NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

JERRY L. ROSS
INTERVIEWED BY JENNIFER ROSS-NAZZAL
HOUSTON, TEXAS — 4 DECEMBER 2003

ROSS-NAZZAL: Today is December 4th, 2003. This oral history with Jerry Ross is being conducted for the Johnson Space Center Oral History Project in Houston, Texas. Jennifer Ross-Nazzal is the interviewer, and she is assisted by Sandra Johnson and Rebecca Wright.

Thank you for joining us today. We really appreciate it. We know your schedule is very busy.

ROSS: It's good to be here, and it's nice that the holidays have slowed down a little bit. The holiday period has slowed things down a little bit, so, glad to join you.

ROSS-NAZZAL: Great. I'd like to begin by asking you about your interest in space. I've read that in fourth grade you decided you wanted to become an engineer and go to Purdue [University, West Lafayette, Indiana].

ROSS: Right.

ROSS-NAZZAL: Can you tell me how you came to this decision at such an early age?

ROSS: Well, I feel blessed that I did, and I feel even that much more fortunate that I've been able to follow through on it. I actually grew up during the space race, and the threats of A-bombs

being lobbed both directions and stuff. During that period of time, people were starting to talk about rockets and their capability for warfare, but also the capability that they would have to launch satellites and maybe even people into space. That captivated my imagination.

I can remember watching Disney shows about Wernher von Braun's ideas of Space Stations and all that kind of thing. And I, literally, was so fascinated by it that all my family members, the bigger family of aunts and uncles and cousins, knew that I was fascinated by it, and many of my aunts and uncles would save their *Look* and *Life* magazines, and other things that had articles about space in them, and send them to me. So, with my mom's help, we actually cut out the articles and made a scrapbook.

It was then in the fourth grade that was the time frame when the first Sputnik was launched in October of 1957, and the first U.S. satellite was launched in January of '58. Being in the fourth grade, that obviously was a momentous occasion for me.

It was through reading the articles that I'd put in my scrapbook, I found out that it was scientists and engineers, for the most part, that were making that happen. I truly didn't fully understand what an engineer was, but I knew that they had to use a lot of math and science. I liked math and science, as far as I knew at that point, as a fourth grader. So I thought that that's what I wanted to do. I wanted to become an engineer. And since many of the articles that I read were from Indiana, they tended to focus on the people who were from Indiana, and many of them had gone to Purdue University for their academic degree. So, be an engineer, go to Purdue, get into the space program, that was the formula for me.

Literally, with that goal, my mom always said that I was really a one-track kind of kid, one-track mind. I started working on farms that summer, and every dollar I made driving tractors or bailing hay or whatever I did in the way of jobs around the farms or elsewhere, all that

money went into a bank account that I'd established, and other than buying a bicycle and maybe a motorcycle or two along the way, all that money went towards the college education.

ROSS-NAZZAL: How closely did you follow the human spaceflight programs?

ROSS: Oh, very closely. In fact, I played hooky when John [H.] Glenn launched. My mom let me do that. But I kept a scrapbook going, or at least followed everything very, very closely.

ROSS-NAZZAL: What are your memories of the Apollo 11 landing?

ROSS: That was in July of '69. I was in college at Purdue. I was working in Gary [Indiana], in United States Steel [Corporation] for the summer, which is what I did for four summers going through college. I can't remember exactly the sequence, but I remember they landed in the afternoon, and then they went out on a spacewalk that evening.

My wife-to-be, my fiancée, was up visiting, and we all sat there late in the evening watching our TV and getting ready for Neil [A. Armstrong] to take that first step and sat there in the family living room. My wife-to-be was sitting on my lap. My younger sister had her little camera out and she was snapping away, pictures of the screen of the TV, and I'm going, "That's not going to come out." But they did, which was pretty amazing. And just totally fascinated by it.

Karen will tell people that she used to watch me sit in front of a TV for hours on end, and watch nothing happening in mission control, other than the picture of mission control.

I was totally captivated all the way through college and beyond with the space program, and many of the decisions I made on academics and other decisions were things that I did in a calculated way, trying to help me get closer to what I ultimately wanted to do.

ROSS-NAZZAL: Did you ever think that you might be an astronaut?

ROSS: Initially, no. I mean, when in fourth grade, the term *astronaut* really wasn't even invented yet. I mean, people were just starting to think about sending men into space. But as time went on, and as I got into Purdue then, and was getting close to the completion of my academic program, and had signed up for the Air Force ROTC [Reserve Officer's Training Corps]; the Air Force was the DOD's [U.S. Department of Defense] prime user and provider of space assets, and operator of those. That was one of the reasons I chose the Air Force ROTC over any others that might have been possibilities.

Also I started following, with some curiosity, the fact that NASA was starting to think about building this thing called a Space Shuttle, and you'd not have to be a military pilot/test pilot to qualify for the program. So that piqued my interest, and I kept very close tabs on that from that point on.

In fact, when I came onto active duty in the Air Force in 1972, was the year that NASA let the contract for the Space Shuttle. It's also the same year that that Air Force let a contract for a B-1 bomber, which I ultimately got to fly on and do flight testing on later on. So that was another significant year, '72, finishing my degrees, coming onto active duty in the Air Force, and having those two very significant programs be initiated.

ROSS-NAZZAL: Why don't you tell us a little bit about your career with the Air Force, before you came to NASA.

ROSS: Okay. I came onto active duty in February of 1972. I went to Wright-Patterson Air Force Base in Ohio. I can honestly say that I hand-picked every desk I sat at during my twenty-eight-year-plus career in the military. I had several military people that were in advanced degree programs at Purdue when I was going through on my master's program.

When I became assigned to the Air Force Systems Command, which is their R & D [Research and Development] branch—or was; it's all changed now—I talked to some of the people that were there [at Purdue] on military assignment to get their degrees, and told them I'd like to work at Wright-Pat, because that's relatively close to family, and with little ones it would be nice to be able to get back and see grandparents and things.

So one of the guys pulled out his Wright-Patterson Air Force Base phone book from his desk, and he opened up—he knew that I'd been working on ramjet propulsion as my research program—and he gave me a phone number of a guy at the Air Propulsion Laboratory at Wright-Patterson, and I called him. This was just before, I think, Thanksgiving vacation. I said, "Hey, I'm completing my master's degree here at Purdue. I've just been allocated to the Air Force Systems Command, I've got a background in ramjets, and I'd like to come work for you."

And he said, "Okay. I'll check into it and see what we can do." And I packed up. Soon as I got off the phone, we packed up and left and went to my in-laws for the holiday. A couple hours later he tried to call me back and tell me that I'd been hired, but I didn't get that message until he called me early that Monday morning, following the holidays. So that was my initial cut at how I was going to get into the Air Force.

I went to the Air Force Propulsion Lab at Wright-Pat, and worked there as a ramjet engine project engineer. I had almost no computer background, because that was something that was just coming into being at that point. I'd had a little bit of Fortran programming in my junior and senior year. The first job I had at Wright-Pat was working in a shop of three or four people that were in charge of doing all the computer-aided design work for this group of about fifty or sixty engineers. There was two captains and a GS [General Schedule]-13, and a new lieutenant called Ross in there.

So they started giving me these programs so I could start getting smart on them. Well, within about a year, year and a half, the two captains were gone and the GS-13 had been RIF'd [Reduction in Force], so I was the only guy left in that shop to provide all the computer support for all the rest of the folks. And while I don't really enjoy computer programming and that kind of stuff that much, it was a benefit to totally immerse me in it, so I had a much stronger background and capability in it than what I had before.

After that, then I was given a job of conducting a test out [on] sled track at Holloman Air Force Base [New Mexico]. They had a missile that had actually been flight tested, but the facilities at the Tullahoma Tennessee Arnold Engineering Development Center [Arnold Air Force Base] did not allow this missile to be tested on the ground at anything other than a zero-degree-angle attack. And they thought that maybe by putting this one remaining missile that was available onto a sled track at Holloman and shooting it down the track at 2.7 Mach—in about, let's see, about ten seconds it got to 2.7 Mach, so it was pretty cool—and then lighting it off and trying to get some data on performance of the missile, first of all we'd do it at zero-degree-angle attacks so we could repeat the wind tunnel data, and then we would cant it at four-degree-angle

attacks so that we could get some validation of the principle of testing air-breathing missiles on a sled track like that.

So for the first couple of runs on the track—I think we did a total of six of them—I worked with a more senior engineer, and then the program was turned over to me for the rest of the program. That was a great hands-on experience of real practical engineering work, and yet doing some theoretical work as well.

I was fortunate in that I had some supervisors that allowed me to have about as much responsibility as I could possibly stand, and they challenged me with exciting and interesting jobs. I did well at them and they went to the effort of writing me up for awards and things like that, which kind of helped to set me apart from some of the other folks, maybe, and they also continued to challenge me with new jobs.

The last job I had as an engineer was working on a computer-aided design of a ramjet missile that would be an air-launched missile that could be used for attacking airplanes or the ground. This put me into somewhat of a moral conflict, because it would have been potentially a nuclear-armed missile, and I wasn't too comfortable dealing with that kind of thing. But I still did some of it, so that I had that experience behind me as well.

After I'd completed that program, then I was asked by the outgoing head of the laboratory to serve as the Executive Officer for the incoming colonel. I had applied at that point for the Air Force's Test Pilot School, because I had followed the Shuttle Program and I knew from experience that it was flight-test flying people and flight-test-background kind of people that had been hired into the astronaut program earlier, and it made sense to me that if they wanted test pilots, then maybe flight-test engineers would fill the bill for the mission specialist category that they'd be hiring for Shuttle.

So I had applied to the Navy Test Pilot School, but I found out that I didn't have enough time in service and things to qualify to actually apply. So a year or so later, I applied to the Air Force's Test Pilot School as a flight test engineer student. The first time around I was an alternate and wasn't included in the program.

