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ORAL HISTORY TRANSCRIPT

SHERWOOD C. "WOODY" SPRING
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is November 18th, 2003. This oral history with Sherwood C. ["Woody"] Spring is being conducted for the Johnson Space Center Oral History Project in Arlington, Virginia. Jennifer Ross-Nazzal is the interviewer.

Thank you so much for taking the time to meet with me today. I really appreciate it.

SPRING: Happy to. [I know you are looking for anecdotes and stories from our NASA experience, and that you will lead or elicit these with questions. If it's okay with you, I will feel free to digress into stories as they occur along with answering your questions.]

ROSS-NAZZAL: [Sure.] I'd like to begin by asking you what your interest was in aviation and engineering as a child.

SPRING: As a child, engineering was just something I always tended to gravitate to. It's where my interest lied. I remember repairing bicycles, repairing toys and trinkets, taking things apart and putting them back together again. I ended up growing up on a farm in Rhode Island and that type of a talent was needed. There was always a use for somebody to go fix things, and I enjoy[ed] doing that.

I went to West Point [the United States Military Academy, New York], where the engineering definitely got reinforced. [I] got into aviation on my second tour in Vietnam, and

that's when I decided that aviation is where I wanted to be, and to maximize that, I applied for the Navy Test Pilot School. It's one of the Army programs. Got accepted to that, and then it was pretty much of a natural step to apply to the astronaut program.

ROSS-NAZZAL: When did you find out that they were actually going to be selecting astronauts for the 1980 class?

SPRING: [I got the word while stationed in Korea about January 1980.] I [had been] a test pilot at Edwards [Air Force Base, California] when the '78 class was picked. Bob [Robert L.] Stewart, one of my good friends that preceded me in the '78 class, got picked up in that group, and I kept pretty good contact with Bob to see how things went and what the process was. I was in Korea getting what we called regreened [when the class of 1980 selection began]. … So I applied while I was in Korea, and then I got invited to come back and do the interview, from Korea, which was quite a thrill.

ROSS-NAZZAL: Can you tell us about the interview process itself?

SPRING: The interview process is fascinating. One day you'll just get a call or a letter saying, "We'd like you to come be part of the interview." And for me, coming from the other side of the world, was wonderful.

I remember showing up at—oh, I forget what the—probably the Holiday Inn or one of the hotels just outside the main gate, and there was a little reception the first night, and I met Anna [L.] Fisher and [Judith A. "Judy" Resnick], a couple of the ladies in the [1978] class. And

wow, [that was] so cool, because there's a whole bunch of folks there to meet you and everybody's just so smart and so clever and so with it. …

And George [W. S. Abbey] did his usual mumble of the introduction and told us that he was going to have us [write a paper due the next day] on why we wanted to be astronauts. [Laughs] So you got to go back and do creative writing that night, but put in words what you really were feeling.

I remember during the interview process, one of the sessions is with a shrink, or a psychologist, and that's one of the questions they ask about your basic personality. "Are you a risk-taker?"

And I said, "Yeah, I'm a risk-taker, but I enjoy taking risks that I believe I can pull off safely or do safely." I enjoyed spelunking and river running and a lot of things like that, but very seldom, if ever, get hurt. Except now. [Laughs] That's just getting older and still trying to make believe you're younger.

[The reception] was a standard Texas barbecue. But the whole week was just a fascinating week. [I got] to meet people, some of whom were heroes, like the John [W.] Youngs, [Paul J. "P.J." Weitz, Christopher C. Kraft, and Robert L. "Bob" Crippen] and things like that, others you've heard about, and in a place that you always wanted to go visit and be part of. And, of course, they spen[t] the whole week prodding and testing and evaluating, but letting you do so many cool things, too. [It was] a fascinating week. Nice people, every one of them.

ROSS-NAZZAL: Let me ask you about that paper you wrote. What did you put in that paper? Do you remember why you wanted to be an astronaut?

SPRING: I don't remember exactly what I said, but the theme was that I think the challenge of mankind, going into space, is such a wonderful opportunity that I am so privileged to be alive during this period of history when we're doing that, and that it would be such a privilege to be allowed to be part of something so big, so wonderful, so grand. I don't know if that's what got me in there or helped a little bit or not. I think you can blow it one of those, but not make it just on that. … But I believe[d it then], and I still feel I was very, very privileged to have been part of [the nation's space program].

