was in the OFF position and I put it to the EXTEND position. Then I put it back to the OFF position. Periodically, throughout the flight we put it to the EXTEND position and back to OFF to make sure that if it got screwed up the first time that it would go on out. The first extension was supposed to be with the spectrometer-magnetometer on. So, I checked to see the circuit breakers were on, and they were on. I turned the spectrometer-magnetometer on and then I extended the boom. And in this way the experimenters hope to get some indication from the lines of force that they were picking up if the thing actually extended at that time. I hope they got it.

White Incidentally, you got a pretty good operation on the swizzle stick. I was asleep and Jim was doing that on my side.

McDivitt That's right. I did it with the swizzle stick way over on Ed's side. I didn't aline the platform or anything. We were in free drifting flight at this time. As soon as we finished the

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EVA we went into free drifting flight. We powered down the platform and the computer, shut off the attitude indicator lights--we went through a complete power-down procedure. We were really trying to save battery power, CAMS fuel, and everything else we had. We went on a complete power-down, down the checklist, and we just didn't have anything on.

McDivitt And we stayed in this free drifting mode for about two days. That right, Ed?

White Closer to 2 1/2 days.

McDivitt Mostly for the first 2 1/2 days we were in a free drifting mode. We didn't do the platform alignment and the translation at around 8:10--8:20 in the flight plan. We did not obtain any booster-star measurements. As a matter of fact, I'd like to comment on the booster-star sightings, or just the booster sightings. We saw the lights of the booster definitely on the first pass as we were tracking it. The second pass, as Ed said, he saw them, and he said he was sure he saw them because they were flashing. I was pretty sure I saw what he was talking about. However, this occurred just at sundown. Every other time at

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sundown we'd call out the booster a couple of more times before we finally figured out that this was not the booster, but a planet.

White One or two times I'm fairly confident I saw the booster.

McDivitt You're pretty sure you saw it?

White Yes. That was the booster.

McDivitt Well, I was pretty confident that I saw it flashing, too. But later on I watched that star, that particular planet, come up. I sat right there and watched it, and it flickered as it came up through the atmosphere.

White Yes, I agree with you.

McDivitt So, it could have been that we were just really looking for the booster and at that particular time we looked out and saw this thing and it flickered. I spent one whole sunset doing nothing but keeping my eye out for that planet. Sure enough it popped up and I saw it.

White But, you know never flickered.

McDivitt It flickered. I watched it as it flickered. It flickered all the way up . I watched the thing as it set, and it flickered all the way down-- the last at 10 degrees or so. This is exactly

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where we thought we were seeing the booster, right where it was low on the horizon, as you would expect to see a booster. That old thing was flickering away like mad.

White I think that was Venus, too.

McDivitt It was the planet that was trailing the sun by just a very slight amount. I made it a point to check during the remainder of the flight, two or three times to see if that thing flickered as it came up. It really did. So, the more I saw it flicker the more I began to doubt that we had really seen the booster on that second pass. Maybe we did, and maybe we didn't.

White Well, it's not really too important.

McDivitt No, it's not. But the fact is, that little planet was flickering away like mad.

White Let me ask you one more question about the flicker. Did you see it coming up through the air glow? Was that where you felt it flickered?

McDivitt Yes.

White Everytime it was above the air glow it was loud and clear to me.

McDivitt Yes, except that you couldn't see the air glow as the sun was setting.

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White That's right.

McDivitt Initially you saw the sun out there and you saw this thing looking like it was flashing. Once it got above the air glow, the planet did not flicker anymore. It was perfectly bright.

White Very bright.

McDivitt When we saw that thing that looked like the booster, it was very low on the horizon. It always popped out. Remember how that bright light used to pop out? You'd have the light sky and all of a sudden there'd be a bright light there.

White We saw that planet come up so many times during the flight, I feel quite convinced that the first sighting or two weren't of the planet.

McDivitt Well, maybe it wasn't.

White Actually, I continued to see the blinking on it after the stars were out.

McDivitt Wait, let's take a look and see which way the booster would be. The booster was below us so it should be going out in front of us like mad. You're looking into the sunset which was behind us. The booster shouldn't have been there. The booster should have been out to the front of us.

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It should have been in the opposite direction.

White I'm not convinced which way we were looking.

McDivitt We had to be looking to the rear. The sun sets to the rear. We had to be BEEF to see the sun when it set. You see, you're BEEF to watch it set.

White Were we BEEF for the full time or were we in free drift?

McDivitt We were in free drift but this was near the sun when this thing came out.

White No, they always come out loud and clear when you're away from the sun, when you're looking away from the sun.

McDivitt Yes. I know it, but at that one time when you said, "There's the booster.", you were looking at the sun. Remember, I had turned around? They told us that they wanted us to be BEEF and heads down when we opened up the hatch. That's where we were. I turned around to be BEEF. We were BEEF when we saw that thing.

White We'd better look at the tapes. I think we can probably get better information on this when we check.

McDivitt I think we were even looking in the wrong dir-

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ection. The next pass around I called out and said, "I see the booster on top at 9 o'clock, perpendicular to our flight path." I don't think that was the booster either.

White It's kind of academic.

McDivitt Yes.

White The reason that I brought the thing back up again is I wanted to be sure it's brought out that the planets are so clear and so bright, even far more brighter than they are looking at them from the ground. Looking at them up there, it really is striking the first time you see them. If we took a lot of pictures of anything, it was a picture of that planet.

McDivitt Sunrise and sunset. The sunsets all had the planet in it.

White That's right. That planet has always been there.

McDivitt Very pretty.

White It certainly was.

McDivitt Okay, I got a call after Ed went to sleep that we were going to pass by Typhoon Base which would be north of track, at 7:56.

White I wasn't sleeping. I heard it.

McDivitt Did you? Okay. Well, I didn't have any fuel to

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point the spacecraft at Typhoon Babe so that was that. If I had drifted around so I could see it, I was going to take a picture of it but I never drifted around so I could see it. I just passed on by. A little bit later on, I was called up and told that at 23:55 GMT my ascending node would be at 83 degrees East on my 6th Rev. This was just a map update. I was told I should eat at some particular time. I think it was 00:15 to 01:00. It was already past that time, so, I ate when I felt like it. The pilot was supposed to do a No. 1 Aero-Med Pass at 02 17 43. This was the first instance of us running into a case where a man was supposed to do an aero-med pass when he was asleep. This continued on intermittently throughout the flight.

White It seems like I was always asleep when I was supposed to be doing an aero-med pass.

McDivitt This continued on intermittently during the flight. As the flight progressed, the doctors got more coordinated on the ground and we got more coordinated with them to tell them who was sleeping and how long we were going to be

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sleeping. We had less requests for aero-med passes of guys that were sleeping. We, in general, refused to wake the other person up to do an aero-med pass. We were told by the doctors and the flight planners on the ground, that at 02 30 59 we were supposed to turn on D-8. Now, I don't know why we had to have this to the nearest second. I was also supposed to go to sleep at this time, to the nearest second. It seemed a little academic to me. So I woke Ed up at 02:30 Greenwich Time. He turned on the D-8 Experiment and I didn't go to sleep until I did something else. I think I had something to eat but I'm not real sure. But I didn't get off to sleep right away. Then I told Ed he was supposed to turn that MSC 2 and 3 off at 03:00. I awoke at 06:15. But what happened in between that elapsed time, Ed? Shoot, that's not right --

White 06:15?

McDivitt I must have awoken --

White About four hours is what you had.

McDivitt Right. Looking through my notes here I see that I wrote down "Awake at 06:15," and I

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didn't get to sleep at 2:30 and Ed didn't wake me up at 6:15. So I guess we were down from anywhere from 3:30 and 4:30.

White Right. You slept approximately four hours. I let you go about 30 or 45 minutes after that time of 6:15, as far as getting you up. While you were asleep, the things that I did: I believe that I had a meal which you had gotten out. I believe we had one before this, though. Didn't we have one after MVA before I went to sleep? Or, did I just drink a lot of water and go to sleep?

McDivitt No, I think we had a meal before you went to sleep.

White That was my second meal that I had shortly after I got up. I believe they called and asked me to give them an aero-med pass, which I don't have the time logged on. I imagine the medics will have that. I ran through a D-8 Experiment at 02 30 59. The MSC 2 and 3 recorders were supposed to come off at 3 o'clock, but I didn't turn them off til 04 19 40. It didn't seem like that was particularly important anyhow to get them off. I guess that's

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why I didn't think about it. I got instructions from the ground to maintain the oxygen pressure at between 930 and 960 with the O₂ High Rate. This is the time I told them that the Command Pilot was asleep and I'd prefer to do it at a later time. I think they called me back a few times on it; finally, when it got up to about 960 I went ahead and dumped it.

McDivitt It scared me to death!

White The O₂ High Rate started filling the cabin up, pressurizing it up around 5.4. At 5.4 on the button the vent valve relieved and Jim about came through the top of the hatch.

McDivitt I was there half asleep with my gloves off, my visor down, and a cover over. The cabin vented and the cabin pressure dropped about 3/10 of a pound. I knew that I didn't have my gloves on and I figure, "Boy, I am going to have to get those gloves on in the next half a second or I'm going to be --"

White He didn't get his gloves on but he sure was thrashing around for a little while til I got him the word. I didn't want to wake him up.

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I didn't want to wake him up. I was hoping it would go through without waking him, but it sure didn't.

McDivitt Man! It liked to have scared me so bad I don't think I went back to sleep.

White No, you went back. You slept better at the end of your sleep cycle than at the beginning.

McDivitt So you were trying to get to my end earlier.

White I think I did the other. I always slept best at the beginning of my sleep.

McDivitt No, I always slept best at the beginning .

White You did too?

McDivitt There was a period where I had to get to sleep, then there was a period of solid sleep, sometimes 15 minutes, sometimes an hour. But after I went by that first bunch, then I was in a state of semi-wakeness.

White Kind of like dopey, fitfull sleep. That's the same type of sleep I had, at least until the last time. Okay. There really wasn't anything else that went on except a few tape dumps and an update for the orbital plotboard. I found this to be very useful. I used the plotboard to keep track of my orbits, where I was during the first part of the

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mission, exclusively. It was very accurate. You could check the times in the plotboard as against what you saw on the ground and you could locate yourself quite adequately. How about you?

McDivitt While I'm thinking about it, I thought the plotboard information early in the flight was excellent. But I thought that the plotboard information at the end of the flight was not correct. As a matter of fact, I started to call them a couple of times, but I never did. By the time I would get the stuff plotted, and get the map put where I wanted it, we would be someplace else. I'm sure that that information they were sending up to me wasn't right; I'd be off an orbit or two.

White After about the last day and a half, I used the nominal orbit plot maps exclusively. I could see the time and the location. I could spot it right with the ground. And I think I figured it was seven minutes behind near the latter part of the mission. This didn't bother me. I could tell how far it was behind, and then update my position on the map quite easily. I thought those pre-plots were real good.

McDivitt So did I. I thought they were, too. But I was a

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little disappointed with the map information at the end of the flight. I don't know exactly what was happening. But I'm convinced that it wasn't right. As a matter of fact, a couple of times I was even on the wrong orbit. They'd give me a time and a longitude and I'd plot it. I wasn't even over that part of the world. I'd be over a whole orbit from that.

White Jim, I made this mistake once, too. I was using my plotboard. I'd plot everything out and I came down in a place in Mexico at night, Tampico, Mexico. So I told them something about seeing this spot in Mexico. They didn't pick up my mistake. I was back checking over and I got to looking at my map and said, "What the heck are we doing here at night?" I was actually on the other side. I was clear around in Australia.

McDivitt Had you plotted east instead of west?

White No, I don't think I did. I think I plotted it correctly. I went back and checked it and I never did get the plot. I went on to do something else and I didn't get the plotboard squared away on that. But I realized that instead of passing over Tampico, Mexico, what I was really seeing on the ground was

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Sidney.

McDivitt You only missed it by half the world.

White That's right. It was exactly on the other side.
But not exactly. It was about 120 degrees off.

McDivitt Mine was something like this. One that I remember specifically--they gave me a map update and they wanted me to do a check over El Paso and El Centro. Looking at this I could see that if I was at the right time, I would have come up from the south; whereas, my pass was down like this, and I was an orbit or two off.

White Well then, we're not talking about the same thing. I think I had probably slipped it somehow on here.

McDivitt You might have plotted 60 East instead of 60 West, or something like that.

White Yes.

McDivitt But I was off by a time factor.

White It wasn't too hard to realize that Mexico wasn't at night.

McDivitt I have a note here that says, "RKV tape dump and a No. 1 Medical Pass on the Command Pilot at 07:02 GMT."

White That's right. And I got you up a few minutes before 07:00, if you recall. In fact, just before

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you had to make your Medical Pass I woke you up. So I'd estimate that Jim got up around 6:55, just enough time to transfer the equipment to him and let him make his Medical Pass.

McDivitt At 7:15 Greenwich Time I was supposed to eat.

White Right. At 11:15 Greenwich Time I was supposed to go back to sleep.

McDivitt Is that when you did? I don't even see that on here.

White Where it says "Pilot sleep".

McDivitt Is that a penciled-in note?

White There was just a series of instructions that we got from them.

McDivitt Okay. Good, because I don't have that.

White It doesn't really mean that's when we went to sleep because you know we did things somewhat out of sequence.

McDivitt At 8:55 over the RKV we got a list of PLA's and CIA's.

White Was this one of our first big batches of them? You know, initially, we didn't get too many of them, and then we started getting them on a very regular basis throughout the flight. I thought that communications of those was quite good, once we started.

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McDivitt: I have a list of notes here that say: Rev 12 was over the RKV where we were supposed to get the CIA's and FIA's. We did. Rev 13 was over Canary where we were supposed to have a C-Band track. I think that meant C-Band went to CONTINUOUS, but I'm not really sure.

White: This is the time at about 17 or 18 hours that I called down and asked them how the tape dumps were coming out, because we weren't holding any attitude for them. We were holding nothing more than a drifting attitude and I know that over some stations we were blunt-end-down and rolled upside down. We were talking, I know, upside down to the stations and getting good transmissions through. They came back and

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said all of the tape dumps to this time had been excellent.

McDivitt

At a GMT of 12 16 00 I got a comment: "No fuel, but do a Flight Track Orientation." This is like saying, drive from here to the drug store, but don't use any gasoline--and don't take the car.

So as I flopped over near around 12:16, I looked down to the ground. We could do a Flight Track Orientation pretty well, considering that we had this movable orbital map and we had a pretty good idea of where we were going to be to start with so we could pick out where we were. Got a map update at 10 17 49, 73 degrees West. A tape dump at Canaries on Rev 13 and at Carnarvon at Rev 14. Around 19 hours, I checked on our orbit and it was 155.7 by 88.