But let me back up. I had committed to take this job as executive officer in the Propulsion Laboratory, and I told the colonel that was coming in that I'd applied for this program. He said, "Yes, I understand that, but I want you to commit to being in the job for at least a year, to give it some stability," and everything.

And I said, "Well, okay." So when this application for the Test Pilot School had worked its way through the system and the selections had been made for the classes, I did come out as an alternate, and then somebody backed out, and I actually did receive notification of pending orders to go to Test Pilot School. But since I'd made this commitment to the colonel, I went in and I said, "Here, boss."

And he says, "Well, you made a commitment."

I said, "Yes, sir, and I'll live up to it." But he was good enough then to call the guy who was the head of the Test Pilot School, another colonel, and explain the situation, and hope that it wouldn't be taken as prejudicial for me on subsequent selection processes. And fortunately, the next year, then, after I'd completed my one-year tour, I was selected for the next class.

So that took me from Wright-Patterson to Edwards Air Force Base [California] in the summer of 1975, and I went through the Air Force's Test Pilot School as a flight test engineer, where we had classroom academics normally in the afternoon, and then we would do flying in the morning. The concept was to go to the same academics as test pilots, and learn the same kinds of principles of testing and what's of interest, and how to analyze the data once you'd

collected it. And then we would go fly, to collect the data, do the different types of tests, and then to analyze the data and do the reports on what we'd learned.

I got to fly in T-38s, T-33s, F-4s, KC-135s. Probably around fifteen or twenty airplanes altogether was the total that we got some experience in. But one of the neat things was I got to fly with Brewster [H.] Shaw, a future astronaut, and Mike [Richard M.] Mullane was also in my class, another future astronaut, both of which I got to fly with on subsequent Shuttle flights once I was selected into the Astronaut Office. Mike sat right in front of me and Brewster sat next to me, so we were the only three from my class that were selected, so it was kind of a fortuitous situation.

I did well in Test Pilot School. I came out as the top flight test engineer grad [graduate], which then gave me additional opportunities in terms of kind of helping me select what I wanted to do. The B-1 bomber at the time was the Air Force's highest priority program, and after going down the street to the flight test engineering guys and talking to them, I was given the opportunity to come onboard as a B-1 flight test engineer, and to work in the stability and control and flight controls area of the B-1.

Shortly after I got into the B-1 program was when NASA put out their first call for astronaut selection, in '77, and just like everybody else at Edwards Air Force Base and at other flight test centers around the country, everybody was scrambling to get all of their paperwork pulled together and submitted. It's my recollection that there was close to nine or ten thousand people that NASA had applications on for that class, being the first astronaut class they'd had since Apollo era. And I was extremely excited when I was notified that I was going to be one of the 210 brought down here [for interviews], but I was very disappointed when I wasn't one of the thirty-five that was ultimately selected for that class.

But I went back to work and continued to fly on the B-1 bomber and do flight testing, and that was really a rewarding experience for me. The B-1 was a very complex airplane. Being a mechanical engineer and by academic training, and being responsible for the stability and control and flight controls testing of the B-1 was very challenging to me, because when I got to Test Pilot School, I didn't know the difference between an elevator and an aileron. So it was quite a growth experience for me to be dealing with a very complex airplane, trying to understand its aerodynamics and its performance capabilities in an area that was totally foreign to me up until the year that I went to Test Pilot School.

I got to fly, I think, a total of 23 flights on the B-1; had about 150 hours or so flying on it. The interesting thing was that the B-1 and the Shuttle were both built by Rockwell [International Corporation]. The cockpits looked amazingly the same in terms of the layout of the instruments, the type of instruments. Many of them were identical. So the first time I got into a Shuttle mockup and trainer, I went, "Wow. This looks very familiar."

It was a great growth experience. I think that it gave me a good background, a solid understanding of what it takes to be a crew member and fly under somewhat stressful conditions, and to be able to ignore the environment and perform what you need to do, to do the given task. So I think that my intuition of what might give me a good leg up, eventually, to apply for the astronaut program was well founded, and by a series of taking advantage of each opportunity as it came along, and not giving up too easily, which is something I always preach to kids, is that they need to do well in academics; they need to set goals for themselves; they need to pursue those goals and not give up too easily. Those are the kinds of things that have worked well in my career, and something I've always tried to stress to young people.

In fact, now I've been doing that for long enough that I will have either young people or their parents come up to me and say, "Hey, I remember when you came and talked to my fifth-grade class. I heard what you said and now I'm an engineer," or, "I'm a medical doctor," or, "I'm a teacher," or whatever it is, whatever their calling in life was. But they listened and prepared themselves, and now they're enjoying the fruits of that.

So in a way, I get a good sense of what teachers must get as a reward for their hard efforts, is that I've got some of that same type of feedback from young people. So it's been pretty nice.

ROSS-NAZZAL: Yes, that must be great to have that sort of impact on an individual.

ROSS: You just never know. Sometimes you'll talk to a large auditorium of students and you don't think that anybody is listening. They're all sitting there poking their buddy or whatever, you know. But every once in a while, evidently somebody's listening.

ROSS-NAZZAL: Let me ask you another question. As you pointed out, you put in an application for the '78 class and you weren't accepted. But you were encouraged, I understand, by someone on the selection committee, to accept a job as a payload officer. Can you talk to us about that?

ROSS: Right. Well, this is part of "Don't give up too easily." I was extremely frustrated when I was sitting there at Edwards and all my friends were boxing up and getting ready to go to Houston to become astronauts. But at the same time, I've always tried to look ahead and try to plan ahead. So one of the things I did a couple, three months, I don't remember exactly when,

but a period of time after the selection announcements came out, I called George [W. S.] Abbey, who had been the head of the Selection Board, and said, "Hey, I'm trying to figure out what to do with the rest of my life, basically. I'm trying to find out whether or not you guys saw something that totally turned you off, or could I expect it to be reasonable to anticipate a possibility of another interview on a subsequent selection."

And fortunately, they said, "No, we didn't see anything that we didn't like, and in fact, we hope that you'll apply again."

I said, "Okay. Well, with that understanding, I'm trying to figure out what to do with my career and how I can enhance my opportunities for a subsequent selection." And at that point I had agreed with the Air Force Test Pilot School to go back and be the head of the flight test engineer curriculum for them, and would have done that probably within the next year. The Air Force had also asked me if I was interested in going back to get my doctorate, and then going to the Air Force Academy as an instructor, or going straight to the Air Force Academy as instructor with a master's level of education.

I told Mr. Abbey those were the options that I had staring me in the face at that point, and he says, "Hey, those are all good options, but there's one more I'd like you to consider, and that would be to come to Houston as a military officer, working as a detailee in our payload operations area, and help us with the integration of military payloads into the Orbiter from an operational perspective."

After doing some soul-searching—and he said, "No promises should be expected, and none are being made here. But it gives us a better chance to look at you, and it gives you a better chance to understand the organization and what the astronaut job would be all about." So I knew if I did that, I might be shooting myself in my foot because it may be the last time I ever get to do

flying in the Air Force, if I went down to NASA and wasn't selected, and then try to figure out what I was going to do with the rest of my Air Force career. But at the same time, when somebody like that suggests that you come down here and go to work, it opens up another avenue of opportunity and experience that you hadn't anticipated.

So I made the commitment, and it took us about a year to work the Air Force assigning me down here as an Air Force detailee. I worked in the Payload Operations Branch, initially working on the inertial upper-stage vehicle, and making schematic drawings and things like that, that would go into the flight controller handbooks.

Shortly then I started picking up jobs working with some of the more senior NASA engineers, on helping to do the initial meetings with the Air Force and other organizations on starting the process of integrating military payloads into the Orbiter, and what it would take from a security or classification standpoint, and how we dealt with all those different issues. After a period of time, basically, I was then assigned as the person responsible for all the military payloads that were being integrated into the Orbiter, and that was a real handful.

It was about that time frame, then, that I applied for the next selection of astronauts into the office, and was interviewed in early 1980, and the announcements were made, I think, in May of 1980. And that time, out of I think it was around 6,000 people applied, they interviewed 120, and picked 19. And then our class added two European mission specialists, so we ended up with a class size of 21. And everything was off to the races from then on.

ROSS-NAZZAL: Let me ask you if you could compare the '78 application and interview process with the 1980 process. Did it change at all?

ROSS: It didn't change at all, is my recollection. And, in fact, the process here, in terms of the interviews and physicals and everything else, were basically identical. They were performed in different facilities from what they had been done the previous year. And it's kind of interesting, because when I walked out of the interview process, which is the most significant part of the whole week, the one-hour interview, I walked out the first time thinking, "Well, I don't think I messed anything up too bad." Didn't get selected.

The second time around, I walked out and I thought, "Ross, you idiot. You just blew it. You might as well pack your bags and go." And then I got selected. So you just never know, I guess is the bottom line.

ROSS-NAZZAL: Tell me about that phone call, when George Abbey called you.

ROSS: I was working over in Mission Control Center. I was getting trained on how to use the consoles and the communications systems and everything else, and they had tracked us down over there, and I got this phone call. I had known, by the way, that there were four of us in the Payload Operations Group who had been brought down here after not being selected in '77, '78 time frame—Mike [John M.] Lounge, Bonnie [J.] Dunbar, a guy by the name of Jerry [Robert J.] Jost, and myself—that were all working there. We quickly found out and figured out that we were probably competing against each other. I was the last guy to get into the organization, so all the good deals had already been sucked up, as far as I was concerned. I had found out that at least one of the others had already got a call and been told that they'd been selected, and that the calls were going out. So that morning, everybody was on pins and needles.