ROSS-NAZZAL: And where were you when George Abbey called you?

SPRING: I was in Tucson, Arizona. I had just come back from Korea and I was en route to my next [Army] assignment, Fort Monmouth, New Jersey. And George called and said, "Well, we wondered if you're still interested in the job."

"Wow! Yes, of course I am." So I diverted from Fort Monmouth, New Jersey, to Houston, Texas, and got all my household goods changed in [to] final destination, and that was it.

ROSS-NAZZAL: What did your family think when you told them you were going to be an astronaut?

SPRING: Oh, they were excited for me. I was away from my mom and dad and brothers and sisters, but my wife was there and she was certainly excited. It had been something that they knew was a goal or a dream; they were delighted for me.

ROSS-NAZZAL: Why don't you tell me a little bit about astronaut training and the first few months of being in the Astronaut Office. What are you memories?

SPRING: [For] the first few months you're definitely the new guys. The first year you're really an astronaut candidate. That's somebody who is—you know, "We're glad to have you aboard" type thing of thing, "but just don't get in the way." Once you learn the ropes, you can make yourself useful. …

Every Monday morning we had this big old astronaut meeting where everybody gets together and they talk about the Shuttle and the process. We started in June of 1980, and the Shuttle hadn't flown yet, but [first flight] was just around the corner. So the Shuttle [was] getting ready to fly, and we [were] tracking all the systems and doing all the training [on] what was still kind of an unknown thing.

The stars of the show were Bob Crippen and John Young, and they were very magnanimous, very friendly. [The atmosphere in the Astronaut Office was friendly—a] very nice office. No animosity, no hostility. It was just, "We've got a big job to do, and take your place in line, but just put on a harness and start helping us get this thing ready to go." And, [that] was great [by us].

The first four or five months or so are spent in training [and general orientation]. They brought in the experts from [around] the United States on the various things they wanted you to learn: [geology], plate tectonics and Earth atmospherics, and the magnetosphere and oceanography, [weather, and Earth observation]. Oh my word, all these great sciences that are important to you. [It was] a saturation learning experience, taught by folks who were hand-

selected because they were so good at transmitting this knowledge and the wonder of the technologies that you were going to be a part of. [It was also a great time for bonding as a class.]

[Later, about the fifth month], you also start working on the single systems trainer. You're given a whole bunch of books to read, [to] start understanding the engines and the navigation systems and the computers [and all the other main components of the Shuttle Transportation System]. There's a thousand systems on that beast and you need to know every one of them well. [Later], you'll become expert in [a few] of them, depending on what the job [you were assigned] but you still need to know all of them reasonably well. [We] were just in a learning mode.

At about the six-month point, you're assigned to a job. I got SAIL, Shuttle Avionics Integration Lab [Laboratory], which is basically a [fully functional] Shuttle [avionics system] inside. None of the skin to it, but all the avionics [were there]. As a former test pilot, [I got to fly this on shift work]. We just did regression testing on the software [for every change made]. That was a twenty-four-hour [a day]—seven [day a week] thing because the computers were key to making the whole [Shuttle] work. We had to test everything when they did new software releases. That was a really good job for learning how the systems [performed] together.

At about the one-year point, you're finally declared a noncandidate [and are now an astronaut]. Now you're really an astronaut and authorized to [and expected to] wear the little silver pin. But the big thing that meant was you're also authorized to start doing PAO work, Public Affairs Office work. [So we had to] start doing speeches and [representing the NASA in public].

That's one of those bittersweet things, doing the PAO work. Everybody knows it's part of the job, but it takes you away from home, from family, and from what you're doing. But it's

one of those things that goes with the job. They [now] had a new group of twenty or so that they could put on the road, start doing PAO. [They worked us pretty hard.]

ROSS-NAZZAL: Do you remember how long you were on the road doing PAO work?

SPRING: [The PAO never stopped.] Oh, there was a limit to it. I mean, most folks were expected to do two or three a month, if I recall. You just signed up for them and did them. One of the tricks was that that was also a way to get a T-38 occasionally. If you could arrange a weekend [PAO] that was near an airport or for a military organization, then you could agree to take a T-38, and that way, get your flight time in.

ROSS-NAZZAL: You mentioned STS-1. What were your specific duties related to that first mission? Did you have any assignment?