At 11 52 43, turned the C-Band Adapter Switch to CONTINUOUS. At 11 59 23 we turned it back to COMMAND. This is Greenwich time. All the stuff in the flight plan such as the Orbit Navigational Checks and the Apollo Landmark Investigation were not done. We were doing tape

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dumps, medical data passes and that was about it. The next M-3 Experiments were all part of medical data passes. I don't even know why they're in the flight plan.

White I couldn't figure that out either.

McDivitt We did an HF Check. Check began at 16 58 30 GMT, and ran on through 19 07 00 GMT; this included the sunrise, sunset, day, night--all the HF checks and we'll cover those in the experiment part of our debriefing.

McDivitt During this period of 16 58 30 GMT to 19 07 00 GMT, we did the HF Checks.

White Oh, here it is! Command Pilot asleep.

McDivitt Where?

White At 11:45 Zulu. Pilot awake at 11:30. I don't know when I went to sleep here.

McDivitt Okay. Let's check that some other time.

White Okay.

McDivitt It'll take a long time to sort that out and I don't think he needs that right away.

White All right. I got Command Pilot asleep at 11:45.

McDivitt Okay. I don't have me up or asleep or anything. What I've got here in my notes is, Ed to bed at

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20:15, up at 22:15, back at 23:15. These are Zebra times, I'm sure. So I don't know exactly what happened in there.

White Well, you're clear over on 24 now. Okay, you've skipped the time when you were asleep.

McDivitt That's right. I don't have anything on that.

White Okay, I have you going to sleep. I logged myself awake at 11:30. Command Pilot asleep at 11:45. These are Greenwich times. If you add 8:45 onto that, it comes out 20 hours and 30 minutes, elapsed time. You gave me the instructions for the C-Band adaptor times. I did turn those on at 11 52 43 to continuous C-Band on the adaptor, and at 11 59 23 to COMMAND. Also during that period of time, I had been told to go ahead and run Apollo Landmark Investigation without any fuel. But luckily, the spacecraft rotated right around as we came up to it and I was looking right down at the junction of, I believe, the ... and the White Nile.

McDivitt That's right. That was the first task we had of finding something on the ground.

White Yes, it really worked.

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McDivitt It was no trouble.

White It really worked. That was the one that I was probably most familiar with. It's such an obvious one. It's out in the middle of the desert and it's the intersection of the big Nile, where it junctions into two other sections, a little island and a northern tip of the island. I was able to pick the island up from the tip quite clearly. I did take a couple pictures, I believe, of it, but we were just passing and I wasn't tracking. I did report that it was a good landmark and quite easy to see.

We did get an instruction at this time to go to the normal flight plan at 22 hours. This was something that was kind of hard to do. I don't think we really ever got back on much of a normal flight plan for the whole flight, but we did get instructions at 22 hours elapsed time to return to our normal flight plan. At this time Jim was still asleep. We got the update that the Hawks won 3 to 2.

McDivitt Ha ha ha ha ha.

White I relayed that information to Jim when he woke up.

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McDivitt That's right. Okay, I think we've already covered our HF Checks, which were part of the regular flight plan.

White Yes, we did that.

McDivitt I said they were between 16 58 30 GMT and 19 07 00 GMT.

White Right.

McDivitt We scrubbed the Apollo Landmark Investigation at 28:40 and again at 29:10. We were allowed to do the D-9 at about 29:30 in drifting flight only. Doing the D-9 in drifting flight means that you look outside with the sextant and you pick out whatever two stars are there and you measure an angle between them. It was a qualitative rather than a quantitative type investigation for the experiment. I'm telling you, with D-9 it was mostly qualitative throughout the whole mission. We did a few quantitative things, but the number of quantitative things that we could do were very limited.

White The HF Test took us one and a half orbits.

McDivitt Yes. It took two hours and 15 minutes at least.

White I think around 28:30, we had a call up for D-9.

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McDivitt Yes. This is where we did D-9 in drifting flight only.

White Yes, and again that was like taking the car out of the garage without gasoline.

McDivitt All it amounted to was looking through the window and picking out two stars that you can see and taking a sighting between them. Just a qualitative check to see what the sextant would do. We did that. D-9 turned out to be a qualitative, rather than a quantitative experiment, except in a very isolated instance. We weren't even stabilized.

White You were trying to talk me through some of the things, but I had the helmet off and on--

McDivitt This was when we first discovered that the light bulb in the readout portion of the sextant was burned out or something was wrong.

White Right.

McDivitt We couldn't read out the angle.

White We called down, but we never got a call up on that or any instructions.

McDivitt Well, there weren't any. Ha ha ha. Okay, then I have in my notes here, as I mentioned earlier:
"Ed went to bed at 20:15, got up at 22:15 and went

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back to bed at 23:15." That's all Zulu time, but I don't see when he finally got up for the last time.

White Maybe I've got it in here.

McDivitt We had another map update in there but it's really not important. We scratched the Apollo Landmark Investigation--

White What time did you have me asleep? 23:15, Jim? Okay, well I obviously was up shortly thereafter because I got on the horn and you were asleep when they called us up and told us we'd passed the U.S. space record--

McDivitt That's right.

White At a little past 32 hours, which is 23:15. That's 32 hours. The space record was 32 hours.

McDivitt We cancelled the Apollo Landmark Investigation, Run 3, at 30 hours and 10 minutes. Got that, Ed?

White Yes.

McDivitt We didn't switch to bio-med recorders. I made a note here early in the flight plan on the bio-med recorders, "Ed slept first and turned No. 1 off." When I slept, we forgot to turn it back on, so we had No. 1 off, and No. 2 on for a long time,

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for a period of about eight or ten hours. Then when I went to sleep the second time, we turned No. 1 on and No. 2 off, which is the way it should have been. But as soon as I woke up, we turned No. 2 on again and No. 1 off, because you were going to go to bed. Now you didn't go right back to sleep again so I have a note here, "We have to turn on No. 1 as soon as he wakes up." We did. Ran No. 1 for awhile with No. 2 off. We turned them both back on, and left them running for the remainder of the flight. What we did is that we picked up a cushion of about eight hours on each recorder and let them run the rest of the flight. The D-8 Experiment at 2300 hours-- Ed was asleep then. I told them that Ed was sleeping and couldn't make it.

White Right. I think I probably did that later on.

McDivitt That's right. Remember we discussed that you would turn on the experiment later on when you went through the South Atlantic Anomaly?

White Right.

McDivitt You plotted it out on the map and turned it on yourself. The portion of the flight plan at 31

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hours elapsed time says, "Prepare for S-6 Experiment, update D-8, MSC 2 and 3 on." Now I turned MSC 2 and 3 on again, about then. We did not do an Orbit Nav Check, Run 3, because we didn't want to use any fuel. We scrubbed Experiment D-8 and we were going to turn it on at 23:00 or do it at 2300. But, I guess Ed was still asleep, so we didn't do it then. At this time we were both in pretty bad shape as far as rest went, so I felt it much better to get some sleep than to fool with the experiments. Then going through--

White Okay, this is the period of time when you were asleep.

McDivitt Yes, because I don't have any notes there. Go ahead.

White Right. I had a very busy time shortly after I got up. I had a requirement to, at 00:15, --

McDivitt Oh, yes. They called the update to me and I passed it on to you and then I went to sleep.

White That's right. I turned on the MSC 2 and 3, and then I went D-8 at 02:15.

McDivitt 00:35 Greenwich time, you were supposed to take some pictures of cellular clouds. No fuel allotted.

White I think I took some pictures of clouds.

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McDivitt MSC 2 and 3 were supposed to go on at a GMT of 00:30, and you were supposed to control the spacecraft to BEF for that pass.

White That's right, and we went with BEF for that pass, for MSC-2 and 3 Experiments. At 02:15 I was supposed to do D-8.

McDivitt That's right.

White I did D-8 at 02:18, as a matter of fact, and it's logged in the D-8 card.

McDivitt Then at 22:35 GMT, we were supposed to do S-6-- I see that I've got a scratch through it. I think that you weren't up. I was up and I tried to do it, but there weren't any clouds around. I wasn't pointed in the right direction, so I just scratched it out.

White Yes, this is where I went back to sleep and you got up. We had a very important tape dump at 03:03. I think I relayed that to you before I went to sleep.

McDivitt Yes.

White I must have really snoozed here. I was gone for four hours.

McDivitt I'm on 36 right now. We had a tape playback. We

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were eating along in here and I can't tell you where we ate because we ate whenever we felt like it.

White We always ate when we woke up and usually before we went to sleep.

McDivitt That's right. That's when we were eating and that's when we had originally planned on it. That's the way it went in the original flight plan. At this time of the mission I guess we weren't doing much except staying alive. My impression of what we were doing was eating, sleeping, and dumping tapes.

White -- and looking at the ground as it went by.

McDivitt As a matter of fact, we were still pretty well pooped out from that long period right there--

White Your eyes were just getting better. Your eye looked lousy at that time, the first 24-hour point. Your left eye was as red as can be.

McDivitt At about 36 hours it was still pretty bad, but from there on it improved continuously.

White I noticed that whenever I slept, I got much hotter when I had my faceplate closed and my

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gloves on. Remember? I kept turning on the double fans.

McDivitt Even when you didn't sleep in that configuration, you got hotter when you slept than when you were awake, which is the reverse of what I figured it would be. I figured that when you slept, we'd want to go to one fan all the time.

White Well, I slept good when I had my visor open.

McDivitt Did you? The last day or so, though, we had two fans on every time you slept.

White The last day we did. Of course, I slept the best then too as a matter of fact. After the first day, I had my faceplate open more often than I had my faceplate closed.

McDivitt I wasn't. I had a problem that when I'd put my visor up, I was really crunched down in the seat, because I'm quite a bit taller than you. It was more comfortable for me to keep my visor down than it was to keep it up. We had an RKV tape dump, around 36 hours, and I have an Orbit Nav Check, Run 4, here. I don't believe we did that, did we, Ed, at 36 hours and 50 minutes?

White I was asleep and I can't tell you.

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McDivitt We didn't do any of the Orbit Nav Checks with fuel so it was just a matter if you could see the ground you did one. They called up some more S-6 information for me, but I wasn't to use any fuel on it. They said I was to pass Typhoon Babe at 06:06, point of closest approach, and there was a new storm brewing. I'd have my closest approach to it at 06:13. Oh, yes. I also have a period that Ed slept here.

White Which time was that?

McDivitt Well, you got up at 08:15, Zebra time. That's about 40 hours and 30 minutes elapsed time. I drifted around to where I could see Typhoon Babe, but there wasn't anything to take a picture of. There was just a mass of clouds down below; smooth tops and nothing worth even a frame. I got another update that said: "Over Cairo on the 26th Rev I'd have my closest approach at 07 13 37. It would be 90 miles slant range on the closest approach. Don't use any fuel. We were just supposed to look at it. We did pick up Cairo and Alexandria both. I think you were awake at that time, weren't you?"

White It was the tail end of my sleep cycle.

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McDivitt Well, you weren't awake then.

White What time was it, Jim?

McDivitt It says 07 18 37. You should have been asleep then. I have in my notes that you slept to 08:15.

White Well, I was like you were. I wasn't sleeping very good the last--quite often, I had my cover up watching out the window. You could always hear everything that was going on the radio, so you knew pretty well what was going on.

McDivitt Well, anyway, Cairo and Alexandria were both clear, but this was the first time we'd seen them and it took a long time to find the targets-- the particular target that we were looking for. We could find the Red Sea and we could find the Mediterranean, obviously. You could see the Suez Canal. You could see the river. I had difficulty finding the town of Cairo. How about you, Ed, with Alexandria? You were looking for Alexandria.

White I found that one.

McDivitt You found the town all right, but finding the airfield that we were supposed to take a picture of was pretty difficult the first time. Later on

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when we'll discuss the experiments, we'll comment on that. It looks like I was asleep here for awhile because I don't have any notes.

White Okay. I have a set here. I was given the first time to take a look at some of the D-6 targets. I had No. 1, No. 12, and No. 13, and I had all the times for them. I think No. 1 is Tripoli. We'll go over these in a little more detail when we go to the experiments. Tripoli was covered by clouds. Alexandria was pretty good, and I was able to follow it pretty well.

McDivitt Did you take any pictures of it?

White Yes. I took some pictures. Actually, I think we should go back and look at these. I got several passes. This was the D-6 Experiment. No. 12 was Tripoli and it was covered with clouds. No. 13 was Alexandria, and I took manual pictures with the 20 mm Contarex. I didn't actually see--

McDivitt The 50 mm Contarex?

White No, the 200 mm Contarex.

McDivitt The 200 mm. Hand-held?

White No, I had it mounted. I didn't actually see the airport but I had seen it before. I was

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actually looking at the camera when I was firing it, so I--

McDivitt Did you see anything in the ground glass?

White Not very much.

McDivitt Were you trying to track that way or were you just looking out the window.

White No. Just looking out the window. The point that I brought out is that they gave me four targets. The targets should be far enough apart so that you can actually get set for each one. I had four targets here but I could only use--

McDivitt Oh, that was when you zapped from Tripoli to Alexandria to Tel-Aviv to --

White Tel-Aviv and a whole bunch of them all in a row.

McDivitt You could have a thousand miles between targets to evaluate. You finish one and you're starting to take pictures of the other ones.

White I had them at 10 61 51, 10 21 50, 10 25 30 and 10 30 15. Well, that was a beautiful row of targets in there but--

McDivitt A pair though or every other one would have been enough.

White And we were still being very parsimonious on fuel

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and I didn't feel like zapping the spacecraft all around. We had some more updates, tape, and a medical data pass for myself at 45:45. We got the word to delete Translations 2-A. At that time they put in D-9--the first D-9 with fuel.

McDivitt We also scrubbed the Horizon Scan Moonset Check at 46:33, or whenever that is.

White Right. It was scheduled with the platform up and we didn't have it up.

McDivitt Also I've got the Scanner Thruster Plum Checks scrubbed at 47:40.

White Also a deletion of the ES Sensor - ON because we weren't going to translate. So at 14:14 we had our first D-9 Experiment with OAMS.

McDivitt We were both up.

White Right.

McDivitt This was the first one with fuel and the first big disappointment of the experiments.

White Right. It was certainly very difficult to use.

McDivitt This is where we tried to do the dayside pass when we had stars, and we couldn't see past the nose of the spacecraft.

White We didn't get any stars so actually the run was

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quite short. We were not able to see any stars so we weren't able to do much on that run at all.

This is the time we knocked off any more day star sightings.

McDivitt We were supposed to turn on MSC 1 and acq aid off for five minutes between Mananarive and Carnarvon, I guess.

White Oh! This is where I missed a sleep period. This is where we missed a sleep period. We got busy and ran the D-9 right through the sleep period. Then I got back to sleep at 54:55 to 60:65 elapsed time.

McDivitt Oh, yes. You got about one hour's worth of sleep between 49:40 elapsed and 50:20 elapsed, or something like that.