Three of us ultimately got selected. Jerry Jost was the one that was not, but I think he had medical things that disqualified him. So, anybody that would have been a reasonable betting person would have never thought that three of us out of the four would be selected in the class. So when I knew at least one of them had been selected, I was not expecting a phone call from George. I was expecting a phone call from one of the other board members that was going to be, "Sorry, but no good" again.

George tracked me down over in Mission Control Center. I was called to the phone. I recognized his voice. I'm going, "This sounds good." And basically, he asked if I was still interested in going to work in the Astronaut Office, and I don't remember the exact words, but he understood something that meant yes. And from then on, I mean, I just blew off the rest of the training session. I floated across the ponds, I think, back to Building 4, and went up to our offices, which were at the other end of the third floor from the Astronaut Office facilities, and found out that both Bonnie and Mike had been selected, too.

So we had a party at Mike Lounge's house that evening, to celebrate, and it was unbelievable. My kids were up in Indiana. We had taken them up a week or so earlier. School had just got out, and so we had to call them and tell them that Daddy had been selected into the Astronaut Office. I think my wife and my folks and maybe my kids, but maybe they were too young, I think they had mixed feelings. I think my folks were apprehensive that I might get selected, but they were also afraid that I wouldn't, and so my feelings would be that much more dashed than they had been in the previous times. And I think probably my wife had the same kinds of emotions and feelings going, too. But what an amazing day that was.

ROSS-NAZZAL: Great memories.

ROSS: Yes.

ROSS-NAZZAL: Why don't you tell us about the training that you underwent as an AsCan [Astronaut Candidate].

ROSS: Okay. Basically, we were still trying to figure out how to train astronauts, so our training program was not anything close to what it is now, and it was much less effective. In some ways it was good and in a lot of ways it was not so good. We got a lot more in-depth training on a lot of the parts of the Orbiter and the solid-rocket motors and external tank, that you really don't need to know, you never see, you can't do anything about them.

We got training about the nuts and bolts of the solid-rocket motors and the external tank and things that I've never heard about since we went through that initial training. So it was a somewhat frustrating training period, especially for all of us that were used to a very high level of activity and very intense working. The training was kind of laid out in parcels. It was, as I said, not very effective or efficient, so we ended up having to learn a lot of the stuff ourselves. We were given a lot of material, but trying to separate the wheat from the chaff was not easy.

I was already knowledgeable on flying a T-38, so my checkout program for the T-38 was pretty quick. Some of the civilians who had never flown before, it took them a much more lengthy training period. I think one of the nicer parts of the training period was just getting to know the rest of your class members. We did some field trips to some of the other NASA Centers and stuff, and had a lot of good times, and some things I'm sure that are in Bonnie Dunbar's book that probably shouldn't see the light of day.

I guess that's about all that I really remember about it. We didn't get much of a chance to do what the AsCans do now. We didn't get into simulators and do training. All of our training was basically books, and a little bit of the single-system trainer. But the single-systems trainers back then really were almost just cardboard layouts, many times. There weren't even actual functional switches in the simulators. There were not the computer-driven displays, for the most part, that they have now, which are very high fidelity and all that. So we were still in the very formative stages of the Shuttle Program, and so we had to deal with not very high-fidelity training aids or programs yet.

But albeit, we knew that our class was not going to fly for a considerable period of time, and so we had the luxury, if you will, of knowing that we were going to have time to get a lot of that training through other methods, including the on-the-job training kinds of things that we were going to do, supporting the program as we got ready to go fly.

I guess that pretty much summarizes it. It was about a one-year-long program. Towards the end of that one year we were asked to make out our desires on what things we'd like to do in the way of on-the-job training, or at least first and early jobs in the Astronaut Office. I have always wanted to do spacewalks, as I think most astronauts do. That was my second thing, because I didn't think I would get it. I put down SAIL [Shuttle Avionics Integration Laboratory], which is our avionics testing facility, where we test the software in the Orbiter and make sure that everything functions and works properly.

I think I broke the code. I think I found out that if you volunteer for SAIL, they won't give it to you. I think the reason, probably—this is why I tell people I think the reason is—I think the reason I got assigned to EVA [Extravehicular Activity] was because I was the class rock. When we did our swimming training and our scuba training, I was the guy that sank to the

bottom. I can't swim. I still can't today. We had a couple of different people in the Astronaut Office who had Red Cross swimming training, badges and all those kinds of things, try to teach me how to swim.

Mary [L.] Cleave took me over to Bill [William F.] Fisher, Bill and Anna [L.] Fisher's house, into their swimming pool. She says, "This'll be a half-hour thing. No problem. We'll have you swimming." She showed me several strokes, and either I sank straight to the bottom or I went backwards. After a couple of sessions, she says, "You're right. You can't swim." [Laughs]

And I worked with the scuba trainers, George Price and Bill [William F.] Moran, and basically, they didn't care if I could swim. Well, they wanted me to swim. But once they figured out that I couldn't swim, and I couldn't tread water, and I sank like a rock, then they just got to the point where they made sure that I was comfortable with the water. I wasn't afraid of the water. They put a snorkel and fins and mask on me and I did ditch and dons, and demonstrated all that. They tried to get me to float, and with my overexpanded chest I could get about that much out of the water. And, of course, every time you had to take another breath of air and exhale, the water covered the whole face, and so that didn't work too well.

But finally they got me to the point where I did scuba and I did all the ditch and don stuff, and I've scuba-qualified. I've never let that lapse. In all my time in the office, I've never let my scuba qualification lapse, because then I'd have to go back through the whole re-cert [certification] process, and I certainly didn't want to have to go through that.

So I started working in the EVA area. Bill Fisher and I were the two guys responsible for EVA types of activities, along with some of the more senior guys like Jim [James F.] Buchli and Joe [Joseph P.] Kerwin and Bruce McCandless and Story Musgrave. I was responsible for

procedures, and Bill was in the suits and stuff, and I got to do a lot of the early development of tools that we used for contingency payload bay door closing and things like that.

I can remember getting my suit qual [qualification] in an A7LB, which was a spacesuit that was used during Skylab era. I used Pete [Charles] Conrad's suit, and Pete's about five-five or something like that. So, getting into the thing was a little bit of a challenge, and once it was inflated it felt like the shoulders were going to collapse down to my knees, because it was just tearing me up. By the time I got out of the suit, I was qualified for the water tank, and that's all I cared about.

From then on, then I got to do more and more work. I did a lot of work over at the Marshall Space Flight Center [Huntsville, Alabama] on early developmental work for the Hubble Space Telescope. I did that for probably a year or so, developing the tools and techniques for making it an on-orbit serviceable satellite. Much of the work I did, ultimately was not implemented, or deleted because of cost overruns in the program, and I said, "You guys are going to be sorry."

And they were, because a couple of years later, after they'd made that decision, they went back in then and tried to retrofit EVA capabilities into a lot of the systems, which caused them to have to build literally hundreds of tools, because they hadn't been done right in the first place. But still, a lot of the things we did were incorporated into the satellite, and it, hopefully, helped to make it the success that it ultimately has been.

I also started working on the final development of the Manned Maneuvering Unit with Bruce McCandless. I used to accompany him up to the Martin Marietta [Corporation] plant up in the Denver [Colorado] area, where they had a six-degree-of-freedom flying machine, if you will, that allowed you to fly up and down this room and across the room; went up and down, and

then orientations as well, attitudes as well, and to learn how to fly the Manned Maneuvering Unit.

Then Bruce and I also worked on the development of the techniques and plans for capturing and repairing the Solar Maximum Satellite, that ultimately was done on STS-13 or 41-C, as we changed the numbering because people were superstitious. So since I had done the developmental work on the Solar Max Satellite, and since I had a broad breadth of experience in EVA area as well as Manned Maneuvering Unit flying, I was ultimately assigned as the support crew member for 41-B and 41-C, and my responsibilities were in the area of EVA, and some in robotics, because I had worked in the robotics area for a while also.

I was the office's head for development of the arm for a bit, and also was responsible for helping both those crews develop some of the rendezvous techniques they were going to use for joining up with the Solar Max Satellite.

My overriding responsibility was to make sure whatever we did on 41-B as a precursor, the demonstration of many of these techniques and pieces of hardware, would cooperate and provide the knowledge and capabilities that were going to actually be implemented and used on 41-C for the capture and repair of the Solar Max Satellite.

So I got a lot of in-depth experience there. It's when I started to get into the simulators and to learn the checklist procedures and stuff. I was also assigned then as their capsule communicator, CapCom, for those flights and some subsequent flights, and specifically I did the complete CapCom'ing role, but I also was the guy for the spacewalks on all those flights as well.

I got to do some development of some contingency procedures that were ultimately used on those and some other flights as well. So, it was really in the game. I really felt like I was a contributing member of the team at that point, and not just doing the developmental things that

may get used some day, but I was actually there, almost part of the crews, and helping to make sure that everything went well.

I did the CapCom'ing for those two flights. I also did the CapCom'ing for STS 41-D, Judy [Judith A.] Resnik's first flight and Mike Mullane's first flight. And also, then, I was brought in as a CapCom and support crew member for 51-A, which was when we went and recovered two satellites that had gone into the improper orbit on 41-B, one of my other flights.

Again, they used the Manned Maneuvering unit. This is Joe [Joseph P.] Allen and Dale [A.] Gardner that went out and retrieved those two satellites and brought them home, and they were subsequently re-launched on expendable rockets. Again, Manned Maneuvering Unit was used. I was the CapCom for just the spacewalks on that flight, and had, again, also developed some contingency procedures that we had to use because some of the hardware didn't fit properly on orbit.

I was also deeply involved in the development of the spacewalk and the RMS [Remote Manipulator System] procedures that we used for the flyswatter trick. Boy, what flight was that? I don't remember what flight that was. Anyhow, if you remember, we had a SYNCOM satellite that came out, and it comes out like a Frisbee, out of the payload bay of the Orbiter. There's a little spring-loaded lever that's held against the side of the payload bay, and as the satellite comes out, then that spring throws a switch which is supposed to activate a timer, and after some period of time the rocket engine's supposed to fire and shoot the satellite to the proper insertion orbit.