SPRING: For STS-1, I [worked] the SAIL, the Shuttle Avionics Integration Lab, doing the regression testing on the software. [I got to work] with [a number of other experts like] Judy Resnik used to work with us quite a bit on the arm. Anna Fisher worked on some of the flight data file. I was working with "Hoot" [Robert L.] Gibson, the Hoot. I still remember Story Musgrave [the first time I met him at SAIL. He was] straddling the C-3 console there, working both [pilot and commander] positions, [throwing switches and working all the radios]. Just, "Stand back." Arms are flying. Story was a wonderful trainer. It was fun working with him.

… After I spent almost eighteen months in SAIL that I got transitioned to doing a VITT, or Vehicle Integration Test [Team]. That was one of the more fun jobs. [The VIT Team works

mostly at Kennedy Space Center or the Cape Canaveral, Florida.] [The] work [involved] tracking the various problems, the anomalies that they found on the last flight or during the recent inspections. [We would] track anomalies, reporting the progress back to the Astronaut Office, helping to integrate various payloads [and conduct many tests as the Astronaut Office representative]. It's a very busy job, a very important job, a very fun job, because you got a chance to work with all the technicians that processed the Shuttle and the payload integration. We're the ones that did the [final] switch list, seat the crew and then close the hatch before they take off. That was cool.

ROSS-NAZZAL: So you did that for the crews from STS-5 through STS-9?

SPRING: That sounds right. You probably know more than I do right now [about which missions I worked when].

ROSS-NAZZAL: Do you have any memories of any of those missions or any of your time at the Cape?

SPRING: Oh, a lot of memories. The one thing about the NASA family was that everybody—I think everybody—shares the dream about space. For some people it's a job, but it's also a job that leads to a pretty cool mission. Working with the technicians, just being able to go into the high bay or into the Orbiter processing facility and see this [big beautiful] spaceship there [was a thrill]. This is really a spaceship. You know, that's magic. To me, it's magic.

[There are lots of impressions and memories. On a foggy day at KSC], Vance [D.] Brand took [a] picture of the Shuttle rolling out on the launch platform, and it's just all foggy. I remember being in the vertical assembly building when we opened the doors for [the stack] to go out. [These doors are one hundred plus feet tall] and just fog just rolled in like it was a movie set. Everything is so [much] bigger than life, almost surrealistic, and [the fog] just made it twice as much so. I just remember [thinking], "Oh, wow." It is just so cool being around these big monster vehicles that are going to go to space. It really is bigger than life. … Every American ought to see a launch, by the way [an experience what goes on at NASA].

ROSS-NAZZAL: I would love to.

SPRING: You should.

ROSS-NAZZAL: It's one of the things on my list.

SPRING: Yes. Well, hopefully, we'll get started again and you'll be able to.

ROSS-NAZZAL: Let me ask you about your class. Your classmates called themselves the "Needless Nineteen." Can you tell me who coined that phrase?

SPRING: I don't recall that. No, I [really] don't recall that. I mean, there was the TFNG, which Thirty-Five New Guys, which was in '78. … [We knew we were the new guys, the last on the list. There were about fifty people ahead of us in line for a flight.] If you recall, the Shuttle

hadn't even flown yet, and [NASA] brought in thirty-five folks for the class of '78. There was already a herd of probably forty or fifty folks already sitting in the Astronaut Office, waiting for their turn, and then they piled on, really, twenty-one, nineteen U.S. and two of the foreign folks in our class, to just jump into the waiting line. [We found a way to help.]

I remember a couple folks saying that, "I'm not sure what we're going to do with you all." But there were more than enough jobs to put us all to useful work pretty quickly. Some of our guys turned out to be real workhorses to keep the [NASA or the Astronaut Office] going, like Jerry [L.] Ross.

ROSS-NAZZAL: I've also heard that you were the Astronaut Office expert on EVA [Extravehicular Activity]. Can you talk to us about that?

SPRING: Well, I don't know if I'd make that title for myself. At one point I had EVA as my main job [so I was the designated expert]. If I had to call an expert, it would be Story Musgrave or maybe Jerry Ross, who taught me most of the stuff that I know. For a while, I had the lead on EVA in spacesuit designs, [glove designs, Hubble Space Telescope repair, and Space Station construction], and things like that. That was a totally fascinating job [like every other job]. In fact, I never had a nonfascinating job while I was there.