White Right before D-9, I got a little sleep.

McDivitt That's right. I've got a little note in here that says, "Ed got about one hour of sleep."

White That's right.

McDivitt We were supposed to do S-5 over the States on Rev 32. Start at 17:40. We were supposed to do Apollo Landmark No. 4 starting at 15:00 Zebra on Rev 33. That was El Paso.

White That's right. We were both up for that.

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McDivitt We did the S-5 Experiment together and that was the best series of pictures we got on the whole flight. It was really fabulous. We got good pictures both for the S-5 and S-6 on this one.

White They should really come out good.

McDivitt I did the Apollo Landmark Area No. 4. I did the tracking task with it at 19 16 42 on El Paso, and it turned out pretty well. We tried to make a tracking pass on El Paso International Airport, and we never even saw El Paso.

White This was a very big surprise to both of us because we thought we'd nail that one cold.

McDivitt That's right. We've been in and out of there so often, you know, it's just like another home base.

White Which leads to one of your conclusions, which is--

McDivitt You can't have targets out in the middle of a land mass. They've got to be near a body of water.

White You need something to identify the landmark.

McDivitt There are some beautiful topographical features near El Paso. There's a range of mountains just to the west that show up and the white sands are out there to the west--Shoot! We never saw anything. I think I saw El Paso when we were right

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over it. I said, "I think there goes El Paso.

I think we missed it."

White The next thing we said was, "Yes, it is. There's Texas." We could see Corpus Christi coming up on us. That's where you took it.

McDivitt That's right. So then I went to a tracking task on a pair of sand pits, with a channel between them, right on the coast--around Corpus somewhere. So, we did a tracking pass on it because we were all set up and we'd already used the fuel to get stabilized. We were all set to do something so we went ahead and did something. We took some 200 mm pictures of this.

White I took about 10 pictures.

McDivitt We'll just see how the target stayed in sight. This was our first real tracking pass, wasn't it?

White I had one good one on Tel-Aviv.

McDivitt Did you use the fuel required to do it and all that stuff or did you try to chintz on it?

White I tried to chintz on it, but I think it was good tracking. I actually tracked the airport at Haifa instead of Tel-Aviv. I realized it at the last minute that I didn't have Tel-Aviv, I had Haifa, but

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I had an airfield and I had a town so I--

McDivitt You took some fixed-mounted 200 mm pictures.

White Yes. I took about two pictures of it. I couldn't take a series. I--

McDivitt That's right. You didn't have the gunsight to track with either.

White No. I just put it in the middle of the window.

McDivitt At this time our orbit was 88.1 by 148.7, so we had come down about 7 or 8 miles. D-9 and Apollo 4, were around 51 hours. I don't know exactly how that fit into this schedule that we were doing. We were switching back and forth from elapsed time to Greenwich Mean Time so we got a little confused on these. We got updates of the PLA's and CIA's. This plan says, "Prepare for D-6." Well, we didn't have a D-6 Experiment anymore. Ed went to sleep again at 54 hours.

White Yes. At 54:30 I've got myself asleep.

McDivitt Ed asleep at 54, and I have him waking up at 59:15. That was when we started trying to make you sleep a little longer, Ed.

White Half our notes here are elapsed time and half of them are in Greenwich Mean Time. I think this is

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probably one of the weakest points in our flight planning--trying to get times correlated.

McDivitt This correlation between one time and the other time is hard to handle. We were getting start times in GMT. We said that we wanted these start times in GMT because this is the only official time that we had. The elapsed times were just for planning. We only kept them to the nearest two or three minutes. I started my Omega watch on elapsed time at take-off, and I just let it run through the whole flight. I never set it. I never checked elapsed time or anything. It could have been off two or three minutes, but I was doing the flight plan to the nearest 10 minutes off the book here. When we got retrofire times and when we got start times for things, we got them in GMT. It made it awfully confusing in the flight plan by switching back and forth. Fortunately, we got off at 15:15 which is better than getting off at 12:36 or something like that. On the Apollo mission we've got a better set of clocks. We're going to have Mission Time and Phase Time, so whenever you start a new phase

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you go back and start all over again.

White Well, I'm not convinced that we couldn't have even handled this one on elapsed time.

McDivitt We did.

White Well, I mean let everything go elapsed time. Forget about your Greenwich Mean Time.

McDivitt No.

White I don't know what we would have lost.

McDivitt The retrofire times.

White Put the retrofire time on elapsed time. Like you say, it was much clearer to you using that one watch on 12-hour increments, and it was to me too. That's the one I used. I used this one watch right here on elapsed time.

McDivitt Well, let's get into that as a separate thing at the end. We had the MSC Experiment 2 and 3 off at 02:25. We turned it on at 22:14. These are Zebra times now. I have a note here, "Perform D-8 Experiment, Radiation Experiment, at 55:30 elapsed time," and I've got, "No. Pilot asleep." Did you do that experiment later on, Ed?

White Which one was that, Jim?

McDivitt D-8 Experiment.

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White At what time?

McDivitt At 55:30 elapsed.

White I've got them in Greenwich Mean Time here again.

McDivitt That's around 22 or 23:00. Something like that.

White Yes. I've got one. I did it at 23:58 GMT.

McDivitt How did you do that? You were supposed to be asleep then. Maybe you woke up and did it and went back to sleep.

White You know, this was the time when you went to sleep. I've got you asleep on the fourth day at 03:30 Greenwich Mean Time.

McDivitt We're not on the fourth day. We're still on the third day. I'm between 54 and 59 elapsed.

White All right. That's the period of time I'm asleep.

McDivitt I've got the D-9 Experiment was run between 22:43 and 23:22. I must have done that. Okay. We got hd up at about 59 hours elapsed time, and did a Medical Data No. 2 Pass on mg except by then. I think they were Medical Data No. 1 Passes. I went to sleep at about 60:15 elapsed, and I got up about 65:30 elapsed. I had about five hours there when I was supposed to sleep.

White Shortly after you went to sleep we started having

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the RCS heater troubles and we had them coming on for the next three to four hours. We had them cycled on and I called the times down. I don't believe we want to go over them all right now. I had them cycled on and off at intervals of about 15 minutes, for a total of eight different times. They started coming on exactly at 06:47 and the last one I had was on at 08:23. That was the last time we had any RCS heaters. It was rather peculiar because they alternated. First the A-Ring would come on and the B-Ring would come on and the A-Ring would come on, and so on.

McDivitt Is that right?

White They came on at approximately 15-minute intervals and it took approximately five minutes to bring the temperature down to within limits. I reported those down and they seemed to be interested in getting exact on/off times of our heaters to plot our electrical profile curve. I ran an Apollo Landmark Run No. 6 with yaw 15 and pitch 30. I think the results of that are in the other log-book. I reported down at this time that Jim had a successful bowel movement. I already had one.

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I had an HF Check at Ascension at 05:09, which didn't work out--

McDivitt How could I have a successful BM if I was asleep?

White You had already had it. I reported it at that time. I wasn't able to read Ascension on this HF Check. I got the okay for an Apollo D-9 Run No. 2 for 06 01 44. I called down to get clarification on it and they said I could use stars of opportunity. This is what I did. I ran the D-9 with the stars of opportunity. Why we did this will be brought out in the D-9 debriefing.

McDivitt This was a no-fuel D-9?

White No. This was with fuel. But, remember, the stars were placed so it was hard to get much.

McDivitt Yes.

White We scrubbed the Apollo Landmark Investigation No.1. We didn't do that. We gave a Medical Data Pass. Ran the D-9 Experiment, I believe, and got fairly good information back on that. As a matter of fact, I did do the Apollo Landmark Run No. 6 and that information is in the flight log. I got Jim up, it says, at 08:31. This doesn't sound right to me.

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McDivitt I got myself up around 65:40 something elapsed time.
I just drew a mark there.

White That's exactly where I've got you up--at about
65:40.

McDivitt I got a comment here. This is something that
went on throughout the flight. I went to sleep
and I looked at the OAMS Quantity Gage and it was
reading 60 percent. When I woke up it read 56
percent. This meant a 4 percent drop and it
was somewhat alarming since we were saving fuel
so much.

White He accused me of having to use all the fuel up
while he was asleep. Ha, ha.

McDivitt No. I'd noticed that the gage went up and down
before, but it never had gone up and down so much
in such a short time. It would move up and down
by 2 percent quite frequently over a period of
15 minutes to an hour. It would change by 2
percent. It did this between 60 and 70 percent
for a long, long, long time. We were going pretty
easy on the fuel. It did move up and down like
this quite a bit. This is just a comment that
throughout the flight the OAMS Quantity Gage did
fluctuate quite a bit. We had the uncertainty

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in the system and this 2 per cent was, in general, about 7 pounds. That was really quite a bit of fuel. 4 percent was between 12 and 15 pounds, depending where you were on the scale. This was an awful lot of fuel to have suddenly disappear. I just wanted to comment on that. It was an interesting thing. We'd been dumping our ECS O₂ pressure. We'd gone to High Rate or cabin repress and dumping the stuff overboard--overpressurizing the cabin and having the cabin vent to keep the pressure down. Finally around this 66 hours, we'd dumped the thing down to 880 psi on the gage. This was why we didn't have to dump it so often. We'd been dumping it before around 960 psi--dump it there and bring it back to around 930 psi and let it build up, and then repeat the cycle again.

White That was about every 4 hours.

McDivitt Yes. We had to dump at least every 4 hours.

We brought it down to 880 psi and this gave us a period of around 12 hours.

White You know, I thought this was a very clever method of holding the cabin at a higher pressure than normal by McDonnell--putting the vent down so low that it vented in a normal mode. You

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certainly could tell on the gage when it was going to vent. It vented right down there at about 960.

McDivitt Yes. I thought we'd really rack that apart when we got to the systems.

White Yes. All right. I wanted to be sure that we didn't forget it.

McDivitt I guess we were both awake at this time. We did MSC-10 some place. Here's where we got into a bunch of bad flight planning. Someone on the ground screwed up.

White They ran our Horizon Scanner and MSC-10 Checks right together.

McDivitt We started out our MSC-10 Check and at the same time we were supposed to start powering up the platform and aligning it.

White What time did you have MSC-10 Experiment?

McDivitt We were supposed to power up the platform at 10:15. Let's see if I got the start times here for MSC-10.

White We'd have it in the book.

McDivitt Well, we didn't get a start time because MSC-10 starts when the horizon comes into view, when we could see the first light. We started the MSC-10

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as a sequence of pictures every five minutes.

The sequence is three pictures every five minutes, for as many passes as you can get. So you have to start this thing at sunrise, or as soon as the horizon becomes light. We took our first three pictures. We went on through and we were supposed to start our Horizon Scanner Check--.

White Jim, the time we started you've logged in here as 11:04.

McDivitt Okay, at 11:04 we started our MSC-10 Experiment. We were given instructions to start the Horizon Scanner Sunset Check at 11:54. It just so turned out that we were going along and we weren't out of frames of film yet for MSC-10.

White It was still daylight.

McDivitt Yes, it was still daylight, that's right, and we could still get some more good pictures, I thought. Here we had instructions to start our Horizon Scanner Sunset Check, and in looking through this thing, it looked to me like that was the only place we were going to get it; so I don't understand exactly why we had to run MSC-10 and the Horizon Scanner Check simultaneously. They

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couldn't be run simultaneously! It looked like somebody with a little foresight on the ground could have seen this.

White That was really the only bad screwup, I think, in our flight planning. It was right there.

McDivitt I think so, too. So we terminated MSC-10, although we had enough pictures, I'm sure, to have completed the experiment. It would have been nice to use up all the film. There's no sense in carrying it and not using it. At 11:54 we did the Horizon Scanner Sunset Check--the platform up and aligned. At 12:15 we did the Horizon Scanner Moonset Check. At 12:22 we did the Apollo Yaw Orientation. At 12:58 we did the Horizon Scanner Thruster Check. At 12:59 we did the Horizon Scanner Track Check. At 13:14 we did the Attitude Thruster Check. At 13:20 we were supposed to power down and at 13:20 were supposed to turn off the MSC No. 1 Experiment. What happened as we went through here--we got a little behind because it took a little longer to do some of these things, especially this Horizon Scanner Track Check. It was taking so long that

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we eliminated the last two steps in it. We did the zero bank angle and the pitch up and down. We did the zero pitch angle and the roll left and right. We did the bank to one side and the pitch up and down, and we did the pitch up and the bank on both sides. We didn't do the pitch down and the bank on both sides, and we didn't do the roll left and the pitch up and down. We were running late and at that time I didn't know how we were doing on electrical power and everything, so I elected not to do the last two portions of the check.

White We had it pretty well ironed out, anyhow.

McDivitt Yes.

White Surprisingly broad bands, too.

McDivitt The scanners seemed to be working perfectly. The attitude thruster check was just as it should have been. We powered down the platform and turned off the MSC Experiment No. 1 about two minutes late.

White We powered down at 13:27.

McDivitt Okay, seven minutes late. We never did take any 16 mm photos of the plumes.

White Before you went to sleep on this one.

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McDivitt I hadn't gone to sleep on that one.

White Before I went to sleep.

McDivitt Before you went to sleep, yes. Okay D-9 --

White We were really busy at this period of time.

McDivitt Yes, a D-9 at 20:51 Zulu.

White I have a feeling I was asleep here, Jim.

McDivitt I think you were, Ed. You went to sleep at 21:15.

White 21:15?

McDivitt Right. I did the D-9 Experiment at 20:15.

White At what time, Jim?

McDivitt At 20:15.

White So you did the D-9 while I was asleep.

McDivitt I have a note here that we're going to be over Guaymas at 15 44 55. They wanted a No. 1 Medical Pass from me. They wanted me to turn the TM switch to REAL TIME and ACQUISITION for three minutes over Guaymas. Guaymas must have lost it's command function or something -- not for the whole time though.

White Yes, this is where I was asleep, Jim. I remember that now.

McDivitt Okay, now I have a comment here. I turned on our horizon scanner at 16:03 with about a 25 degree

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nose down attitude, with a pitch up rate of about two degrees/second, in the Horizon Scanner Mode. The thing caught and hold the spacecraft within the deadband and finally damped it down, and we stayed in the Horizon Scanner Mode. I think that this is about the time that we went to Horizon Scanner, isn't it?

White You were in Horizon Scanner while I was asleep.

McDivitt Yes. I don't have that in my notes, but we went in the Horizon Scan Mode around 72 hours, I think. I think it was at 16:03 GMT that I mentioned it. I didn't do an Orbital Nav Check at the 72 hours and 50 minutes as shown in the flight plan. Oh, here's where you were up again, Ed. Because you were up when the computer screwed up, weren't you?

White Yes. I saw the light.