We couldn't tell if the switch had been thrown or not, but the satellite didn't fire its rocket motor at the expected time. So we had the crew fly back in after we had attached a couple of mechanisms. This was Senator Jake Garn's flight, by the way. We had fabricated some

things that kind of looked like flyswatters, and we had developed the procedures on the ground on how to attach these things to the end effector, the outside of the end effector on the end of the arm. Dave [S. David] Griggs and Jeff [Jeffrey A.] Hoffman went out on a spacewalk to attach them, and I literally walked them through the procedures of how to do it, based upon what we'd learned and developed in the water tank.

We used a TV camera looking over their shoulder to watch them and coach them, and when we lost signal, we just said, "Okay, take a break. When we get TV again, we'll continue the task." And we did that. They attached it successfully. We flew up next to the satellite, and Rhea [Margaret] Seddon was the arm operator, and she held the flyswatter out gingerly against the side of the spacecraft and the mechanisms caught the little lever arm, what should have been sufficient to throw it if it wasn't completely thrown, and then they backed off and waited and the satellite didn't go anywhere.

So a subsequent mission with Bill Fisher on it and Jim [James D. A.] van Hoften went up—that would have been 51-[I], I think—went up and basically hotwired the satellite. It had been improperly wired, so they had to do some jumpers around it to provide a different way of firing the rocket motor, and that was successful, and that satellite went on into orbit.

Let me see. That kind of gets me through most of my work. Let me go back and talk a little bit about the robotics activity. Once I got into the EVA area and worked EVA, I never let it go. Even if I wasn't officially assigned to it, I continued to work in it and to do whatever I could to have opportunities to get in the tank, do development or testing work, that type of thing. I also was assigned as a lead robotics person for a while. Judy Resnik and Sally [K.] Ride had been doing that, but they had been assigned to flights and were starting to get to the point of needing to turn it over.

So I got to go up to Canada, to Spar [Aerospace Limited] in the Toronto area, and do several developmental runs, several of them looking at NASA satellites, some of them looking at military programs, and some of them just developing basic principles and controls and displays, and making sure that the arm operated the way that the operator would like to see it, and things like that. Again, the simulator was fairly rudimentary. It didn't have the nice visual displays that we've got now. It was basically just kind of line drawings, and it made it kind of tough to visualize what you were seeing many times. But overall, it was satisfactory for what we needed to do at that point.

So I think that was basically my jobs in the Astronaut Office until the time I got assigned a flight. I worked EVA a lot, as you've heard. I worked robotics. I worked as a support crew member. I guess the one other area I did is I did do a considerable amount of work also on military payloads, working on crew aspects of those over the period of time that I was getting ready for my first flight, and then subsequent to that, as well.

ROSS-NAZZAL: Let me go back and ask you a couple of things. You mentioned that you worked as the EVA CapCom on several of these missions where they used the MMU [Manned Maneuvering Unit].

ROSS: Right.

ROSS-NAZZAL: For instance, on 41-B, what were you thinking when Bruce McCandless finally got into that MMU?

ROSS: Those lucky guys. [Laughter] I knew that Bruce had waited a long time and worked many, many years here in the office to get a chance to fly, and so I was happy for him and Bob [Robert L.] Stewart when they got a chance to go outside and do their thing. So I ended up being the EVA CapCom and support crew member for every flight and every EVA that used the Manned Maneuvering Unit. That was a lot of fun to do that and to watch those guys do that. But you can imagine how envious I was getting, sitting there on the ground and watching all those guys go out there and have fun.

So when I got assigned to my first flight, it originally had the EASE [Experimental Assembly of Structures in Extravehicular Activity] and ACCESS [Assembly Concept for Construction of Erectable Space Structure] experiments on it, and then, as you might remember, during that period of time, many times the payloads were shuffling between various different flights, and the crews were getting shuffled all over the place. So I lost my EVAs, and I was really bummed out by that, because I was really looking forward to it.

But Woody [Sherwood C.] Spring and I kept track of the experiment, and when we got bounced to another flight we said, "Hey, there's room for that experiment in there." [Laughs] And talked to the program people, and ultimately it did settle out that we did have the EASE and ACCESS experiments on the flight with us. And what a great time that was.

ROSS-NAZZAL: Could you share with us the role that you played when they had some trouble capturing the Solar Max Satellite, and then also capturing and stowing PALAPA.

ROSS: Yes. The Solar Max Satellite, the plan was that we had a capture mechanism that had been mounted between the arms of the Manned Maneuvering Unit, and George [D.] "Pinky"

Nelson was going to fly out to the satellite and use this to capture a trunnion that was on the side of the satellite.

Everything worked great until we tried to do the capture of the satellite, and we found out later, in looking at it, that there was a little Teflon nub that had been installed on the satellite to hold the thermal insulation on the outside of it in place, and that had not been documented in the satellite drawings. The satellite was never expected to be handled by humans on orbit, even though some of it was designed for on-orbit servicing, and this was just one of our lessons learned from that mission, was that you need a very carefully documented configuration of hardware that's in space, so that you can properly design the hardware that's going to interface with it.

But basically, Pinky Nelson flew out, tried to dock and grab this pin. He couldn't, because he couldn't get quite close enough to the surface of the spacecraft because of this thing that was protruding and prohibiting from getting flush up against the satellite. He tried it at least a couple of times, maybe more. Couldn't get docked, and because he had hit the satellite several times, it started doing some additional gyrations and spinning. And we weren't sure that we were going to be able to get the satellite at that point.

So he came back in. We backed away with the Shuttle and we did some RMS work. We also did some water work, to see whether or not we could save the day, basically. I don't remember exactly what the water work was now. But basically, the plan was that the Goddard Space Flight Center [Greenbelt, Maryland] guys would try to get the satellite restabilized, and then we would fly back in with the robotic arm and see if we could do a direct capture of the satellite without stabilizing it using the Manned Maneuvering Unit first.

Fortunately, Terry [J.] Hart, the arm operator on that flight, did a great job, and Bob [Robert L.] Crippen did, too, flying a rendezvous and getting into a position that Terry could grab onto the satellite. This was still in the days when we had ground sites. We didn't have TDRS [Tracking and Data Relay Satellites] everywhere. So just as they were getting ready to grab the satellite, we went LOS [Loss of Signal] at one place, and then when we got AOS [Acquisition of Signal] again, I said, "We're standing by for a report, guys." [Laughs] And fortunately they came back and said they had it, and so they were able then to carry out the repairs of the satellite and re-release it over the next couple of days.

ROSS-NAZZAL: Did you do any work with the 51-A [flight]? Did you do any work in the WETF [Weightless Environment Training Facility]?

ROSS: Yes, we did. Just before they launched, the crew, in fact, had asked me to do a development run to do some what-if-ing, and if certain things didn't work, how would we deal with that? One of the devices was a fixture that was going to be installed. The concept was that the guy in the MMU would fly out, fly up the backside of the satellite where the rocket nozzle was at, and put a stinger up in there that would capture the cone of the rocket engine, and then, using the Manned Maneuvering Unit, they would stabilize, stop the spin of the satellite, reorient the satellite around, and then they would attach a device to the top of the satellite that would allow the arm to then pick it up and bring it in, put it into the payload bay.

Well, the first satellite that we captured, this bridge device that we were going to put on the top of the satellite with a grapple fixture would allow them to then grapple onto the satellite and put it into the payload bay, it didn't fit. Lesson two. Again, you need to know the detailed

configuration of the satellite that you're trying to interface hardware to. There was an antenna feed line, an RF feed line, that was basically manually tuned to get the right frequencies and performance out of the antenna, and it was bent and positioned in a place that we hadn't accounted for, and it didn't allow us to put this bridge-type mechanism on the top of the satellite.

So basically what we had to do was, we stabilized the satellite using a Manned Maneuvering Unit, and then we basically just grabbed onto the satellite, using Joe Allen and a foot restraint on the sill of the payload bay, and he sat there and held onto the satellite while Dale Gardner then did the work on the back end of the satellite that needed to be done so that you could put the satellite down into the payload bay, and hold it for reentry. So I had developed that technique and procedures, the setting of the foot restraint and what you had to do to get the task done.

After we had done that with the first satellite, then after that EVA I went back into the water to verify that the procedure would work for the second satellite, and to develop the foot-restraint locations for it, and re-verify those as well, and see if there was any other techniques that we needed to think about some. So, they worked.

ROSS-NAZZAL: Great.

ROSS: You know, it's kind of that and the flyswatter thing and some other things I've been involved in with Hubble Space Telescope, are all things that are kind of reminiscent in some ways of Apollo 13, because you have this team of people that comes in, and you work night and day until you get the job done. It's kind of a neat feeling. You're exhausted, but it's very rewarding that you're contributing to the success of the mission in a way that's not normal.

ROSS-NAZZAL: That is nice.

ROSS: Yes.

ROSS-NAZZAL: Let me ask you, when did you finally learn that you were going to be selected for a flight?

ROSS: Well, if I remember right, it was like in January of ’84 that Mr. Abbey called me over to his office, and that wasn’t the most usual thing to have happen to you, and you kind of suspect that maybe that’s what’s going to happen; he’s going to tell you you’re assigned to a flight. But in his typical way, he would call you in and he’d kind of ask you how the weather was and, “Are they keeping you busy?” and all these other things, and, “Well, how would you like to have another job? I know you’re real busy, but how would you like to have another job?”

“Well, okay.”

“Well, you know, we’re starting to put this crew together, and we were thinking maybe you’d like to be on this crew.” So that’s the way I found out.