Following our flight, we found that there were a number of problems with the suits [and the pre-breathe protocol]. I remember my right arm went numb [from the wrist down, and that lasted for about five months]. (That's one thing you didn't tell the docs [doctors].) [The joint in the suit was] rubbing on the nerve sheath in [my] wrist area. We'd armor ourselves up with Teflon, little Teflon plates taped on to your wrist [pressure points at various places] to try to

avoid the contact. … [The gloves needed lots of improvement. The suit itself was good, but had no heat source, so you got very cold. There was also no propulsion for the suit.]

… The gloves are actually a work of art. We tried one-size-fits-all, then four or five sizes [and] fit the average, and it really doesn't work that well. Reusable gloves are an okay idea, but people's hands are so different and they're so intimately involved in what you do if you're trying to manipulate anything [that we ended up needing customized gloves]. On our particular flight, we handled maybe a thousand piece parts, because we did those two EVAs with [multiple assemblies of both structures]. That's handling struts and nodes and little pieces and putting them together and taking them apart, just a lot of finger work. We were the first EVA really aimed at trying to understand what it would take to do the Space Station—a Hubble [Space Telescope] repair went in between there—but just a lot of manual manipulation of things. So the gloves needed a lot of work, and I had the challenge, the privilege, to work with a couple of different glove manufacturers to help come up with some better designs.

Then I got a chance to bring a number of astronauts into the [water] tank [to] do a lot of evaluation and try to make [various protocols] better, and I think we did a lot of good things to help. In fact, a number of the current astronaut crop now were design engineers and worked from various parts of the community that we helped get interested and get on board.

ROSS-NAZZAL: Can you tell us who those glove manufacturers were? Do you remember?

SPRING: International Latex [Corporation (ILC)] and Dave Clark [Company] were the two big ones that I recall, one out of Dover and the other one out of Springfield, Massachusetts. In fact, Dave Clark had almost given up on [glove] work, but they'd [made] some really nice [gloves]

during the Apollo era and we encouraged them to come back and start doing some of the work [for us].

ROSS-NAZZAL: Did you spend a lot of time at the manufacturing plants?

SPRING: [Not a lot.] We spent some time [at the plants meeting and shaking hands, and generally helping people] understand what [we] were trying to do. We [also visited to give] out Snoopy Awards, which were NASA's award for excellence. A lot of people dedicate so much of their energy and passion to try to do things better [for NASA and by extension the astronauts].

[Some of the glove issues were women would] crochet [and build] special meshes. This mesh holds the bladder.] Each joint has to be articulated, but the finger [material is] generally too long, so they have to be brought back down [to your size]. If you bunch up too much material in the crotch of the fingers, it [hurts and you can't work]. So you need to get the gloves where they're comfortable, because these EVAs are six and a half hours or so apiece, and that's a long time to be in pain if you're hands aren't working right for you.

ROSS-NAZZAL: So what was your primary task? You mentioned, for instance, that one-size-fits-all doesn't necessarily work, or reusable gloves don't necessarily work. What was the impact of your work?

SPRING: The impact of my work. [I improved the awareness of many spacesuit issues and started the process of getting things fixed for suits and gloves.] In general, [I helped] improve the suits, improve some of the understanding of EVA and its importance. I [also] did some

pioneering work on the EVA protocol [for] the pre-breathe. We brought Mike [Michael L.] Gernhardt in as a consultant [who helped us develop a safer and more effective pre-breathe protocol].

I don't want to get into the technology too much, but you've heard of the bends. You know that you [can] get [the bends] when you go from a high pressure, as in deep-sea diving, back to sea level. Well, for spaceflight what we get is a different way of getting the bends; you go from a standard atmosphere into a [lower] pressure and then work for a long time, the nitrogen [can] still come out of your system [and cause the bends. For Space Station, I knew we had to do lots of EVAs and needed a safe way to do many of them.]

So the protocol [options] that we had were basically two. One is pre-breathe, for almost four hours of pure oxygen, and that's painful. [The] helmets were uncomfortable, [and four hours of inactivity is boring]. [The other is to] bring the cabin pressure down to 10.2 [psi] or basically like you [are on] a mountaintop, [while] increasing the partial pressure of oxygen; then you only had to pre-breathe for an hour. Mike Gernhardt helped us develop that protocol, and [others helped obtain certification] that it was legal [and] safe. NASA is, and always has been, concerned with safety. It's just it's a risky business, [and you need to be safe when you can].