McDivitt Okay. During the course of our passes over the States, here, around 75 hours, I was told to do Orbital Nav Check No. 9 at about 75:30, and I was to do Orbital Nav Check No. 10 at about 75:50. Okay. I completed the Orbital Nav Check, Run No. 9, and then you must have waked up, I think. I think you were asleep when I did that.

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White What time do you have me waking up? I know about what time I woke up.

McDivitt You woke up around 75:30 or so. I was going to do an Orbit Nav Check No. 10, and we were over the States. They wanted us to turn on the computer to send us a load, so I did. That's probably what woke you up, when I was trying to turn on the computer with the swizzle stick.

White Yes.

McDivitt But this time the computer stuck in the on position.

White When you tried to turn it off.

McDivitt And it wouldn't go off.

White I remember watching. I saw the mal light go on.

McDivitt So it stayed on, and that's when we had all of our computer trouble, which you'll check and cover in systems. Oh, the time the malfunction light came on was right when we were about to turn it off.

White I'd say around 75:45 or something. In that area?

McDivitt 75:50 CSQ-Hawaii. I think it was about 75:50 or thereabouts. They sure do have some peculiar times here. It only takes, according to flight

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plan, 30 minutes to go from Guaymas back to Guaymas. That's a high speed orbit.

White That's right. It does have that, doesn't it? Looks like a goof, doesn't it?

McDivitt It only takes 40 minutes to go from Hawaii to Hawaii. We were really traveling! I don't know what time the computer stopped.

White I think they've got it on the ground. They can read the mal light.

McDivitt We were talking to them on the ground. It should be on the air to ground tape. Then we were cleared to do Apollo D-9 in the orbit that covered the night time around 1 1/2 hours or so.

White That was my D-9 at night, wasn't it?

McDivitt That's right. Ed did this.

White Before you went to sleep, though, we had one other thing. We had the zodiacal light photographs that we took, and we had a special procedure called up where we pointed straight down.

McDivitt Oh, yes. That's right.

White Pulsed it, with the shutter speed of the Hasselblad open. You operated the Hasselblad and I operated the spacecraft. We pitched down and

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ran through this test and pitched up and ran through --.

McDivitt The Contarex.

White You used the Contarex. That's right.

McDivitt We did this at about 78:30, and I went to sleep at 79--

White No, we didn't. We did this at 76:30, Jim.

McDivitt 76:30? I have 78:30.

White I just took on Rev 51. You're correct. That Rev 51 they called up wasn't right. Okay, we did it at 21:40, which I have as equivalent to 78:25.

McDivitt Then at 80 hours I went to sleep.

White You went to sleep about 80 hours elapsed time. That's right. Okay, while you were asleep, I ran a D-8. In fact, I had quite a bit to do while you were asleep this time. I ran a D-8 at 23:57. These are all Zulu times. I turned on the MSC-2 and 3 at 23:57. This is where I had the requirement to attitude hold, small-end-forward, through the anomaly. On the first pass through at 23:57 to 01:30, I didn't feel that I had a good attitude. From 23:57 to 01:15 I didn't feel my attitude small-end-forward was satisfactory.

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I elected to make a similar pass through on the following orbit, watching the stars and making sure that I had a good small-end-forward. I found out that the first pass through was pretty good until the tail end, where I thought the stars were in the wrong position. It turned out that this is just the way they came up, and I was good for both of them except for the tail end of the first run through, I logged in two small end passes through the South Atlantic Anomaly. I also ran the D-9 Experiment and I found that by using the fuel and having the Horizon Scan to hold when you wanted it to hold, the use of the sextant and horizon in making measurements was considerably easier. I made what I feel was a good Apollo D-9 run. I ran the D-8 Experiment. I had two times to run the D-8 Experiment. I ran it at the Greenwich Mean Time of 01:30. I was to look for Pegasus at 02:28, straight up at 268 nautical miles, and I was all hot to watch Pegasus go over and was just approaching my straight up attitude when--

McDivitt

The sun shined on the window.

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White No, I was called and they said, "Say we got a critical tape dump. We want you in a level attitude for it." And I said, "Well, you just gave me instructions to watch Pegasus." And they said, "No, we want the critical tape dump." So I went right down to that attitude, and we got the dump off in time for me to go back up to the attitude prior to 02:28. I got up there about 5 minutes prior to that time, but the sun, as Jim said, was up and was reflecting off the particles on the windshield, and I really couldn't see very much. I tried to see Pegasus, but I couldn't see it. I turned MSC-2 and 3 off at the appropriate times. We got instructions from Houston CAP COM to try a few things with the computer. We were to turn the computer off, the IGS on, the computer on at 20 minute intervals to try to recycle the mal light off. They thought that it might have been cold.

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McDivitt Let me step back a little bit to this computer problem. The computer stuck over the States at around 75 1/2 hours or so. The computer was stuck on. If you've got to have something stick, you're better off to have it stick on, I guess, than off. Especially if you ever want it to work again. As we went out of earshot of the ground UHF radio range in the States, I asked them if that they had any instructions. They said, "Stand by." I sort of felt that the thing that we ought to do was just leave it on for a while. We got a call from Tananarive and they said to place the computer switch to the ON position and a.c. Power Switch to the ACME. I said that's certainly a peculiar place to put the switch and they said these are the instructions from Houston.

White I think we had a good computer at that time.

McDivitt I know darn well we had a good computer at that time. I think this is like getting your landing gear stuck up and you fool around with

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it and it comes down and then just for the hell of it you pull it up again to see if it's going to come up. I don't think we should have ever turned off the computer. Unfortunately, I didn't have all the information at my fingertips that I needed to really make a decision on it. When we got to the next station, which was Hawaii, I asked them how we were doing on electrical power. They said that we were 160 amp-hours ahead of the curve. We had a 200 amp-hour cushion, so that meant that we had a 360 amp-hour pad on our flight plan. In the meantime, I had checked to see what the computer-ON, IGS Power Supply-ON took. It took 5.6 amp-hours to power this thing. We were at 76 hours on a 96-hour mission and we had about 20 hours to go. Twenty times 5.6 is a little over 100. So, if we had used up these 100 amp-hours, we'd still finish up with a better electrical pad than we started out with, or than we expected when we started out. So, I sort of feel that we needlessly threw the computer down the drain. After we got the

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thing turned off and ruined, we went ahead and turned the IGS Power Supply on, the computer on, and left it on the rest of the flight anyway. So, whoever sent those instructions accomplished it. I guess what he wanted to do was turn off the computer. He sure accomplished that. It seemed to me like it would have been more worthwhile to leave the thing on till we got a little more data out of the thing, instead of rushing to get it turned off the way they did. I don't understand it. I don't feel that it was a wise decision. Unfortunately, I didn't have the electrical power consumption at my fingertips right then, or I never would have turned the thing off.

McDivitt Okay, I guess we're over about 86 hours. I got up at 86 hours. That's one of the longest rest periods that I've had. At 05 48 45 Zulu we were supposed to perform a D-9 Experiment, and I guess we did. Then I have in my notes that Ed went to sleep at 87 hours elapsed time.

White And this was my five hours of very good sleep.

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It's my best and last. You must have let me sleep till when?

McDivitt I don't even have when I got you up, but it was about five or six hours. I think it was around six hours.

White No, it wasn't that long, was it? Because that would have run us a little short. You had about an hour 45 minutes or two --

McDivitt I had an hour and a half nap. I got up at three hours before retrofire. Retrofired at 97:45. I went to sleep at 93 hours.

White Okay. So, I got up --

McDivitt Ed got about six hours nap.

White I got up about 95:05 that time. You went to sleep about --

McDivitt No, you went to sleep at 87 hours and got up at about 92 -- a little past 92.

White This is what I'd estimate, Jim.

McDivitt A little past 92. So, you had about a good 5 hours. I know that you were still sleeping at 92, because that's when the urine system stopped up, and you were asleep then. So, I think you got up -- I'd guess, around 92:30.

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I know I went to sleep at 93. I went to sleep in pm GMT and 15 after the hour, whatever the hour was, and I woke up again. During the time that Ed was asleep, I did two Apollo Landmark runs using Area No. 16 for the first one. This was on Basrah. It was a good run. We'll go into this a lot more in detail later on. I did the second one on Cairo. This was a good run. I went through some more computer mode checks. Every ten seconds, I changed the computer modes and turned the switches on and off, pushed the malfunction lights, hit the Start Comp button, turned the switches on and off, ran the IVI's and a whole bunch of other things. The computer was dead and it was pretty obvious that it was. At 92 hours, the urine flush system stopped up. Just prior to that Ed had urinated and we had a big bellows full. As it started going overboard, it always went overboard in squirts.

White Did you have it at 92 or 95?

McDivitt 92.

White Okay, that was when I was asleep.

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McDivitt You were still asleep, and I think you got up around 92:30, I would guess. Sometime around in there. I know that I got up three hours before retrofire and I slept about an hour and a half. You can go back and say that you got up about 92:30 or 93 elapsed. Ed had urinated in the bladder and the bellows was full. As it got towards the end, it started going out very slowly, but it did all go out. So, I turned the thing off normally. I left preheat on for a short time, two or three minutes, and then turned it off. After my urine dump, I had about half air and half urine in the bladder, and the bellows filled out. It just stopped. It was pretty obvious that it wasn't going to go any farther. I turned off the OVERBOARD position and went to PREHEAT on the other switch. I then went over to the evaporator and dumped through the evaporator and it dumped right overboard. We used the evaporator dump system one other time during the flight. We played back the tapes and the things we were supposed to do until about 93 hours, I

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believe, and that's when I went to sleep. I woke Ed up and I went to sleep at this time.

White

Actually we got our update while you were asleep the time before. We got the update for how to perform the retro. We figured that with the procedure they gave us, if we followed it, we would get a three-sigma miss distance of 70 nautical miles. We were to use an OAMS retor with a manual retro. At this time, we were going to push the manuel button. They didn't know at this time that the TRS was working all right. They later came in and told us to use the automatic mode of time. We were to use zero-lift rolling. We were to start the terminal maneuver at the 400 000 foot marker. They told us to expect to encounter about 8 g's during the reentry. We were told the recovery area had three to four foot waves, 18 knot winds, and good weather. I'll cover this more later.

White

There wasn't much more. We got an update. I took a few more pictures, and I did a medical pass. During that hour and 40 minutes there wasn't

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anything else. Nothing else was scheduled.

We were down through what we felt was all the fuel we wanted to use, so about all I did was a couple of tracking tasks.

McDivitt Going back for a moment--at 17:19 I did an Apollo D-6 on Yuma. Okay, I think that brings us to the preretro portion of the mission. Right, Ed?

White Yes, sir. I think you'll find there are quite a few errors and omissions in what we've put on the tape right now. I think you have to compare them both--the two tapes together--to get anything.

White That's like air to ground tape, also.

McDivitt That's right. It has to all be put together. This is just a piece right here.

4.4 Preretro Preparation

White We really started our preretro preparation about three hours prior to preretro. At this time we started stowing equipment and preparing the spacecraft and ourselves for the retrofire. I think we worked for probably 30 to 45 minutes without making a very big

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dent in the pile of junk that we had in the spacecraft. It was apparent to me at that time that we were going to have to go a lot faster than we were going or we'd still be up there stowing stuff away at retrofire time. So, Ed and I then went into high gear and we really started stuffing stuff away. We put the film in the middle food box, and we put the cameras and some of the refuse, including three defecation bags, exerciser, and some other things, in the left-hand aft food box. I took a lot longer to stow the equipment than we had planned. Do you have any comments on that?

White Yes, I thought this also. We had just everything out prior to this time. We hadn't really been able to stow anything. We used every piece of our equipment right up to the time we started our stowage. In fact, I think you were getting a little uneasy there for a little while that we weren't going to get it all in.

McDivitt That's right. At the rate we were going, we

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wouldn't have.

White That's right. We had to accelerate our pace a little bit and perhaps get a little faster and not quite as thorough in our stowage as we would liked to have been. I think everything was put away. Everything was put away except for the umbilical. We knew we weren't going to stow the urine hose, so we put that in the umbilical bag. The two meals that we had left we put in the umbilical bag also.

McDivitt We had some other things. We had the extra-vehicular sleeves off your suit, the blanket that went over my leg, the launch-day urine bags, and a couple of other things were down underneath my legs. They were between my legs and the seat.

White Right. I put my launch-day urine bag in the bag also, so that things wouldn't ricochet around.

McDivitt I think we had all your stuff in the bag and I had all my stuff wedged between my legs and the seat.

White We both also had a trash bag on either side.

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We had that on the launch also.

McDivitt The trash bag was full.

White Did yours stick on the side?

McDivitt It stuck.

White So did mine. I put mine further up --

McDivitt It didn't have anything heavy in it. It was light weight.

White It was all trash.

McDivitt Dry trash.

White It all stayed there pretty well. We did get the stowage done in time. I think we had about 10 or 15 minutes in which to collect our wits for the --

McDivitt That's right. I was trying to make an effort such that at the time we arrived over Carnarvon the greatest part of the stowage would be down. However, we didn't quite make this. I had a time powering up the spacecraft, and I had the IGS power on. I had already turned the IMU on. I was beginning to warm it up, and had it in the Cage Mode. When we got to Carnarvon we were still stowing things away. I think by that time I had al-

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ready strapped myself into the spacecraft. I had my survival gear hooked up, my shoulder harness hooked up and my lap belt on loosely.

White We did the things that I could do by myself, such as stowing the ventilation module and stowing the cable. You were doing other things.

McDivitt: That's what I said. We were coming up to Carnarvon. I was shooting to have all this stuff put away by then. We didn't have it all put away but we had most of it done, where I could actually get around to flying the spacecraft again. We checked in with Carnarvon, and confirmed our retrofire time. We weren't really supposed to pick up our retrofire data until we passed over the States. From Carnarvon on up to the States, we continued to stow away little bits of pieces that we had. I think you were still eating. We finally decided that you'd better stop eating or we weren't going to be ready for reentry.

White With a little prethought I had taken one meal, prepared it and set it aside so I could eat it just before reentry. This is what I was

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doing.

McDivitt As we came up on Carnarvon, I thought that we were in excellent shape. We had a lot of spare time. We could get ready for retrofire. We came up to the United States and ran a pass across the United States. We got the update times and we got all the reentry quantities that we needed, both with and without OAMS. They told us that they had a valid load in the TRS. At this time, I assumed that they checked the TRS, but when we got our early retrofire, I wondered if anyone really had checked the time.

White I know it was off at least a second. I'd estimate it was off a little more than a second.

McDivitt A second and a half, probably. No more than two seconds because we didn't arm it until three seconds. But it sure fired shortly after that.

White Yes. One thing that we got was different. All our quantities checked out except for one. They called up a landing time which, the first

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time, I copied it as 15:55, and the second time I copied it as 17:10. This was prior to firing anything, so I think they corrected one time only. I thought the rest of it was very well handled. We had the times called up and verified several times.