And, of course, I made as many phone calls as quickly as I could, except I had to be a little bit careful because I think the crew wasn’t ready to be announced yet, so you had to tell people, “Be quiet.” But a very exciting day, and certainly something that you really anticipated and looked forward to.

At that time, I think in January of ’84, I think we were supposed to fly in January of ’85, and ultimately that flight got slipped out till late November, early December of ’85. In between

then, because of the satellite problems we'd had with the two satellites that went in improper orbit, I was subsequently assigned as 51-A support crew member to help with that task. But a great day. And even greater was, I was assigned to a second flight before I flew the first one, and it would have been the first flight out of Vandenberg Air Force Base [California].

When I launched in November of '85, I was supposed to fly again in January of '86, out of Vandenberg. Of course, everybody knew that date was not realistic at that point. But while I was on orbit, that date had been slipped out to July of '86, and most people thought that that was a fairly realistic date. So that would have been very close, two flights within six, seven months of each other.

I've talked to Bob Crippen once or twice since he's retired, and he says that's probably one of the biggest regrets he's got, is that we didn't get to do that flight out of Vandenberg, because it would have more of a polar orbit, sixty-seven-and-a half-degree inclination orbit, and it would have been awesome. We'd have basically seen all the land masses of the world, so it would have been neat.

ROSS-NAZZAL: Let me ask you about training for this flight, in addition to training for the flight out at Vandenberg. Can you talk to us about juggling those two flights?

ROSS: Yes. Well, let me start by talking a little bit about the training for 61-B, which is the flight that I ultimately flew. As I talked about earlier, during that era we were having problems with inertial upper stages, with the PAM boosters, Payload Assist Module boosters. We were having problems with some of the payloads. TDRS, I think, had some problems.

So, continuously we were juggling the manifest. Crews were getting shifted from flight to flight. The payloads were getting shifted from flight to flight. And basically, throughout 1985, our crew trained for every mission that flew that year except for military or Spacelab missions. So I trained on PAM satellites. I trained on IUSs [Inertial Upper Stage]. I trained on the SYNCOM satellites, and we trained on a lot of different payloads that were on top of those boosters.

At one time, our crew was assigned to the *Challenger* accident flight, the 51-L flight. But ultimately, as I told you, we had the EVAs on flight. We got bounced to a couple of different flights. We finally settled out on 61-B, which was the launching of three communications satellites that were on Payload Assist Module upper stages. And then we had the EASE and ACCESS experiments in there as well.

We were flying at a very high rate that year. I think we flew like ten flights that year, but we probably trained for about fifteen. So all of our integrated training in the simulator with the Mission Control Center was basically boiled down to the last month, because they weren't ready for us. And so we were doing like thirty-five hours of integrated training per week, that last month or so before we flew.

So, as I said, we'd train on so many different payloads and types of payloads that basically by the time we flew, we could have flown any other flight that flew that year, except for Spacelab or military. Very busy time, but I did manage to squeeze in some time to go do some preliminary training for the military flight out of Vandenberg. Mike Mullane was on that crew, and he was leading the development of the checklist procedures and things like that.

But I did get to do probably four or five trips to go see the payload hardware at various different locations. I got a chance to go to Vandenberg Air Force Base and see the facilities

there and get some tours. I had sat through several training sessions on some of those trips, as well as some training sessions here. Actually, I had even done a little bit of simulation work here and other places, in preparation for that flight.

So, I was worried about with the flights getting so close together that maybe they were going to replace me. I talked to "Crip" a couple of times about that, and he said, "Don't worry. We'll take care of you."

So I said, "Okay. Great."

ROSS-NAZZAL: How different was it training for a NASA mission—NASA's a very open agency—and then training for a military mission?

ROSS: A big difference in that everything was secret, classified. You couldn't tell people a lot of things. When we'd travel places, we couldn't tell people where we were going. I couldn't tell my wife where I was going. I basically couldn't tell her, many times, when I was going to be back. It made it very awkward and very frustrating, but we were an all-military crew, and so we were accustomed to those type of activities, and so we just dealt with it. I think the most frustrating thing was, is that we couldn't tell people, after the mission was over, what we'd done, which is something that you always want to go do.

The training itself here at Johnson was basically the same as for any other flight, except that you had to go through all the additional precautions of making sure that everything was secure and that you'd dealt with your training materials in an appropriate fashion. We had a safe in an office where we locked up a lot of our materials, and made sure that we controlled things properly.

After the flight we had to go through—I ended up going through every inch of footage and every still photograph, and searched through them to make sure there was nothing in the fields of view that would cause us security problems. And then after the flight, I literally made up our post-flight movie that we went and showed to the military organizations, by splicing together footage myself. It was still film then. It wasn't video. So I physically did that myself.

I'll never forget, one of the rolls of film that they gave us had been printed such that the sprocket holes were on the wrong side of the film, so that made it much more interesting when I had to splice it together.

ROSS-NAZZAL: Let me take you back to 61-B. Let me ask you a couple of questions. You had two payload specialists on board this flight. Can you tell us a little bit about the astronaut corps' reaction to the inclusion of payload specialists on these flights?

ROSS: Very mixed feelings. As we're still talking about now, eighteen years later, the Space Shuttle is not an operational vehicle in a normal sense. It's still very much a research and development experimental vehicle, and so, we were getting pressures to fly civilians, teachers. We were getting pressure to fly politicians. We were giving away seats, is the way we kind of saw it, to nonprofessional astronauts, when we thought that the astronauts could do the jobs if properly trained.

With all that being said, I think also at the same time we have a pretty parochial view on things; "That's the seat I want to take. Somebody else is getting it." And so you have to look at things a little bit more globally. We were hoping some of the stuff that Charlie [Charles D.] Walker was doing with a continuous flow electrophoresis system experiment, we were hoping

that that might provide us with some really tremendous breakthroughs in terms of processing pharmaceutical products for the world. It ultimately didn't turn out to be that way, and biotechnology has kind of surpassed what they were trying to do anyhow.

But the promise or the hope was that they could make new pharmaceutical products that would be much purer than anything that was able to be made here on the ground, thereby making them much more powerful, much more pointed at specific diseases, and also, since they were so pure, you would get away from having so many of the bad side effects that many pharmaceutical products have, that we currently have. So we were hoping that maybe what he was doing would have great promise, both from a human standpoint, but also from a financial standpoint, and would be a great springboard to the commercialization and use of space, from that perspective.

The other fellow, Rodolfo Neri Vela from Mexico, was one of multiple payload specialists we had that were from basically friendly U.S. nations, that we allowed them to put a person onboard and fly with us. We also did fly and launch a Mexican communications satellite on that flight, and so, obviously, the connection there.

So, mixed feelings. Overall, I found them to be extremely great experiences for me. Two good friends. Charlie also went to Purdue University, so that's also a good connection there. I don't get to see Rodolfo very often. He doesn't come to the States very much, but a nice guy and a good friend.

ROSS-NAZZAL: How long did the payload specialists train with the crew?

ROSS: Well, this was Charlie's third flight in quick succession. He flew three times within about a year and a half or so. We had, I think it was like ten different Mexican payload specialist

candidates that came here for interviews and physicals and things like that, and they boiled it down to three. Then ultimately Rodolfo was the one selected. I think he was here for probably about five or six months to train with us, and that was more than adequate for what he needed to do in the exchange with the crew.

The guys did a great job on orbit. They were always very helpful. They knew that if the operations on the flight deck were very hectic, they stayed out of the way, which is the right thing to do, frankly. But at other times they would come up onto the flight deck and enjoy the view as well as any of the rest of the crew.

So I think the program was very well done. Politicians and upper-level management, I think many times just had a different view of what the Shuttle was and what its purpose was, than what we thought. I'm not saying that either one of them was right or wrong. It's just that it wasn't very well handled in terms of how that was done and coordinated, basically.

ROSS-NAZZAL: Can you talk to us about the crew relationship?

ROSS: On 61-B?

ROSS-NAZZAL: Yes.

ROSS: Sixty-one B was a great time. That was a great crew, almost an all-rookie crew. Brewster Shaw, the commander of the crew, had only flown one time before as a pilot, with John [W.] Young on STS-9, so he was a brand-new commander. Bryan [D.] O'Connor was a Marine guy. It was his first flight. He was in my class. Mary Cleave and Woody Spring, also from my

class, first-time flyers as mission specialists. And we've already talked about Rodolfo and Charlie.

Brewster, as I'd said earlier, was from my class in Test Pilot School. I admired him and respected him tremendously, a very capable guy. He had actually helped me get my private license. He was a certified flight instructor in light airplanes and had started me on my flight certification before he left me at Edwards and came down here. Brewster, I thought, did a really good job as a first-time commander. He basically laid out the responsibilities of who was going to do what, and then he let us go do it. He, from time to time, would have us kind of tell him how things are going, but other than that, he kind of left it up to us to get the job done.

A very challenging flight for a whole bunch of rookies on a crew, launching of three communications satellites and doing two spacewalks in seven days. So it was a very challenging flight, I thought, from that perspective; one of the more challenging ones we did early on in the program. But at the same time, it wasn't nearly as busy as the flights we're trying to do now with the assembly of the station. These flights are incredibly packed and nonstop.

Bryan O'Connor and Woody were probably the clowns of the crew. Woody's just got a silly laugh, and he's always got some stupid joke to tell, or something, and is a lot of fun to be around. Bryan has got this tremendously great dry wit. He will sucker you in on some really serious discussion and then hit you over the head with a two-by-four with some stupid joke or comment.