McDivitt As we started our pass across the States, I started aligning the platform. We had the best aligned platform although we didn't really need an aligned platform since we didn't have a closed loop guidance system. But we sure had the best aligned platform at retrofire that the space business will probably ever see. I aligned the platform across the United States, and then I went to Orbit Rate. I had about a 20-minute alignment on it and went to Orbit Rate. We left it in Orbit Rate. I did this alignment small-end-forward because I wanted to see where I was going for a change. We went into the dark side, and we really got into our checklist then. We performed the Pre-retro Checklist well in advance of when it was supposed to be done. It shows it in the flight

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plan at about 96:40 with the retrofire at about 97:45. I think we did the Retro Checklist right after we completed our pass across the States. We did it right at about 1+30. Then I did it at one hour. At T_A-1 hour we went through the checklist again, and got all those things that we skipped. Some of them we didn't want to do as early as an hour and a half. We went through it again in an hour, and we did the Preretro Checklist step by step. I think at that time we had everything stowed away. We took a couple last drinks of water, and put the water gun away, and then proceeded on down.

White

I had one comment on that checklist. I still think our HF procedures are not too well defined--when we do and when we don't put the HF out. Not out, but when we put No. 2 on HF. It popped up in the checklist again and we questioned this prior to the flight. Why put No. 2 audio on HF during this time? I do not feel we want to be on HF. We had the HF on. We could hear them calling us, if they did call

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us on it. We could switch over to it quite quickly. This wasn't on the checklist, but we put my switch on RECORD and recorded the whole sequence of events.

McDivitt That's right. I think that was sort of a needless position. You could listen on HF without having the transmitter on.

White That was the only discrepancy that I found in our checklist. Everything else we went through. One other thing. They had, "Insert a new voice tape," and we both felt we wanted the full recentry on one tape. If we put a new voice tape at this time we wouldn't have gotten it. So, I inserted a new voice tape at the Minus 36 Checklist and I think this is a good time to do it on future flights.

McDivitt Yes, the T_R-36 Checklist was to be done over Carnarvon. We decided that we would check the maneuver thrusters prior to Carnarvon since we had a lot of time. There was no sense in waiting until the checklist time came around. Since we had a lot of time, which was the thing I was striving for, I went ahead and

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checked the aft-firing thrusters No. 9 and 10 as we had in the T_R-36 Checklist, except we did it between T_R-45 and 40. Got them all checked out, so that by the time we came over Carnarvon we just went ahead and started up our event timer on their mark. We confirmed with Carnarvon that we had indeed checked on maneuver thrusters and that they were all right. We got this checklist completed well in advance too. We went through it a couple of times, although there really wasn't much to it after the Maneuver Thruster Check. I guess we could probably follow the retrofire itself here.

5.0 Retrofire

5.1 T_R-36 Events

McDivitt

I just covered most of this. I set the event timer up well in advance of Carnarvon. At Carnarvon, I got the T_R-36 hack. I got the event timer started right on the money. We got a hack on it later and it was indeed with the ground times. I checked the aft-firing thrusters prior to reaching Carnarvon, and I told Carnarvon that I had indeed checked them

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and they were operating properly.

5.2 T_R-22 Events

McDivitt At T_R-22 I was alining the platform. I started alining the platform over the States, and I put it in Orbit Rate for a while. Finally we got over to the dark side and there wasn't anything else to do, so I alined it some more. I alined that platform for an hour and a half. We had the best alined platform at retrofire in the world. We were in pretty good shape by the time we got to the T_R-22 checklist, which is really nothing at all. It's just another platform alinement. We checked our ground updates, and again Carnarvon told us that we had a good load in the TRS.

5.3 T_R-13 Events

McDivitt At T_R-13 minutes we started the computer. We started our T_R-13 minute checklist at about T_R-14 to make sure we didn't run into any problems. We got into Orbit Rate, and I got all the things out just like the T_R-12 checklist says. We had an OAMS burn of 2 minutes and 40 seconds. They called it up and I

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checked it. I was exactly right. They were obviously flying it off the same card that we were, because I checked it and it was exactly 2 minutes and 40 seconds.

5.4 T_R-12 Events

McDivitt

Hawaii said they would give me a countdown to T_R-12, and they gave me the 3, 2, 1 Mark. I started thrusting at that time. Ed had planned to give me a check at one minute elapsed time, two minutes elapsed time, and at 30 seconds to go, 20 seconds to go, 10 seconds to go, 5, 4, 3, 2, 1, and off. That's exactly what we did. He called me at one minute, and again at two minutes. We went right on down, and he gave me the mark. I was checking the time as he gave me the counts. It was agreeing exactly with my event timer. At Ed's mark, I released the attitude controller and we were within tenths of seconds of exactly 2 minutes and 40 seconds of burn time. During this period of time, I think I held the attitudes probably within plus or minus a degree. It was very easy to control. The thing that I noticed most about it was the

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absence of noise from the aft-firing thrusters.

I could hear the RCS firing, but I could not hear the aft-firing thrusters.

White I could hear them.

McDivitt You know how the "x" is like this? My ears were plugged up throughout the flight, so maybe you could hear them.

White I could hear them.

McDivitt That was in Rate Command.

White And stopping?

McDivitt Yes, I heard Rate Command. I knew what I was doing with the stick. Maybe what you were hearing was Rate Command.

White I was going to comment that the way that I was listening to them I thought they were just cutting out.

McDivitt You were hearing the attitude thrusters, Ed. Here's what would happen. I would be thrusting along and the thing would start deviating. It has a tendency to deviate more in yaw.

White Is it continual? Did you hear it all the time?

McDivitt Yes, almost all the time except for pauses that were frightening, as the attitude would

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drift off just a slight amount, around a degree. It wasn't deviating a lot so I was making small corrections. It would deviate in yaw so I would control it back. It tended to deviate slightly to the left all the time. I controlled it over to the right and I would bring the ball back underneath the dot. Then I would even go back to zero. Then I would release it. I would bring the stick back to neutral, and for a short time, the rates would build up and the silence would be deafening. There would be no noise whatsoever. I would think, "God bless it. Have the aft-firing thrusters stopped firing?" Then the thrusters tended to yaw the spacecraft some more. As it came around, it got past 2/10's of a degree/second deadband and the Rate Command started firing again.

White Okay, that's what I heard. That's right.

McDivitt That was Rate Command. When I yawed back around, it was really going. I'd come back to neutral and it would stop.

White All right. Then I couldn't hear them. I didn't hear them when we took the check on them.

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McDivitt Neither did I. I didn't hear a thing. I agree
 100 per cent with Gus that you absolutely
 can't hear those aft-firing thrusters.

White My ear muffs are loose. They are always loose
 on my ears. So if you could hear it outside,
 I would have heard it. I didn't hear it. I
 heard Rate Command.

McDivitt Those attitude thrusters really make a noise.

White They make a big noise. It sounded to me like
 I could hear the thrusters firing and I was also
 detecting these pauses every so often. Several
 times I thought, "Oh, heck, it's stopped!"

McDivitt That's right. Especially, when we started
 getting down towards the bottom. The old fuel
 gages were going down toward zero and the time
 was running around. It looked like it was
 going to be a dead heat between which went out
 first. There was one particularly long pause
 at about 2 minutes and 30 seconds. I thought,
 "There it goes," and we made a quick correction.
 And when I stopped, I couldn't hear a thing.
 Nothing changed. That's all it was.

White Okay. I retract my statement.

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McDivitt Well, not knowing exactly what I was doing with the hand controller, you--I was making small corrections.

White That's the first time I'd heard that kind of a sound.

McDivitt We were getting it when we were chasing that thing around, too--when we were chasing the booster around.

White You were thrusting again. I thought this was the other one.

McDivitt Yes, that's right. So we got through the T_R-13 and T_R-12 Checklists. The T_R-13 and the T_R-12 Checklists really should be grouped together--the preparation and the CAMS retrofire.

5.5 T_R-5 Events

McDivitt Once more we started doing our checklist a little early. Since we had the time there was no sense in wasting it and then rushing at the end. So we went through what we could in advance of T_R-5 . The things we couldn't do or that didn't need to be done in advance we waited for until exactly T_R-5 . I guess this is where Ed got the

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first clue that the TRS was ahead of the ground time.

White

This is an area where I particularly watch the time. This is an area where I'm making a time check to start the elapsed timer going in order to get our time after retrofire. I was watching it pretty close. The indication on my watch was that the TRS was about a second or so early. I felt we had a good Greenwich Mean Time hack. We checked it several times and I thought we had a good one. With my time reference it was approximately a second to a little better early. At this time I had about half of the checklist completed before we got to the time for it. I verified it several times. It's not a hurried time at all, from 36 down, I don't believe. There's no time in there when you're really rushed unless it--

McDivitt

Yes. It is not hurried, provided you have everything else completed and you're not doing anything else but preparing for the retrofire-- you have nothing going wrong during this period. At T_R-5 the sequence lights came on a little

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bit early and that's where Ed got his first clue that the TRS was ahead of the other thing. I didn't notice it because I wasn't watching my event timer that closely. Ed got his GMT stop-watch started. Why don't you go ahead with the electrical, Ed?

White I turned the main batteries on, verified them on, and verified they were taking the load. They were in good shape.

McDivitt This is where we turned the OAMS off and the RCS on. Let me talk about the checkout on the RCS now. We had armed the RCS prior to the T_R-36 Checklist, and checked out each ring. When I was checking the rings out, I felt that I might have a thruster out. That was because when I pitched up or down, my top left yaw thruster was firing in one ring. I felt that I might be generating a rolling moment by having one of my pitch jets out and the yaw jets were having to take out this rolling moment. I checked it in one ring. I don't remember which ring it was. I went to Direct and did it again. It didn't seem to do it, but on the

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other hand, it didn't seem to make the spacecraft roll either. Then I turned that ring off and went over and did it on the other ring. Identically the same thing happened. I thought I might have trouble with the roll gyro. I turned the roll gyro to SECONDARY. That didn't seem to make any difference. We went back to PRIMARY. I remember commenting at that time that the RCS was a lot looser in control than the OAMS. It seemed to me that the OAMS held the spacecraft attitude better. It seemed like it controlled to a rate deadband that was smaller than the RCS deadband. I don't know why you're using the same gyros and the same electronics. The only thing that could be different would be the attitude drivers on the RCS might be activating slower than they are in the OAMS. It seemed like the rates were such a--seems like there must be a lag in the whole system. It seemed like the deadband in the RCS was twice what it was in the OAMS. It operated properly. There's so much difference between looking at that ball on firing retros

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and looking out and actually seeing the nose of the spacecraft moving around out there. There's no comparison with the simulator. You just can't simulate this. When I looked down at the ball and did the retrofire, it was just like the simulator. When I was looking outside and actually seeing what the spacecraft was doing as I controlled it, it seemed like it was a lot sloppier with the RCS than it was with the OAMS.

White We must have fired over New Mexico or Texas.

McDivitt Our retrofire?

White Yes. I could see the old brown sandy earth down right under us.

McDivitt Yes, Guaymas gave us our countdown, so we were over northern Mexico.

White That's the area that I thought we were over. Actually, it may even look almost a little like west Texas.

McDivitt It could have been. Then I did T_R-5 . I went to our retro attitude. We reported our T_R-5 Checklist complete. I don't know exactly when Guaymas came on the radio.

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McDivitt Yes. At T_R-1 there wasn't really much that we could do in advance, but whatever we could do, we did. There weren't many steps.

White We just waited for minus 1 minute.

McDivitt All you **have** to do is really just prepare yourself mentally, but at T_R-1 I told Ed, "We're at a minute.", and I guess Ed already knew we were at a minute.

White Yes.

McDivitt Ed did it just exactly as we'd briefed it many times. You punched the SEP OAMS. We heard the bang. He followed with a SEP ELECTRIC, rather quickly afterward as we had planned. We heard the bang. Then we waited a short time as we had planned, and fired the SEP ADAPTER. Then there was a great big bang. The tendency is to punch those buttons 1, 2, 3. We decided that we didn't want to go 1,2,3. We wanted to go 1, 2, (pause) 3. That was exactly what we did, and there wasn't any doubt whether the equipment adapter separated.

White I had no inclination to look around. I knew it

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was gone.

McDivitt That's when Ed hollered, "There go the pump packages! I see two pump packages out there. Just exactly what John Young said!"

White They separate right off to the left side. Jim couldn't see them because of the position of his head. I could see them.

McDivitt That's right. I never saw them at all.

White I could clearly see the two pumps together on the mounting and mounted together. They were right together. And I'll back John up to hit on that one. I saw them too.

McDivitt We got the adapter separated with all the attendant flying pump packages.

White Quite a flourish, isn't it?

McDivitt Right. It sure is. It was a big bang. There's no doubt about it. At T_R-30 , the T_R-30 Sequence Lights came on, and at that time Ed said, "The sequence lights came on about a second or a second and a half in advance." So, I armed retro squibs, and we discussed whether or not to punch off the Auto-retro Button or not. If the TRS was fast, I didn't

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want to punch it off ahead and have the retro-rockets go off early, but I figured that it wasn't in a hurry that much. But if it came on much earlier than that, it was really going to make us short. So, I finally decided that we'd go ahead and arm the Auto-retro Button at about three seconds so that we weren't going to be any more than 15 or 20 miles short as a result of the retrorockets going off early. We'd still get the auto-retrofire signal through, so that if something went wrong with the manual retrofire signal we'd still get the retrorockets fired. I felt that three seconds early would be better than a possible 15 or 20 second one in case we had to go through some non-nominal method of firing the retros in case the manual button didn't make it work. I told Ed to arm the auto-retrofire, and he did this at about three seconds and it fired automatically at between two and one seconds, I think, in the count.

White Yes.

McDivitt I felt that we got a one-plus second early

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auto-retrofire.

White Right. I did too. We went through the little discussion there from minus 30 down, and I knew what Jim's point was. I think I distrusted the system a tad more than Jim did, but I thought his logic was good. We had two systems working to fire the rockets. I was in full agreement.

McDivitt We went through and saved fuel for four days so we could do an OAMS retrofire. I felt if we're going to adopt that sort of philosophy and go through that long of a lean fuel period, then we could afford another few miles of inaccuracy thrown in by an early retrofire if we got the redundancy that you would get from a double-firing. So, I elected to go ahead and have Ed push it. Although it probably contributed on the order of 8 to 10 miles to our miss distance, I don't think it really hurt us that bad.

5.7 T_R-0 Events

McDivitt I had the spacecraft in the retrofire attitude, and when the retrorockets fired, I--

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White I had also pushed the manual button on time. So, it was about a second after they actually fired.

McDivitt Excellent. The spacecraft was in the proper retro-attitude and we got a real good push from the retrorockets. There are four distinct pushes, and I never felt a pause between any one of them. Did you?

White Yes, a little pause between each one. I think my cues were tuned up in a different manner than yours. Yours were working on the controls. Did you feel that you could actually see the acceleration? You weren't looking out the window.

McDivitt I was a little bit. It looked like we were actually turned around and started back the other way. Ha, ha!

White I really could feel the g's. Nothing that was uncomfortable, but I felt each one of them and I also felt looking out that I could see the spacecraft slowing down. I know it was such a pitiably amount compared to our velocity, but I was looking down on the ground when they fired.

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Your view of the ground is considerable at minus 30 degrees, and it did seem like I could see the spacecraft actually slow down.

McDivitt I don't know what the magnitude of the g's was during retrofire. We were super-sensitive, I'll tell you that. We'll get to that later. As a matter of fact, later on when I was debating about whether or not the g meter worked, I stopped and hit the reset button, and it did come down. It came down from something less than one to zero.

White I'd say between 2/10 of a g and 1/2 g during retrofire.

McDivitt I'd guess something about that order too. It sure seems a lot.

White Your cues are really up for the g's.

McDivitt You've been at zero g for so long, anything feels like it's a lot.

McDivitt I was at zero rates and in the proper attitude. I was in Rate Command when the retrorockets fired. I maintained the attitude very well. It was very easy. There were no deviations at all. Ed was standing by on the roll rate gyro

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in case it looked like I was losing control in yaw. He could turn off the roll rate gyro and get all the authority that I needed in yaw. As far as I could see, it never deviated more than a degree from where I was supposed to be. I don't think it ever got off that center bar in yaw, and it never got a dot-- that little dot--away from the 30 degree mark as far as I could tell. Could you see any, Ed?

White I was sitting there watching it and enjoying it at that time because the attitude was staying right on.

McDivitt Yes. It was right on. We got the ΔV in the right direction. Now, the IVI's didn't read out, because we didn't have the computer on, so we really couldn't tell.

White It was as steady as a rock. You could see the decelerations and locking out the window, I couldn't detect any movement in attitude. I was looking right down on the ground several times during several of the retros, and I think you could detect motion fairly well. I didn't see any.

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McDivitt I'll tell you. I was really happy after that OAMS retrofire and the retrorocket retrofire. I figured that we had exactly what we were supposed to, and I was positive we were going to come down on that cotton-picking carrier. I was really quite happy after that, because I don't think even in the simulator we ever had one that easy.

White Shall we make our admission on OAMS retro at this time, Jim?

McDivitt Yes. As a matter of fact it might be appropriate. I'm probably one of the biggest antagonists to the OAMS retrofire that there possibly is at the Manned Spacecraft Center, because I think it's a fuel wasting maneuver and a lot of other things. I still think it is. I'll still say one thing--after I fired the OAMS retrofire and I knew I was going to come down, I was a lot more relaxed than I had been before I got there. I'm going to have to tell Dr. Gilruth that, but I still think we can get by without it.

White It was nice to see it work. It was nice.

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McDivitt It was, and I was real sorry we didn't have a computer because after those two things, which I thought were done certainly as good as I could possibly do them. I felt sure that we could have landed right on the cotton-picking carrier's deck if we just had a computer to tell us where to go. I would have liked to have tried the guidance. I worked hard enough on that reentry guidance and I didn't get to use it.

White Jim, I think there is one thing that we left out--the reading of the percentage of OAMS fuel left. I think we called out 3 or 4 percent.

McDivitt That's right. I had 3 or 4 percent remaining on the gage. We called it out and it will be on the tape.

White I wrote it down at 3 percent. Here it is. 3 percent of the fuel left after OAMS.

McDivitt Yes, and it was a little hard to read down there and parallax was pretty bad. I estimated that it was 3 percent.

White I read off the quantity on the gage and it was a little over 1100.

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McDivitt 1100 psi?

White Yes.

McDivitt I'll tell you one thing about the out-the-window view at 30 degrees pitch-down attitude. You're really pitched down at 30 degrees.

White That's another thing that I noticed. I was looking out the window, and I surely wasn't observing much in the way of a horizon. I was looking at the ground.

McDivitt The top 2 inches of the window has the horizon in it. So, if you really had a bad retro and you got screwed up a little bit, you could lose your horizon.

White You could lose your horizon, but I think you've got a good enough view of the motion of the ground and an object on the ground. I think you could do a very effective job.

McDivitt If I really had to do an out-the-window retro I'm not even sure that I'd look out and use the horizon. I think I'd pick a spot on the ground.

White That's the point I was making. You'd put a grease pencil on your window.

McDivitt You'd have to use both.

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White I think you'd find a spot on the ground, and hold it.

McDivitt Because the spot on the ground is going to move.

White Yes, it's going to move during the fire. That's exactly what you do on an attitude ball, you know. You have a horizon and you have a spot and then you fly that spot. So, it sounds kind of like the thing I think you can do.

McDivitt The retrorockets fired, as I said, in the order 1, 2, 3, 4. We got the manual fire out-- button punched. Ed got that. We had said that because we're getting a countdown we were going to fire the Manual Retrofire Button exactly when we got to zero. We weren't going to wait around a second after that so that we got the computer and all that jazz on the line. We didn't have any computer to get on the line.

We weren't going to read out anything on the TVI's or anything else. All we were concerned with was firing the retrorockets.

5.8 Retropack Jettison

McDivitt I waited 45 seconds. I started rolling over at this time. When 45 seconds came, I had the

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retro-jett squib on, and I punched off the retro—

White The light came on and you punched it.

McDivitt That's right. The light came on at 45 seconds and I punched it. There was a real solid bang, and I knew we separated from the retro-pack. No doubt there either. As we went on down, we finally saw the retro-pack come on around behind us.

McDivitt Do you have anything else on the retro-pack jettison? I guess not. That's pretty simple.

5.9 Communications

McDivitt We got the com from the ground.

White I thought we had good communications with the ground.

McDivitt No problems with the communications. I was a little concerned with the communications earlier in the flight, because we weren't getting anything. We weren't getting retrofire times or any other information. But towards the end of the flight communications were excellent.

5.10 Update

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McDivitt The update was awful, I think. As I mentioned earlier, they updated our TRS but the TRS was obviously not running with the ground.

6.0 REENTRY

6.1 Reentry Parameters Update

McDivitt We really didn't have a reentry parameters update post-retro. We went into black-out pretty quick. There wasn't anything to update. We were going to start rolling at 400 000. Regardless of anything else, we had a pre-programmed reentry.

6.2 400K

White We were at 400K before you got your 3 - Minute Update.

McDivitt That's right. At two minutes and 38 seconds we were through 400 000 feet. We got there in a hurry. I rolled upside down, and I flew down to 400 000 feet, which was to be at 2:38. However, I thought that we'd retrofired a little early, so I wasn't in any great rush to start my rolling reentry. I delayed about another 30 or 40 seconds. The only reason I delayed was because I knew there wasn't any rush to get

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over, because if we were going to be anyplace, we were going to be short. I just wanted to get over and get in a good attitude. So, I rolled the thing upside down, got the--

White One thing--on the Post-retro Checklist, we decided this time to use Reentry Rate Command rather than Direct.

McDivitt That's right.

White That's a deviation on our checklist.

McDivitt When I got the thing upside down, I was still in Rate Command. I held the lift vector up, heads down, until I got down to about 3 minutes and 15 seconds. I got my 3 minute time hack from the ground. I got my clock counting up a 3 minutes. At about 3 minutes and 15 seconds I started the roll. What I did was, I put in about 15 degrees/second, and then we turned off the roll gyro. I just left the thing rolling. I controlled the pitch and yaw inside the rate deadband, which was plus or minus 4 degrees, just as you would in Direct. I still had the rate deadband to take care of any wild perturbations that we got into.

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CONFIDENTIAL6.3 .04 g

White We didn't even have a time for .04 g's did we?

McDivitt No. We didn't have anything like that. We started rolling reentry at 400 000 feet, except that I didn't start it until about 45 seconds after that to make sure that I had good attitude. I started the thing around the way I wanted it. Just about this time, we saw the retro adapter start floating back past us. I figured the other day that thing was small-end-forward rather than blunt-end-forward.

White I'd say it was front-end-forward too.

McDivitt We saw the spherical end of the retrorockets. Remember?

White Yes. All four of them.

McDivitt All four of them. We didn't see the nozzle. It had done a 180-degree turn small-end-forward and it was as stable as a rock. We could see the whip antennas sticking out to the side.

White Exactly the position it should go to. That's the heaviest end, I would presume.

McDivitt It would tend to trim that way too. Except that

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I didn't think there would be any aerodynamics at 400 000 feet. But it was turned around 180 degrees and was perfectly stable with the whip antenna sticking out, which at that time was up to the right.

White Yes.

McDivitt We were upside down. It sure was a funny looking sight.

White It sure was. It was really pretty.

McDivitt And it was as stable as a rock and very slowly drifting behind us. As a matter of fact, for a while I thought that our opening velocities were too slow, and I thought it would just come back and hit us. But, it just stayed out there, and we started our rolling reentry there. We were coming on down and we were rolling around and before I got any noticeable g's at all--Isn't that right--before we got any noticeable g's it started burning?

White Okay. We saw the reddish pink layer come around the spacecraft--

McDivitt Well, didn't we see the retro pack start burning before the--?

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White Whichever way we saw it, it's on the tapes, because we discussed it pretty thoroughly.

McDivitt That's right, as we were doing it. But I sort of vaguely recall that watching the retros after us as we spun around, it started glowing a little bit and then you could see this big spray come off the front--shock or something. It looked like it was just melting and coming away. It just looked like a great big orange mushroom back there, and that's when it really started falling behind us.

McDivitt We hadn't felt any g's at all. Had you felt any g's?

White Not that time.

McDivitt I'm sure that I hadn't felt any g's.

White I was wondering why we were so light. We were looking down at Florida. We had watched Florida go by and commented on it.

McDivitt Shoot, we really made a low altitude pass across the States. We should have probably filed a DD-175 to get clearance.

White We had to come through the control zone, you know, at Eglin. They're kind of sensitive about

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lower altitudes.

McDivitt ... started glowing and burning and it was as stable as a rock as long as I could see it. Did you ever see it tumble?

White No, never did.

McDivitt Okay. It was behind us and it looked like it just ate the front right off, and I guess when we first saw it, it was on the order of 200 feet, maybe?

White Yes.

McDivitt And the last time I saw it, it looked like it was about 3/4

White That was about the position that I saw the booster for the first time.

McDivitt I think you're right. I guess we could see the dome on it and all that stuff. As a matter of fact, it was a pretty good reentry shape. It looked stable as a rock.

White It stabilized right out.

McDivitt So, we finally saw it drop behind us and burn up. As it finally started drawing behind us.

White We started to get --

McDivitt The first thing I saw was the orange flame--the

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orange or pinkish flames coming out. It looked like the flame was coming up around my side of the spacecraft like this. Was it doing that on your side, too?

White Yes. It looked like it was almost coming from three points.

McDivitt Okay. Probably what it was doing was coming around both sides because of the angle of attack and going out this way. But I definitely could see the orange fire come up around the left-hand side of the spacecraft and out in front of the window, and pretty soon I saw some green fire--

White Coming out of the top --

McDivitt Oh, is that where you saw it? I didn't. I saw the green fire down close to the left-hand side coming up over the nose inside of the red fire, and then it was all swirling around there. Then while we were coming down, we were coming down in a roll, but with our relatively high L/D, we were in a great big roll with a big wallow. I guess this is really indicative of how much lift we had.

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White It looked to me like we were getting a lot of lift out of it.

McDivitt It looked to me we were getting an awful lot of lift out of it.

White It was really whipping around there.

McDivitt And we were going around at a pretty good rate. The needle was off to the left. That's right. It moved out slowly, slowly and got out to about 2 degrees and it just held there. The spacecraft was as stable as a rock. I damped the thing a couple of times in pitch and yaw and it just stabilized right on down there. I don't think I even touched the pitch again. I think I maybe touched the pitch four times all the way down and the yaw maybe six or seven times. What I was looking at was just a huge portion of the sky. I could see the ground, then I could see the sky, and I really saw a lot of the country as we came rolling by.

White What surprised me is how much it was. I knew why it was doing it but I thought it was --

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arc was that this thing cut out. That thing was a real lifting body. You're really getting a lot of lift initially, and if you roll around there, you'd kill it all off; and your aerodynamics is such that you really can't tell, because the stability is so loose right there.

White You know you're going to get some lift if you have an offset CG, but you couldn't tell where it was going.

McDivitt You're in the area where you're getting a lot of lift so if you do a roll, you've lost that range right off the bat. We came down on this great big spiral, and here I think we ought to get into --

6.4 Acceleration Profile

McDivitt -- the acceleration at retrofire. I called down on the ground and told them that we had four retros. We got automatic. We got auto-retro. We got all four in sequence. We got auto-retro. Auto-retrofire appeared to be about a second and a half early. In the acceleration profile I said, "Well, here come the g's, Ed." and I felt the g's going up. He said yes.

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White I said, "Yes. There are two of them, aren't there?"

McDivitt Yes, and then we waited a while longer and--

White I said, "Gee, there's nothing on the g-meter."

McDivitt I said, "The g-meter must be broken ",so that's why I reached up and reset it. It actually went down a little bit. So we went a little while longer, and I said, "Ed, I feel a lot of g's ", and he said, "So do I." Then he said,"We must be up between three and four."

White If felt like that.

McDivitt And I said, "Yes, I think we're up about that high too." And the g-meter was still reading zero for all practical purposes. Pretty soon it started building up slowly. It went up to 2, 3, 4, and I called out at 2, and I called out at 4, and I called out at 6, and I think I called out at 7.

White About the time you called out the 2, I knew we had been had.

McDivitt Yes. It's just that we were super-sensitive to g's and the load pulling us into the seat was on the order of a tenth of a g.

White It's true.

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McDivitt So, we had $1/10$ g and we thought we had 3. And we both felt this way. The g's went up to about $7 \frac{1}{2}$. They told us we would probably get 8 g's coming down. When we got the instrument positions back from the spacecraft, the post landing switch positions, they had the g-meter marked at $7 \frac{1}{2}$ g's, and I suspect that's probably about as high as it went. Now, I'm telling you this was really a piece of cake. I thought that maybe $7 \frac{1}{2}$ g's after being out there for so long would be tough, but I didn't even have to breathe hard to get any air. I just lay there and relaxed and enjoyed the whole thing, and I really got a big kick out of that reentry.

White We chatted back and forth. We talked through the whole g-load, and I was watching outside and inside. I was looking out quite a bit of the time when things were going so smoothly, particularly the g-load. When you get to the high g's, you might as well look out, because you're not going to do anything about it, and I noticed no dimming in vision. Everything was as clear as a bell. Not a speck. I could see

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everything on the instrument panel, and I could see things very clearly outside.

McDivitt Things were going so smoothly on the inside that I looked out too. I enjoyed the scenery on the way down.

White Once you get in that position and you get the high g's you're not going to do anything inside.