I'll never forget, on launch day we were already strapped into the vehicle and kind of sitting there waiting for things to happen, and Bryan was kind of relaxed and everybody was, obviously, somewhat nervous, but everybody's trying to act cool. And as we're getting close to coming out of the nine-minute hold, Brewster Shaw, the crusty veteran of the crew with one

flight under his belt—this is when you're still launching in the cloth flight suits and just kind of like a motorcycle helmet—as we were getting close, coming out of the nine-minute count, Brewster goes like this [gestures], rubbing his hands on his legs, trying the wipe the sweat, the perspiration off of his hands. And Bryan O'Connor looks over at him and he says, "Brewster, I was doing just fine until you did that. I wish you hadn't done that." [Laughs]

And a little bit earlier, Bryan had said, "You know, you think maybe they're trying to tell us something? First of all, George got off at the Launch Control Center, off the van that takes you out to the pad. And then the guys at the pad strapped us in and closed the door, and then they beat feet back about three miles away. You think they're trying to tell us something here?" [Laughs]

But Mary had her own way of being fun and making jokes. Rodolfo brought a new culture and a new flavor into the group, and he was a lot of fun. Charlie, being on his third space flight, he knew the ropes as well as anybody, and we just had a good mix. It was a lot of fun together. Brewster tends to look very serious, but at times he could be a lot of fun as well. And, of course, since I knew him from Test Pilot School, we had that bond there, as well.

We had been through a lot of ups and downs, a lot of false starts, a lot of training, a lot of flights that disappeared from us, underneath us. We'd trained together off and on for approaching two years. So it was a good crew, and I tell people a lot of times that the makeup of the crew is probably as important as anything else, and especially in terms of what you take away from the flight in terms of enjoyment and fun. I couldn't have picked a much better first crew, I don't think.

ROSS-NAZZAL: Let me ask you about training for this EVA. It was a pretty complex EVA. Did you help develop the Space Station construction techniques that were used on this flight?

ROSS: Yes. In fact, that was the purpose of the two experiments, was to look at manual assembly of structures to see if that was a reasonable way to try to build a space station. I had done some of the developmental work on this hardware, even before it became an experiment package that was manifested.

I think General [James A.] Abrahamson was a guy that kind of pushed on it to get it to its final form. At one point he was the head of manned space flight at Headquarters, and I think he was associated with M.I.T. [Massachusetts Institute of Technology, Cambridge, Massachusetts] somehow, and I think he was helping to push the EASE experiment that they were proposing.

The other one, the ACCESS experiment, came from Langley [Research] Center [Hampton, Virginia], and I had worked with Doug [Walter L.] Heard and some of their other people there for several years on manual assembly techniques.

We got to basically choreograph the entire EVA, Woody and I. I mean, we understood what the experimenters wanted, and we sat down with them and talked through things, and added to what they wanted to do, considerably. Basically, we were trying to look at productivity of building things in space. The ACCESS experiment was a long, forty-five-foot-long truss, triangular cross-section, that was built in a one-bay-at-a-time type of manner, using a lazy-Susan type of assembly fixture.

Both crew members were in fixed foot restraints. They had the containers with all of the parts right next to them, and it was basically just a matter of bringing a part out, putting it onto this assembly fixture, hooking the components together, rotating to the three faces, and then

sliding the completed segment of truss up, and repeating the process for a total of ten bays, each bay being four and a half feet long. We knew that that technique would be a very satisfactory way of doing business, because when a crew member's feet are anchored properly, that gives you both hands free to do work.

The other experiment, the EASE experiment from M.I.T., required one crew member to be floating at the top of the structure, and just holding on with one hand and trying to maneuver these fairly heavy beams—if I remember right, they're like eighty pounds apiece or so—maneuver them around, kind of torqueing them into position and then aligning them and sliding the sleeve over that made the connections. We didn't think that that would be a very desirable way of doing business, but we were certainly more than prepared to go investigate it and see what the deltas were between the water and on orbit, and compare those with the ACCESS experiment.

So, the first EVA was to build and disassemble those items about as quickly as you could, multiple times. Woody and I exchanged places on each of the experiments, so that we could see both aspects of each of the experiments. I think we built the ACCESS experiment up and down just twice. We exchanged places for each one. And then on the EASE experiment, man, I think we must have done it at least eight times. We basically, if I remember right, met or exceeded the speeds at which we could do things in the water. And just like everything else, some of the things in the water are easier, and some things in space are easier, and you just kind of have to try to account for those, based upon your knowledge of what the water does to you and what it doesn't do to you.

The other things that we added that were not originally planned, other than just assembling things and tearing them down, we added some other aspects into the flight, like

working off of the foot restraint on the end of the arm to do the assembly of the EASE experiment from the top, as opposed to having a guy up there free-floating. Now, it was easier for the guy to do it, but it took a lot more time because of the robotic maneuvers involved.

We also used the arm to build a complete tenth bay at the top, to see how that would be on the ACCESS experiment. We also used the arm to simulate a repair where we removed one piece of the ACCESS experiment in the middle of the truss somewhere, and then to reinsert it, as a repair technique. We also used a reel of rope to simulate an electrical cable, and how you would then install electrical lines along the side of a truss, once a truss was assembled.

In addition to that, we also removed the completely assembled truss and its inverted tetrahedron that the EASE experiment made, and manipulated those around to see how easily you could do that, number one, assuming that you were building a subset of a structure, and then had to move it somewhere else to hook it up to the larger to-be-completed structure. How easy is it to maneuver it? How much force does it take? How quickly can you do it? How accurately can you position and point it? So, not only taking it off of the fixture that you had built it on, and maneuvering it around, but also, can you put it back onto the fixture when you're done? How easy is that all to do? And we did that with both of those.

We also took up a little short coupling device that we took and coupled together two of these about fourteen-foot-long beams that we made the EASE experiment out of. We put a little coupling in between and then saw how easy it would be to maneuver this longer, about twenty-eight-, thirty-foot-long beam from one end. So it gave us quite a bit of understanding and knowledge of what it would be like to assemble things in space.

Ultimately, that's not the way that we chose to build the Station, because when you think about having to integrate all the electrical and fluid lines and everything else into the structure

once you've assembled this open network of truss, it becomes harder to figure out how you're going to do that, and properly connect everything together and make sure it's tested and works properly.

But we did learn a lot about assembling things in space, and proved that they are valid things that you could anticipate doing, even on the current Station, at some point, if you needed to add a new antenna or something like that. But probably one of the even more important things that we learned is that the water tank facility we had was not anywhere close to being adequate for building an international Space Station. In fact, we came back and part one of our big debriefing points to the world was that that was, in fact, the case.

I think it was Neil [B.] Hutchinson who had been assigned as the head of the Space Station Program at that point, and he had only been there for a little while. He came to our debriefing. We made a very pointed statement to make sure he fully understood that because the facility we had when we built the ACCESS truss, we could only build like one and a half bays before it started sticking out of the surface of the water. And the EASE experiment, when we did it, basically our backpacks of our suits when we were at the top of the structure were right at the surface of the water. So if you're going to build anything that's anywhere close to being big on orbit, that wasn't going to get it.

So, for about the next ten years after that flight, almost twice a year I ended up being one of the delegates from JSC that went to Washington [D.C.] to make presentations on the need of a new facility and our need for construction facility funds to build a much larger facility. I was subsequently then—we can get into that later, but I subsequently worked on helping to design the requirements for a facility, looking at the designs for facilities. At one point I led a Tiger Team that was trying to design a bare-bones facility that would have been built here onsite. And then

ultimately I ended up being the lead for the Operational Readiness Inspection Team that certified the tank that we have out here at Sonny Carter [Training Facility, Houston, Texas] now. So, I've been in EVA for a long time.

ROSS-NAZZAL: You certainly have.

ROSS: In just about every aspect.

ROSS-NAZZAL: And we would like to discuss those with you, but I would like to go back and ask you some things about this mission in particular.

ROSS: Sure. You bet.

ROSS-NAZZAL: Talk to us about what you were thinking on launch. You mentioned what you remember; Brewster Shaw being a little nervous, and Bryan. What were you thinking? What were your thoughts?

ROSS: Well, you've heard it probably many times that going out to the pad when the vehicle is fully fueled and ready to go is different from going out there to the pad any other time. The vehicle really does give you this sense that it's an animal that's awake and just ready to go do something. When you go out there and the vehicle's not fueled, it's not hissing, it's not boiling off vapors, it's not making noises that you don't hear, that you do hear when it's fueled. And there's the tremendous amount of anticipation.

My first flight was the twenty-third flight of the Shuttle, and I had listened to every crew come back, and I took very detailed notes of their debriefings, which were quite exhaustive early on. I listened to everything they said, and they would give us a very detailed description of what it was like, what the sensations were of launch. I put that into my databank, and I would daydream about that when I'd go running or work out at the gym, or something like that. I knew it was going to be a pretty exciting ride.

I was flying on the flight deck for launch on 61-B. I was in the back-right seat behind Bryan O'Connor. Mary Cleave was next to me in the middle seat. And I can remember, because we had the cloth flight suits—I can remember looking out the overhead window down at the base of the pad, just minutes before we lifted off. I could see the water deluge start to happen and stuff. I thought, well, I guess I'd better get turned around here.

As the Shuttle's main engines came up, you could really feel the vibrations starting in the Orbiter, but when the solid-rocket motors hit, when they ignite, it's just—I describe it as somebody taking a baseball bat and swinging it pretty smartly and hitting the back of your seat, because it's a real "bam!" [Ross gestures.] And the vibration and noise is pretty impressive. The acceleration level is not that high at that point, but there is that tremendous jolt [gestures] as the solid-rocket motors ignite, and you're off.

I told you that I'd listened to all these other crews come back and I'd daydreamed about this for a long time, but I can honestly tell you, about ten seconds into the launch, I thought to myself, "Ross, what are you doing here?" I think the cloth flight suits and the motorcycle helmet gave you a much more dynamic sense of what was going on. With the launch and entry suits that we have now, you're in a pressurized suit. There's a lot more bulk around you. It kind of cushions things and deadens the sounds and the vibrations.