McDivitt In the amplitude of the oscillations, --all the simulations show that they tend to decrease as you get to high g's and the frequency picks up. So the only thing you could do is hurt things if you start screwing around with it, except we didn't have any oscillations anyway. It was just as stable as a rock.

White I think at this point I'd like to put something in. I'd like to find out when they analyze the data whether the upper right-firing thrusters on my side were firing a whole magnitude more than the right-hand upward-firing thrusters. In fact, they very early in the profile became a cherry red and just stayed red hot, even a little bit white hot all the way down.

White There was no frequency to it at all. It appeared to me they were firing continually and I think

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maybe this might associate itself in some way with something in the system prior.

McDivitt I think it was prior, because we were in Reentry Rate Command and we started the roll. Then the yaw needle drifted on out and it looked to me like it never got over about 3 degrees/second. I was trying to read the 0.1 degree/second scale. It might have gone on to 4 degrees/second with the roll rate we had in there, and the jets just kept right on firing constantly.

What I had done when we started was to leave the roll gyro on, and I rolled the thing over till I got almost full deflection on the needle. Then I put the roll gyro off so I'd have 15 degrees and we wouldn't tend to overrate the thing so that the Reentry Rate Command was firing all the time. What I think happened was that as we went on down, the yaw rate needle tended to drift on out. I don't know if you noticed it or not, but it tended to drift out. It started at around 2 degrees/second, and it drifted on out slowly until it got to about 4 degrees. I thought it never got out to more than 3 degrees/second. Later on, when we started oscillating

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around like we did, if the thing were out at 3 degrees and started banging back and forth at all, the yaw thrusters would be on constantly; and also that's the side that they'd be on. It would have been on the right-hand side. Are you sure that it was red that high up, or did it get red when we started getting down where we got all those oscillations? Because there I'm sure it was firing all the time.

White it was red for a long time, Jim.

McDivitt Was it?

I was actually watching it, waiting for one of them to bust loose, because it was really firing a lot more than I thought it was out there. Jim asked me about the frequency of it, and I couldn't tell whether it was on or off. It was red all the time. The other one was hardly heated up at all.

McDivitt Shoot. There wasn't any need for any kind of firing then.

White it would be interesting to see if the other yaw thrusters were.

McDivitt Well, it'll be interesting when they cut these things apart to see what kind of life cycle --

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White It really had a good workout.

6.5 Spacecraft control

McDivitt Spacecraft control was like a dream. A good engineering description. There weren't any oscillations. It was as stable as a rock. I don't think we need to say much more about that. It wasn't like any failure simulation we've seen. It was the easiest thing to control, easier than any simulation I've seen. Shoot! A baby could have done it.

McDivitt We started getting oscillations around there and the Reentry Rate Command fired a few times and I damped it in pitch and yaw. There really wasn't any control problem to it at all, I didn't feel. Did you think there was?

White No. I would have been watching closer if I had thought there was.

6.6 100 000 feet

McDivitt The altimeter was at 96 700 feet throughout the entire flight. It started on down, and we were still at about 5 or 6 g's when that thing started on down. It went on down to about 92 000 feet, and then the g's started off, and the altimeter started back up again.

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It went all the way back to about 96 000 feet again, and then it started down again. The second time it started down, it really started down in a hurry, and I was sure that we were still at 100 000 feet.

McDivitt So, I waited until the g level got about 3, which is around 80 or 90 thousand feet. I started slowing the roll rate there. I wanted to get the thing to a zero roll rate by the time we got to 40 or 50 thousand feet, certainly by the time we got to 40. We started gyrating around some more, but I didn't think it was exceptional. The Reentry Rate Command started firing. As a matter of fact, I said, "Here comes the Reentry Rate Command," and then I was firing on top of it so that we really weren't oscillating too much. Then we got to 40 000 feet and I put the drogue chute out, and that's where things really got exciting.

6.7 50 000 feet

McDivitt I put the drogue out at 40 000 feet. We were nice and stable as we went down. We were a heck of a lot more stable than we were when we put the drogue chute out.

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White That's right by several orders of magnitude.

McDivitt When we put the drogue chute out, we were concerned about the thing destabilizing rather than stabilizing. So I intended to put the drogue out and leave the control at Reentry Rate Command. This I did, and we oscillated all over the sky. We estimated plus or minus 40 degrees, and I think we were at least every bit of that.

White We were, and when the drogue chute came out, I was right in the sun so I couldn't see it, and I didn't know whether we had one or not. You called it out, and about the time you called it out, I could see it up there gyrating wildly around.

McDivitt I never could tell whether the thing dereefed or not. I had a lot of goop on my window and the sun was out, and all I could see was the shape of the drogue up there, and it really was fluttering around. We were plus or minus 40 degrees to it without any doubt, and I wouldn't be a bit surprised if we weren't plus or minus 60 degrees to it. We were really getting tossed around. It was just jerking all around.

White It was fast, but I don't think it was that big a

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magnitude. (McDivitt is making a noise to describe it.)

McDivitt About like that.

White I was really surprised the thing held on there, to tell you the truth.

McDivitt So was I. I was expecting the drogue chute to fall off any minute.

White I was, too.

White It worked all right.

McDivitt It held us together.

White If I went through it again, I'd be perfectly happy sitting there riding through it, to tell you the truth.

White The way I looked at it, it was rather interesting. I hadn't quite expected that.

McDivitt Neither did I. I know that Gus said that he had a pretty wild ride and he thought the thing was destabilizing him. He had a scheme where he just turned off the propellant valves to stop the propellant flow. That meant that he had to wait about 10 or 15 seconds to get the propellant valves back open again to get the jets firing. Well, I wasn't going to do that. I thought the thing to do was to turn off the electronics

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and see if the thing was going to become unstable. This is what I did. I turned off the RCS electronics. The thing was that they didn't get any worse. It didn't get any worse. I watched it. I could see enough of it to tell that we weren't becoming unstable.

White It was unstable to a point and then it stabilized out in this oscillation.

McDivitt That's right. It was really gyrating around. By that time we were down to 20 000 feet and I called, "20 thousand feet. Pull down the handles", or something to that effect.

White You called out 28.

McDivitt Is that what I said? And then, I pulled the propellant valves, as I had planned to do, and turned the control mode to Rate Command rather than Reentry, because I wanted to burn up all the fuel that I could out of those manifolds. As a matter of fact, I was interested in burning up all the fuel I could before I got to the ground.

White I have a question. I thought you put it in Rate Command before you turned off the valves, and it pretty well damped itself out on the

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drogue.

McDivitt No, I don't think I did.

White Okay.

McDivitt I don't think I did. I think I left it in Reentry Rate Command until I turned it off and then turned off the power. I went from ACME to OFF on both rings. It didn't get any worse. I think what I might have done is I might have gone from OFF to ACME to Rate Command, to turn the propellant valves off rather than going from --

White Well, I know it damped out there in the end considerably. I think it was when the Rate Command, or whatever it was, was firing.

McDivitt Well, Reentry Rate Command was going all the time. We were going at a heck of a lot faster rate than 4 degrees/second.

White Well, we cut down our oscillations considerably after you did something over there. I thought you had put it in Rate Command.

McDivitt I did put it in Rate Command, but I didn't leave the propellant on. This was why I wanted to get rid of all the propellant onboard the spacecraft if I could. But I didn't want

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to let those things fire for a long time and maybe eat up the drogue chute, and find ourselves without propellant and without drogue chute, too. So, once we got the drogue chute out, I let the things fire for a while and turned the electronics off. Maybe I turned it back on and went to Rate Command, and off with the propellant valves. I'm not really sure.

White I think you had it in Rate Command for a little while ---Probably while you were firing out the fuel.

McDivitt Yes, that's what I did. I went to Rate Command and let all the fuel fire out, just as we had planned. So that I was sure that the rates were high enough that we were going to fire out the fuel without disturbing the thing on the drogue. So we fell on down. Ed got the snorkel on the vent valve about 28 to 27 thousand feet. We came on down. I watched the altimeter go through 11 000.

6.8 Main Chute Deployment

McDivitt At 10 600 I punched out the main chute. I saw it go out with a lot of crap and corruption flying off the nose. It went out and came out in a reefed condition, and I saw and I said we had a good reefed chute. I don't guess you

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could see that too well, could you?

White No, I couldn't see the chute out. I saw it finally when it deployed.

McDivitt I saw the thing hanging up there just the way it was supposed to, and then the thing dereefed, came billowing out just the way it should, and I said, "We've got a good chute". One edge of it collapsed and came back in and collapsed about a third of the chute. We've seen a lot of movies of these chutes coming out, so I wasn't really worried about the thing collapsing. It went in and came back out.

6.9 Communications

McDivitt There weren't any communications that I could tell were there? Maybe we received some transmissions on the drogue, but I'm not really sure. As soon as we deployed the main chute the antenna came off. So we couldn't talk to anybody after that.

White I don't think we got anything on the drogue.

McDivitt I'm not really sure that we did.

White I don't think we did.

McDivitt Shoot! We were getting thrown around so that we couldn't have heard anything anyway.

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They tried to communicate with us a couple of times after we came out of the blackout and before we put the drogue out. I didn't hear exactly what he was saying. He wasn't hearing anything I was saying either as far as I could tell. He wasn't acting like he heard what I was saying.

White He gave us our blackout times of 5-23 and 9-21, and there really wasn't too much we could do to check these out.

McDivitt After we got the main chute deployed, I told Ed, "Quick! Take your blood pressure." The chute came out around 7500 feet or so, and when we finally got the thing dereefed we were floating down nice and gently. Ed started taking the blood pressure, and it seemed like it took an eternally long time. By the time we got down around 5300 feet or so, I said, "Ed, get the blood pressure done because at 5000 feet we're going to go to a two-point attitude." He fooled around and fooled around and fooled around. Finally we got down to 5000 feet and I said, "Ed, you've got about three or four more seconds, and we're going to two-point attitude."

White It was a little slow. I don't know why.

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McDivitt I didn't want to trust that altimeter. Ed kept fooling around with that blood pressure without getting any air out of it, and finally I said, "Okay, Ed, we're going to go to two-point." I guess by then he had the blood pressure completed.

White I think we got a good blood pressure.

McDivitt So, just like we'd always practiced, I said, "3, 2, 1, MARK " and punched the single-point release.

6.10 Single-Point Release

White We both had our heads braced up on our arms.

McDivitt We had our arms up on the windshield and my head wasn't exactly on my arm. Was yours?

White My head was on the arm and pressed over to the side of the spacecraft. I was well wedged in, I felt.

McDivitt So was I. My head went forward a little bit, back a little bit, then back up forward again, and it didn't hit anyplace. Did yours?

White No. I had my head pressed on my arm the whole time. I don't believe it left the arm very much, because I actually had it wedged from behind, too.

McDivitt So, I thought going to two-point was a lot less violent than the ride on the drogue.

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White I agree with you. I think we've got a good operational procedure of bracing your head on your arm up against the window--a satisfactory procedure for this.

6.11 Postmain Checklist Items

White We took the blood pressure on the main chute, too. I went through what I call the reinforcement items on the checklist that I wanted to get off right away, and then I sat back and pumped off another blood pressure. About this time you were making your calls to the recovery force.

McDivitt Right. I started calling the recovery forces as Ed was taking his blood pressure. We got some response from Omnibus right away.

White Good old Omnibus.

McDivitt Yes. And we went right on down. We stowed the D-ring covers. We stowed the D-ring covers between deploying the main chute and going to two-point, just as we had planned. We didn't want the D-ring to flop around there, and once you go to two-point it's too late to eject anyway.

White I called Jim to unstow his D-ring at 35 000 feet and he took his out at that time. I pulled his

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right arm lift up and I saw him pull his left one up.

McDivitt No, I didn't get my left one up. I made three passes and I said to heck with it.

White I thought you got it. I struggled with mine and finally got it up. I had both of mine up, and you went on and completed the checklist.

McDivitt I knew Ed wanted me to get my D-ring out because I was the guy that was going to have to bail us out.

White Again I'd come down with this big bag of stuff resting on my legs up against the bottom of the seat, and as we approached 35 000 feet, I pulled this up in my lap, and just held it. We had agreed that Jim would do the ejection if we had to, and I would just take the ride. I didn't unstow my D-ring. I just sat there. That's why I made pretty sure that Jim got his out.

McDivitt After we got on the main, we went through and turned off all the switches, just as we were planning on doing it. I turned off all the switches on the middle circuit breaker panel except the ones on the last couple of rows. I

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turned off the IMU, the rate gyros, the horizon scanner, and those switches on the center pedestal. I didn't turn off any over on the left hand side except the Landing Attitude Circuit Breaker.

White May I ask you a question? Did you think it was a shorter time from 7500 feet down to the ground than it was in the simulator?

McDivitt Yes, as a matter of fact I did.

White I thought it was a considerably shorter period of time.

McDivitt Yes, we went from 5000 feet to the ground in nothing flat.

White You're not kidding--nothing like we go down in that simulator. I would be curious if we have any data that tells us what our descent indicator was telling us on our descent?

McDivitt It was jumping around. It was between 30 and 40 feet/second like it does in the simulator.

White It seemed like we went down awfully fast. I would already finished turning off everything in the simulator with quite a bit of margin, but, of course, I did take the two blood pressures in here. I got all the essential

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switches off and started turning off nonessential ones when you called out a thousand feet.

McDivitt At a thousand feet I said to get ready to pull out the water seal.

White That's right.

McDivitt You got the water seal out at about 700 feet?

White I pulled it about 500 feet.

McDivitt We pulled it lower than we usually do because usually we're sitting there waiting to go through a thousand feet.

White Right.

McDivitt We got down to about 300 feet, and I said let's prepare for landing.

White Right.

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7.0 LANDING AND RECOVERY

7.1 Impact

McDivitt We got down to about 300 feet, and I said, "I guess we ought to get ready for landing." But as John Young says, "How will you get ready for landing this thing?" So as he did, we just sat there, and we went through zero feet, I believe, on the altimeter.

White We hit very close to the water with zero on the altimeter.

McDivitt I think we hit at about minus 100 feet or so. Anyway, we really plunked down in the water. We hit ten times harder than I expected to hit. The altimeter was set at the lift-off setting. I didn't fool around with setting it.

White That's an interesting point. They ought to give you an altimeter setting for the landing area.

McDivitt I don't think that would do any good. I wouldn't trust that altimeter within a thousand feet.

White No, but I'd rather have my reading on it that much more accurate. You've got a ship sitting out there that could give you the exact altimeter setting. Here we had an altimeter that we hadn't set for

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four days. I hadn't thought about this.

McDivitt The last time that altimeter does me any good is when I go through 10 600. Well, I guess I use it down to about five or six thousand when I'm trying to get the two-point suspension. It's useful there, too.

White It was a good indication that we were coming up to 1000 feet and to get ready for landing, Jim.