But literally I can remember, "Ross, what are you doing here? This is really awesome." I'd listened to all those other guys, but nothing like being there. Just a sheer sense that there's this tremendous energy that's being released back there behind you, and that it's putting out such an incredible force that you really feel like your pink body's just being shoved off the surface of the Earth by something really, really strong. That's exactly what's happening.

I'll never forget the vibrations of the solid-rocket motors. As we accelerated in the first thirty seconds or so, the wind noise on the outside of the vehicle just became really intense, like it was just screaming. It was screeching on the outside. And that's about—well, it wasn't quite then. I was already thinking about "what am I doing here" before then, but just a sheer, incredible experience of the energy and what was happening.

At the solid-rocket motor separation—we launched at night—there was this brilliant orange flash, orangeish-yellow flash across the windscreen, and then the solid-rocket motors are gone. As the solid-rocket motors tailed off, like at a minute-forty-five or so, it almost felt like you had stopped accelerating, almost like you'd stopped going up. At that point we were already Mach 3-plus and well above most of the sensible atmosphere at that point, some twenty miles high or so. And at solid-rocket motor jettison, then you're at four times the speed of sound and twenty, twenty-five miles high.

At that point, I literally had to look around Bryan to see that the three main engines were still working, because it became so smooth, and it almost felt like you weren't going anywhere; you weren't accelerating at all. As the propellant in the external tank is burned off, then the acceleration rate picks up. You also start to bend over your trajectory so that you're not climbing straight up anymore; you're more horizontal, and you're really trying to accelerate now.

So the Shuttle's main engines continued to function. At one point I can remember looking back behind me out the overhead windows again. In artists' renditions of the flames coming out of the three main engines, it's a nice, uniform cone of fire back there and stuff. Not true. The fire was all over the place. It was not static. It was dancing. It was not uniform. And again you go, "Is this thing working okay?" [Laughs] You don't know what to expect.

As we got further into the launch then, we felt a little bit of a longitudinal vibration in the Orbiter, a low, low frequency, what I would call a pogo kind of thing that they experienced in the Apollo era. It wasn't that; it was just a natural longitudinal oscillation of the structure of the Orbiter that I've experienced on other flights, but it's based upon what's in the payload bay, and what its mass is, how it's distributed, where it's attached. All of that will have a tendency, and it's different on different Orbiters, as well. But I thought that was kind of interesting. It was something nobody—I don't remember anybody having told us that before, that there was this longitudinal low-frequency oscillation.

As we got up to about the seven-and-a-half-minute point then, is when you get to the 3 Gs of acceleration, and that's a significant acceleration. It feels like there's somebody heavy sitting on your chest, and it makes it pretty hard to breathe. I mean, you kind of have to grunt to talk, and you're just waiting for this 3 Gs to go away.

When you get to the 3-G level, which is about seven and a half minutes into the launch, is when the Orbiter's three main engines start reducing their power output so that you don't exceed the structural limit of 3 Gs. And so for that last minute, the Shuttle's main engines are coming back. You're getting lighter and lighter. You're accelerating at 100 feet per second per second, which is basically like going from zero to 70 miles per hour every second. So it's pretty good.

And then at the time that the [Orbiter] computers sense the proper conditions, the main engines basically go from around 70 percent power, so on a 3-G acceleration, [snaps fingers] they shut off and you're in zero-G. And for me, the first flight, sitting in the back seat there behind Bryan, I had the sensation of tumbling head over heels, a weird sensation. And it was the 3-G transition, from 3 Gs to zero Gs. I looked out, I couldn't see much of a horizon, because we launched at night, but I looked at the instruments. Nothing was going on.

Fortunately for me, I had to get out of my seat pretty quickly to do activities, and as soon as I unstrapped from my seat and started floating around, I felt fine. It was just that sensation of being in a seat, having that transition of Gs, that was faking out my head or my sensors somehow. But as soon as I got out of the seat, then I was okay.

I might say that I had done a lot of time in the water tank ahead of time, and I had done a lot of time in a KC-135, doing parabolic flights, doing a lot of the EVA hardware developmental work. I'm not sure that the parabolic flight helped you that much with the transition to zero-G. I think the water tank does a lot better on that. But the zero-G time in the parabolic airplane does help you from an operation of operating in zero gravity, learning how to do that effectively, quickly. Mary Cleave never learned that in seven days. Her nickname was "Oops." She'd keep bouncing into people or things and saying, "Oops, sorry." [Laughs]

But I got out of my seat and I went to work right away, and I felt pretty much at home from that point on, and have been fortunate, I've never got sick going up or coming down, so I'm one of the fortunate ones that's been lucky that way.

ROSS-NAZZAL: That's great. If you don't mind, we need to stop and change our tape.

[Tape change]

ROSS-NAZZAL: Why don't you tell us a little bit about the flight. I know you launched and the next day it was Thanksgiving, for instance. Did you have any sort of special dinner, or did you celebrate Thanksgiving?

ROSS: We did celebrate Thanksgiving on orbit. It was kind of a unique and nice way to do it. We had some turkey. I forget exactly what it was. It was thermally stabilized turkey, or turkey tetrazzini. I don't remember at this point. I'd have to go look at a menu and see. But we also did have a loaf of pumpkin bread, and we had a nice meal and we enjoyed it very much.

As I said a little bit earlier, the pace of the flight, while we had quite a few things to do, the pace of the flight was a little bit more gentlemanly in terms of how busy we were, which was nice. It gave us a little bit more time to look out the windows and enjoy the views than what I've seen from some of my subsequent flights.

We launched three communications satellites. I don't remember; I think we launched one of them one day and maybe two of them on another day. We got those out of the payload bay. Then we were free to do spacewalks. I think maybe we launched one on the first day, two on the second day, and then we did spacewalks on the fourth and sixth days. No, it must have been third and fifth days. It must have been third and fifth days.

The communications satellites, Woody and I deployed those. There were two positions. One was over on a switch panel, and then the other guy was at a computer monitor on the aft flight deck, and it took coordination of both guys to launch the satellites. So we took turns on who did what job.

The communications satellites, one was an RCA [Radio Corporation of America] KU-band satellite that was a commercial one. We launched one for the Mexican government, and we launched one for the Australians. The RCA satellite was still functional up until just a year or so ago, so it went for fifteen, sixteen years. I think all three of them are no longer functional, but I'm not sure. Those all went well. I don't recall any problems we had with any of those.

Basically, all the satellites had kind of like a sunshade on top of them that you had to open up, and then you spun up the satellite to give it stabilization once it came out of the Orbiter. The Orbiter pointed in the right orientation, and at the proper time we would then allow the satellite to be released into orbit. About forty-five minutes, I think it was, after the satellite left the payload bay, it fired its solid-rocket motor, which pushed it up into a transfer orbit to geosynchronous, and those all went well.

We checked out the spacesuits in between some of the launches of the satellites. We checked out the mechanical arm. Mary Cleave was the arm operator, and I think Brewster, maybe, was her backup.

And then I'll remember the day forever, when I got to go do my first spacewalk. As we've talked, I got a chance to do a lot of spacewalks as a CapCom on the ground, and I got a little bit more green with envy every time I did that, thinking about what those guys were doing, how much fun they were having. So when I ultimately got a chance to go outside for my first time, I was worried, because I was worried that the Orbiter was going to have a problem; we were going to have to go home early, or one of the spacesuits wouldn't check out and we wouldn't be able to go out, and all those things. Fortunately, none of those things happened.

And I'll never forget opening up the hatch and poking my head out the first time, and I literally had this very strong desire to let out this war whoop of glee and excitement. But I

figured that if I did that, they'd say, "Okay, Ross has finally lost it. Let's get his butt back inside," and that would have been it. But it felt totally natural, just totally natural to be outside in your own little cocoon, your own little spacecraft, and I felt basically instantly at home in terms of going to work.

I'd say the only things that were a little bit different for me were, number one, the temperature changes that you sensed as you went into sunset or sunrise, or if you went above the payload bay, out like on the end of the arm, you could feel a cooling tendency anytime the sun went down, or anytime you went out of the payload bay. But it was never a real drastic change. It was maybe more like the air conditioning fan turning on or turning off. You felt a little bit of a temperature change, but not much. The suit is well designed and really works pretty well to control the atmosphere in which you're working.

We went right to work deploying, I think, first the ACCESS experiment and doing it a couple of times, and then going to the EASE experiment. I can't think of many things that were unusual or exceptional on the first spacewalk. I think everything went pretty much per the normal. We didn't use a mechanical arm on that spacewalk, other than I think they used it as a camera holder to give them an orthogonal view of what we were doing from the elbow camera, pretty much.

I'll never forget the night after we got back in from the first spacewalk. Brewster Shaw was the primary camera operator, I think, and I think we had three or four different tape recorders that were going; must have been three. Brewster was changing out thirty-minute tapes on all three of those tape recorders. We literally had huge lockers of videotapes. I mean, they were big tapes and they were only thirty minutes long. It was pretty amazing. Such is the technology. So he was kept pretty busy doing that.

Bryan was kept busy helping Mary. He was our IV-support guy. He got us suited up out there and ran the checklist. Mary was our arm operator and helped Brewster with the videotapes and things. Charlie and Rodolfo pretty much stayed downstairs during the spacewalks. When we were getting ready for the spacewalks, they went upstairs to get out of our way.

I'll never forget, when I came back in from the EVA, my hands were very tired. My LCVG [Liquid Cooling Ventilation Garment], my long-johns with the fluid cooling in them, were soaked. My wristlets and my comfort gloves were soaked. But the thing that was most tired was my head. Literally, your mind is going a million miles an hour when you're outside, thinking about what you're supposed to do; thinking about every step of the procedures; what your buddy's doing; how's the suit doing; looking up every once in a while and trying to capture a snapshot of where you're flying over. So I was literally mentally the most fatigued, even more than what I was physically. Physically, I was tired. I'd kind of say it was kind of like, from my high school football experiences, kind of like after the second two-a-day practice period. You were physically exhausted but it was kind of a physical high in some way, because you were tired, but it was that good feeling from tiredness.