McDivitt Yes. Like I said earlier, how do you get ready for landing? All we did was sit there.

White We've got to stop throwing switches.

McDivitt Yes, I guess so.

White I think it would be a good procedure to go ahead and get an altimeter setting.

McDivitt I suppose it would. It only takes you a second to crank the thing in.

White Yes. It's there. We ought to use it.

McDivitt Well, we hit the water with a real wallop. Then I sort of felt that we went into about a 150-degree roll to the left and were dragged backward. We were almost upside-down going through the water backwards. Now, the CAG here saw us hit. He saw us from about 100 feet on down. He said it looked like to him that we came down and hit the water

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and tilted the thing up over the top. He said we were going blunt-end-forward, but we were actually tilted over the top. We then did a patch_down maneuver about 180 degrees in the water. I was surprised that we were being dragged backwards, but I got the sensation that I was going backwards and almost upside-down.

White I had the kind of feeling that we went in and touched over a little bit, and that's about all the feeling that I got. I don't believe we got dragged very much.

McDivitt No, but I just felt that was the way that I was going. I was being pressed back in my seat like I would be if I were being dragged, and I was thrown over to the left like I would have if we had rolled over this way.

White I got the left roll and I also think that I had less water in my window than you did. I had a lot of spray and stuff. Did you have solid water in your window?

McDivitt I really didn't look that closely. I didn't look at the window to see what I saw there. I saw nothing but water sloshing all over the thing. We really seemed to hit hard, harder than I thought

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we would, but it really wasn't too hard.

White To put everything in a comparison, the ride on the retro was more than I expected, the drop to a two-point suspension was less than I expected, and the impact was not as much as I had experienced on the drogue, but more than I had expected. In other words, the biggest surprises I had in order of magnitude were the ride on the drogue, the impact, and I didn't think that I had much surprise at all in the two-point. I was expecting a big jolt and got not as much as I had expected.

7.2 Checklists

McDivitt We'd gone over the normal Water Egress Checklist in flight before we came down. We did this in that three-hour period while we were preparing for retrofire. I read it over to Ed while he was stowing things, and we went over it in detail again as to what we would do. Also we went over the emergency egress in case we had to do that. So we had it fresh in our minds.

White We turned everything off that wasn't needed after landing.

McDivitt Ed had the Post-landing Checklist and he read it out to me--the things that I had to do. The only

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thing that I didn't do was to take my helmet off and stow it. I did get my arm restraints down. I didn't put my drogue mortar pins in until I was getting out, and I never did put my seat pin in. It doesn't say on the checklist to put it in.

White I put your seat pin in.

McDivitt Ed put my seat pin in for me. Now, we'd got all the switches in the right positions, I think, except one. I forgot to put my FDI to the OFF position.

White I think all other switches were all right. All our pyrotechnics were safed.

7.3 Communications

McDivitt I talked on UHF. I talked with Omnibus, and I finally was talking to Inkspot 64, the helicopter. I talked to him and I heard him, and we established excellent UHF communications. I heard Gus coming through the auto cap two times, I think--very weak, almost unintelligible. I think he was asking how we were, or if they had us yet. I kept making transmissions in the blind to him. I don't think he was ever getting any of them. Ed operated the HF, and what do you have to say about that?

White Okay. I put the antenna out and turned the HF on.

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I went through one call, and then I went through a short count on the HF. I heard nothing and received nothing from anybody else. This was about 5 minutes or so after we had been on the water that we actually made the HF check. Maybe it wasn't even that long. As soon as I got all the switches where I wanted them, I went ahead and--

McDivitt I saw you put the antennas up, and you went ahead and put in a transmission pretty quick.

White Right. I didn't make another check on the HF. I hadn't been too impressed with the operation of the HF up to this time, and things were getting pretty busy. Five or 10 minutes later we had the recovery people on. I guess we're going to get to that. I heard them say we had a helicopter almost overhead.

McDivitt They called just after we retrofired, I think, and before we got to blackout--called and said that they should have a helicopter over us in 5 minutes. We didn't get any onboard data. The ground information that I got was, as I said, from Gus. Then right after we hit, Omnicus said, "I got them in sight. I'm 48 miles out on PACAN radial..", something or other. So, I figured we

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were 48 miles from the ship. Well, anyway, I was pretty sure we were 48 miles from the ship. Then I heard them calling back and forth saying the helicopters were only 15 or 20 miles away, and they were there in just about nothing flat. We had a good status report on where everybody was. They were on our frequency, and I could hear them dumping their swimmers into the water and standing by and throwing smoke bombs out and seeing the dye markers; and we had more activity than the fourth of July.

7.4 Systems Configuration

McDivitt Okay, as we hit the water, Ed closed the inlet snorket to make sure we didn't get any fumes in as I punched the Parachute Jettison. Shortly after that when we decided for sure that we wouldn't see any fumes--we sort of talked about it a little bit and I peeked out and I guess you peeked out. Didn't see anything but steam coming out of the thrusters and then saw the dye marker out there-- I reached up and re-opened the inlet snorkel.

White That's right.

McDivitt I put the recirc valve at 45 degrees.

White Actually, shortly after we got on the water, I

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noticed the acrid smell that we were to have for the rest of the time we were out in the water. On the ECS system I could actually feel the relief that the pumps and the snorkel-open position were giving us. It did provide some flow. I really didn't think that the heat was oppressively hot, to tell the truth.

McDivitt No, neither did I.

White It was uncomfortably warm--I'll put it that way-- and very stuffy, but I wouldn't say it was overbearingly hot. It wasn't as hot as I thought it was going to be in the spacecraft.

McDivitt I thought the worst thing about the whole thing was the smell. Whatever was burning later was the heat shield, I guess, because I went out and smelled the spacecraft later on when I was onboard the carrier, and it smelled the same way. This terribly nauseating acrid smell was still all over the spacecraft, and it seemed to be worse at the heat shield. So I assume that's what we were smelling inside.

White How was the control, Jim?

McDivitt Spacecraft control in the water is lousy! I couldn't take out the motions. The rates were terrible

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uncontrollable! Why don't you discuss the electrical. It was over on your side there, Ed.

White

Well, there wasn't really much to discuss about it. I turned off the No. 1 and 2 squib batteries and left No. 3 on and the main batteries on, and everything performed as designed. We also had carried along two adapters and about the time Jim said, "Hey, where's my adapter?", I realized where it was. It was stowed underneath a whole pile of trash on the right-hand side. So we went to Plan Bravo, which was our original plan before Chuck Berry sneaked on the extra adapter on the last day before the flight, which is a rather sneaky thing because we'd agreed at breakfast that morning that if the adapter were on the spacecraft, we wouldn't kick about it. But Chuck conversely agreed that if the adapter wasn't on, he wouldn't kick about it either. We later found out that he ran to Chuck Matthews and--

McDivitt

No, as a matter of fact, he didn't run to him. Chuck Matthews said that he decided that on his own. Chuck Berry never --

White

All right. I'll have to apologize to him because I have been falsely accusing him ever since.

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Anyhow, we had an extra one on, and it was stowed very neatly under a great deal of trash on the right-hand outside stowage box; and I felt that we could more readily use the time of switching back and forth. So we switched the aeromedical adapter back and forth, and with the microdot connector it was a pretty easy operational procedure. I don't think we missed any radio calls, and I think we got probably more blood pressures there than one every 15 minutes.

McDivitt Yes, we would probably get one every 5 or 6 minutes.

White We were back on the carrier in 45 minutes, and I'm sure we had two or three blood pressures there on the water.

McDivitt You even got the lightweight head-set on.

White That's right. I very dutifully put the lightweight headset on with my helmet off. I felt better with my helmet off, and I think you felt better with your helmet off.

McDivitt I felt a lot better with my helmet on and my visor closed, because I didn't like the smell of that stench there.

White I was so hot over there. I felt better with it off.

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McDivitt We did a lot of work when we first landed. We were fiddling all over and getting things out of boxes and stuff like that. We probably did more concentrated manual labor in those first 5 minutes after we got on the water than we had done at any other time during the flight except trying to get the hatch closed.

White I think at this time I was completely drenched with sweat. I said it wasn't hot earlier, but with the combination of the suits and the fairly warm climate that we were in, I was sweating pretty heavy. I looked over at Jim, and he was pretty sweaty too, I think.

7.5 Spacecraft Status

McDivitt We didn't have any RCS fumes. We didn't see any RCS colored smoke, which is supposed to be red and purple or yellow or something like that. We didn't see any fumes at all. I saw a little steam.

White I saw steam.

McDivitt I saw a little steam coming out of the RCS thrusters, and I was sure that there wasn't any RCS propellant in those manifolds, because at the rate we were gyrating around with that tight deadband on Rate Command, if we hadn't burned all that fuel up by

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then, we never would have gotten it out.

White But we turned the RCS thrusters off at about three or four thousand feet. So they definitely weren't on.

McDivitt That's right. And we turned all the circuit breakers off on the RCS thrusters, so they shouldn't have been firing from shorts. The prop valves had been off at about 25 000 feet. So we had everything the way it was supposed to be, and we didn't see anything leaking. I'll comment on this window.

White I saw the main chute floating right to the left of us. I think my window might have been a little clearer than yours.

McDivitt I just was going to comment on the windows. My window was terrible! I couldn't see at all. Remember the helicopter was hovering around in front of us about 200 feet away and I never even saw it. You said, "Look at the helicopter!"

White He was a lot closer than 200 feet. He was right smack-dab in front of us.

McDivitt I never saw the helicopter. I couldn't see through the window.

White I'd estimate he was not farther out than 50 feet from us.

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McDivitt I had a couple of little holes right down at the bottom where I could see swimmers down there, and I could see the nose, but I couldn't see up at all. We were talking about the main chute there. I saw the drogue chute floating down right next to it-- drogue chute and the pilot chute with the R & R can floating down right next to it. They were coming down through about--let's see. We were on our backs then, weren't we? We still hadn't gone to two-point?

White I don't remember.

McDivitt I don't remember either.

White I was so busy taking blood pressures.

McDivitt We had the drogue chute and the pilot chute floating down with us for a long time just off to one side going down about the same rate. I thought that they were supposed to go down slower, but I guess it doesn't. I guess what probably happened was we saw them at single-point, but when we went to two-point, we lost sight of them. Okay. We didn't have any leaks that I could tell. We had electrical power. I didn't check to see what the secondary O₂ pressure was. Did you, Ed?

White No. I didn't.

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McDivitt We turned off all our electrical equipment and couldn't read the gages. We left the hatches closed. We were in moderate seas, but I wasn't about to open those hatches up and take the chance of any water getting in that spacecraft. So we elected to stay in the spacecraft until they got the collar on, and kept all the hatches battened down.

White Okay, we both discussed this together and decided that the way we'd like to leave the spacecraft was in our suits, and we felt that rescue was coming pretty quick. We decided to go ahead and stay in our suits. I think this was a reasonable decision.

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McDivitt We both took our gloves off to get the things out of the spacecraft that we wanted. I left my helmet on and Ed left his helmet off. When we got ready to leave, we decided that we would put our gloves back on, take our helmets off, put our neck dams on, inflate our May Wests, and then get out. That's what we did. The sea condition was just like they said it was--three to four feet. Three to four feet in that thing is like 2000 foot waves to an aircraft carrier. We were bobbing around but we had a lot of experience bobbing around before, so it wasn't that bad. I might add that the egress training in the Gulf of Mexico really made me feel real confident when I was out there in that water all by myself.

White When we get to that training, I'm really going to give some gold stars out.

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McDivitt Yes.

7.6 Post-Landing Activities

McDivitt As I mentioned, we stirred around the cockpit and got out a bunch of little bitly things that we needed. We did a lot of work but we were doing all right. We got awfully hot. I guess we really can't say much about the post-landing activities. It went long as we expected it to, just the way we want it to. Ed, do you have anything?

White I think we've covered it.

7.7 Comfort

McDivitt I was hot. I think Ed was hot. We were both perspiring a lot. I think we could have lived in it for a lot longer than we did. Don't you?

White Yes. Did we cover the point where they called and asked what kind of rescue we wanted?

McDivitt No, I didn't. Why don't you? I was just plugging in the bio-med connector and I heard them call you.

White We could either have a helicopter pickup in about 20 minutes or we could have a pickup by the carrier in the spacecraft in about an hour

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and 40 minutes. To me it was very clear.

McDivitt It took Ed a long time to decide-- about two or three milliseconds.

White That's right. I felt that I knew my buddy well enough and made the decision that we'd take the helicopter pickup. I saw that he was actually on the radio at the time and he rogered the decision. So we waited for the helicopter pickup.

7.8 Recovery Force Personnel

McDivitt We had good communications with the recovery forces. They were on our frequency. We heard all the transmissions that were going back and forth. Shoot, we probably knew more about the recovery than anybody else around. They got the flotation collar in the water in a hurry and came over and put it right on. I saw this thing around the spacecraft and I saw it start inflating. I was really elated when I saw that thing purping up.

White I had the first contact with the real live man.

McDivitt That's right. He looked in Ed's window to see if we were alive, I guess.

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White Very good sight. The best sight, boy, was seeing that yellow thing around the spacecraft. I guess I knew we were going to be able to file out pretty quick.

7.9 Egress

McDivitt As I mentioned earlier, we had decided to go out with our gloves back on and our neck dams on. I stood up in my seat, disconnected our survival landing gear (my other hoses were disconnected so that I could stand up), inflated both of the May Wests, snapped them together in the front, and I just jumped right over into the life raft. I landed right on my can, just like I had planned it. It was so good to get out of there. Ed got out. He jumped in too.

White When I got out I actually leaped in before I inflated my May West and I think either you or--

McDivitt I told you. As a matter of fact, when we talked it over in the spacecraft about getting out, Ed said, "Aren't you going to inflate your May West?" And I said, "Okay", and then he got out without inflating his.

White I was so happy to see that raft I jumped right

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over the side.

7.10 Survival Gear

McDivitt We didn't use any of our survival gear. We didn't pull it out. We just left it exactly where it was. I disconnected the lanyard so we wouldn't inadvertently pull it out.

7.11 Crew Pickup

McDivitt As soon as Ed got into the life raft a helicopter come over toward us and I motioned for Ed to get into the sling and go on up. He didn't want to. He wanted to be the last man up and I wasn't going to leave my sinking ship.

White He wasn't getting up with the captain going first so he went up last.

McDivitt No. Ed got into the sling and got a nice pickup. I got a Gulf of Mexico pickup. He dragged me out of the water, bumped me up against the heat shield and the spacecraft, but it was a good pickup though. Shoot, I was so happy to be out there in that nice cold salt water blowing in my face, I was dipping my hands in it and slinging it over my head.

White Did you notice the stability of that helicopter?

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I never knew they were so stable.

McDivitt Yes. He must have had a good stabilization system. They got us picked up safe and sound.

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