I think on both spacewalks, Woody and I made the evening meals, which is kind of unusual. I think the rest of the crew said, "Okay, you guys worked hard. Take the time off."

And we said, "Okay. We've got some time. What can we do?"

"Make the meals." So that was kind of our thanks to having them help us out so much, to get outside and do our stuff.

We had a day off in between the two spacewalks, and I don't remember exactly what we did then. We did some RMS tests, if I remember right, and we did some Orbiter tests. Oh, I remember. At the end of the—shoot, which spacewalk was it? At the end of one of the two

spacewalks, we had taken a little metal sphere which was made from three flat plates that were slid together, and Woody and I had flipped a coin, and he got the honor of—I'm not a gambler; don't do that kind of stuff. He had won the flip of a coin, and got the honor of releasing this metal sphere.

Then Bryan and Brewster did a series of tests of flying in formation with this metal sphere, using some very unusual digital autopilots in the Orbiter, and we were using the large thrusters. It must have been after the end of the second EVA. I won't swear for sure. But it felt like you were in the middle of a war. The main thrusters are firing as "boom, boom, boom, boom!" They sound like howitzers. They're really loud. And the Orbiter is moving around all over the place, and stuff was shaking loose. Stuff was coming off of the Velcro where it was mounted. It was pretty impressive, pretty impressive. We sucked up a lot of propellant very quickly. [Laughs] But I'll never forget that. You can float in the middle of the Orbiter in the middeck or the flight deck, and when the thrusters of the Orbiter fire, the Orbiter actually comes over to you. So it's kind of neat.

The second spacewalk, we did some of the same things, but we did some of the things I'd talked about earlier. We did things like simulating. We worked off the end of the mechanical arm for a lot of the work. We did the assembly, the top bay of the ACCESS truss off the end of the arm. We simulated the running of the electrical cable. We did the simulation of doing a repair of the truss by taking out and reinserting an element there. We removed the trusses off of the fixture and maneuvered them around to see how that would be in terms of assembling a larger structure.

We also mounted a U.S. flag that we had modified, onto the truss, and took some great pictures of us saluting the flag on the end of the arm up there, saluting the flag. We also made a

flag that we took outside. We called ourselves the Ace Construction Company. There's a series of Ace signs that were taken outside on various spacewalks. Joe Allen and Dale Gardner took one out that said Ace Repo [Repossession] or something like that when they retrieved those two satellites that had gone into improper orbits. And there were one or two others that were like that, too. Seems like maybe there was an Ace Repair, which may have been Jim van Hoften and Pinky. There were several of them like that. Somehow we've lost some of that fun over the years. I'm not sure why.

But basically, the second EVA was similar to the first, except we threw some variety into what we were doing. At the end of it I remember asking—or at some point, I think in the second EVA, I asked Woody about going to build a space station, something like, "Hey Woody, let's go build a space station," or something like that. And I repeated that during my last spacewalk on STS-110. I recalled that and mentioned it to Lee [M. E. Morin], outside.

Then the last day was just basically packing up the Orbiter and getting ready to come home, and landing. I entered on the middeck, but I had an agreement from Brewster that I could have out our big 16-milimeter-movie camera and take some pictures out the overhead window during the early part of reentry. We reentered at night also, or at least partially at night, and so I got a chance to take some pretty great pictures of the plasma sheath behind the Orbiter as we were coming in during the early parts of reentry.

The deal was that at half a G, I would put down the camera, put this metal plate that we then flew in that overhead window back in place, and then go downstairs and get into my seat. I put down the camera at half a G, as called for. As I put this metal plate back up into the window—I'll never forget this—I so wanted to get that camera and start shooting again, because the intermittent plasma behind the Orbiter had now become a continuous shaft of plasma that

was behind us, and as the Orbiter would do some roll or bank maneuvers, it was kind of a curving trail behind us, and you'd literally see the plasma swirling inside this trail. So it was this greenish-yellow trail of plasma behind us. It kind of looked like flying through the middle of a florescent tube, basically. And I wanted to pick up the camera and do some more pictures, but I thought, "Brewster's going to kill me." So I didn't.

But the deal was, I was going to leave the camera on the flight deck, but I didn't. I went ahead and took it down the stairs with me, and by then it was probably about a G or more. Went downstairs and I took some pictures of Charlie and Rodolfo sitting in their seats down on the middeck, and then I continued to take pictures out the side hatch of the Orbiter through the rest of the reentry, all the way through the landing and rollup.

I got some great pictures coming across the California coastline, I think it's just north of L.A., and then flying out over the high desert of Edwards, and coming down and landing on runway two-two, I guess. And got some pictures of the hangar that was being constructed on the south side of the base there, that was subsequently used for the B-2 bomber. Since Brewster and I had both spent quite a bit of time out at Edwards, it was kind of a nice homecoming, to go back there in such a grand style.

After the flight, at first you feel kind of heavy, but I didn't feel so much that way on the first flight, because I was literally standing up, taking pictures during a good share of the reentry, and so I was kind of halfway acclimated again to the ground. But you do feel heavy. You feel like somebody's glued your pants to the seat of the chair you're sitting in, and it really takes an unreal amount of exertion just to stand up. But we walked around on the middeck and they came and got us out, and I felt great.

There's such an adrenaline rush going, I think you could do about anything at that point. But I do feel top-heavy. I feel heavy for about the first hour, maybe, and then I feel top-heavy for about the next six hours or so, and I have to put my legs a little bit further apart, just so I don't have the tendency to tip over. I think it's primarily because the muscles, the nerves, and the brain have kind of desensitized, detuned. It's kind of like people who have been bedridden with an illness or something, for several days. They kind of feel a little bit top-heavy, maybe a little bit dizzy. I didn't feel dizzy, per se, but felt top-heavy.

I'll never forget, we went into the facility, the doctor's facilities there at Edwards for our post-flight physicals, and after I was done with the physical, I was cleared to go get a shower and get changed. I walked out of the doctor's office, down the hallway, and turned to go into the bathroom; turned a little bit too smartly and walked right into the doorjamb; kind of bounced off of it, looked both ways. Nobody saw me, so I just kind of smiled to myself and walked into the bathroom and got my shower and got changed. But it was kind of those, you know, silly kind of things that you remember.

I guess if there was anything that came out of the flight from a personal perspective, it was just a real personal satisfaction of a long-sought goal being accomplished, the real kind of real deep personal satisfaction that you can get out of something like that. And that's never left. That's just maybe been amplified by subsequent flights. But that first flight was a dream come true, in its truest sense.

It's kind of interesting, I landed at Edwards; we flew on the airplane back here. We had a welcome-home thing at Ellington [Field, Houston, Texas]; I drove home. I was at home in my family room with my mom and dad, who were down visiting, and my wife and kids, and I was sitting in my rocking chair, my throne, my favorite place. And a neighbor knocked on the door.

And even though this was quite a few hours removed from the landing, the most natural thing for me to do was to push off from the arms of my chair and float over to the door and let them in. And I caught myself trying to do that. I just kind of giggled and smiled to myself, and stood up and walked across to the door and let him in. It's pretty amazing how quickly the body adapts to the environment. And the human body loves zero gravity. It just really eats it up, as far as I'm concerned. It's a lot of fun.

ROSS-NAZZAL: We wish we could experience that.

ROSS: Yes.

ROSS-NAZZAL: Let me ask you just one more question. A lot of times, crews, after they've come home, will go on PR [Public Relations] trips. Could you tell us about your PR trips?

ROSS: Yes. Crews always have a post-flight party. Since we were coming up to the holidays, very close to the holidays when we landed, and since there were a couple of other flights that were getting ready to launch, we didn't have a post-flight party. We were going to have a post-flight party with "Hoot" [Robert L.] Gibson's crew and with the *Challenger* crew. They were going to fly in December and/or January, and so we decided, since we were getting close to the holidays, we'd have three crews together and have a party. Well, we ended up never having that party because of the *Challenger* accident. Likewise, we didn't do a whole lot of post-flight stuff because of the nearness to the holidays and then the accident.

We did do some crew post-flight things well after the *Challenger* accident, most significant one of which was probably a week down in Mexico with Rodolfo, and that was a nice break. It came at a very opportune time. It was multiple months after the *Challenger* accident. Both Bryan and Brewster were pretty intimately involved in the *Challenger* work. I don't think Mary or Woody were that much, and I didn't get involved that much either. So we didn't do, like, the normal, and what we did do was somewhat delayed in activities. I don't remember exactly when we did that. It might have been almost a year after the flight.

I did do quite a few personal PRs. I went and did my hometowner, and made myself hoarse. I talked to every school in the school system, including the parochial schools. I think it was something like fourteen schools in a three-day period. I learned I would never do that again, but I'm glad I did it the first time. I mean, it was fantastic. The kids were just really pumped up, and it was great to see all their smiling faces, and try to get across to them that, you know, "Hey, I was just like you guys. I grew up out in the country. I had a dream and I studied hard, and you guys can, too, and pursue it." And that's been my basic pitch to kids ever since. And as we talked earlier, some of them have actually heard it.

ROSS-NAZZAL: That's great.

ROSS: Yes.

ROSS-NAZZAL: Before we close today, I'd like to ask Rebecca and Sandra if they have any questions for you.

WRIGHT: I don't right now.

ROSS-NAZZAL: No? Okay.

ROSS: Okay. We can get pumped up for next time.

WRIGHT: Yes. We'll have a list.

ROSS-NAZZAL: Yes. Next time I would like to talk just a little bit more about your Vandenberg mission, which was eventually canceled, and then *Challenger*, and then go from there. I look forward to talking to you again.

ROSS: Okay. I'll do some reading up; help me remember.

[End of interview]