So that protocol for the EVA was something I worked on, the gloves [and] the basic suit design. [I also worked on] a lot of the Space Station construction in how to [build or construct] the Space Station. [I also worked on] the Hubble [and helped make it] EVA-accessible. …

ROSS-NAZZAL: Great. Let's talk about your mission.

SPRING: Okay.

ROSS-NAZZAL: When did you find out that you were selected for a mission?

SPRING: Well, [the announcement comes from George. One day George called us into his office and asked us if he was keeping us busy enough. We assured him we were all super busy and employed.]

And he says, "Well, I was just wondering if you had time to take on an extra job."

"Oh, I'm not sure, George." [Laughs] Because George, he's got such dry sense of humor. If he can mess with you, he will. Anyway, so finally he ends up offering you—asking you if you'd be interested in [taking some extra work—like going to space].

"Well, yeah, of course I would." That's what we're here for. "So who's my crew? Who are we with?" And, of course, I was with Brewster [H.] Shaw, who was on his second flight, and the rest of them were all my classmates. Mary [L.] Cleave, and Bryan [D.] O'Connor was the pilot, and Jerry Ross, my good buddy. So we got put together as a crew and found out that we enjoyed each other's company and liked each other very much. Brewster turned out to be a very good mentor and leader.

ROSS-NAZZAL: What did your wife think when you were selected for a mission? Did she have any sort of reaction?

SPRING: Oh, she was happy for me. She was just happy for me. I guess she had some concerns, but [I] pretty well overrode those. I mean, that's what we were there for. In the early days, NASA chose a fairly high percentage of test pilots, folks who kind of enjoyed being on the edge

just a little bit, [and who] understood the risks and wanted them. That was just part of the thrill of it, really.

Anyway, we got constituted as a crew and Brewster brought us together [as a team]. Of that crew, really, all but Mary Cleave were experimental test pilots or experimental-trained. Jerry Ross was not a pilot, but he still went through the Air Force Test Pilot School [as a flight test engineer]. So we made Mary the flight engineer. Have you already interviewed Mary?

ROSS-NAZZAL: Yes, we have.

SPRING: Yes, so she would have told you that, too. [Making her the flight engineer] got the maximum strength out of the entire crew. We backed Mary up at first, when she was learning systems, because if you're not an aviator, some of the aviation things are not instinctive for you. But by the time we were ready fly—actually quite a while before we ready to fly—Mary was a tiger and had it all down pat, and then Jerry and I got to learn other disciplines [like satellite launch and EVA]. It was really a good combination.

ROSS-NAZZAL: Now, your flight actually changed a couple of times. You were originally assigned to 51-D.

SPRING: Oh, yes.

ROSS-NAZZAL: Then to 51-L and then finally 61-B. How did all these changes and payload changes affect your training?

SPRING: [The mission changes did not change our training very much. We were still learning basic Shuttle procedures when most of the changes took place.] The mission-specific training is what you do probably six months to eight months out, except for a really complicated mission, like a Hubble [Space] Telescope or one of the Skylab missions. So we were still learning basic crew work through most of these changes. It was after the first change that Jerry and I started lobbying pretty hard for a spacewalk or an EVA, and we got [knocked] off and [put back] on that a couple times. But there's no way to ever guarantee what you're going to do. You do what you have to do. We tried to lobby as much as we could about the importance of getting a whole cadre trained so that we could actually do a Space Station, and that turned out to be the right thing to do.

… We finally landed on this one, [61-B with three satellites and two spacewalks]. I guess finally about eighteen months out, they gave us this mission, this set of payloads. Once [they announced the mission], we launched on the day we said we would. The Mexico City [Mexico] earthquake changed us from a morning launch to a night launch, NASA's second night launch, [but the mission remained]. From then on everything went like clockwork. The only thing we didn't get was a downlink TV camera, I guess, but everything else was a go and almost went flawlessly. It was a very lucky, very perfect mission.

ROSS-NAZZAL: Let me ask you about this photograph of your crew. Can you tell me a little bit about this photograph?

SPRING: The photograph you're looking at is what became our unofficial crew photograph. [We took this one clowning around while doing our official photos.] One thing I will say is we enjoyed each other, as a crew. I mean, every one of these guys on the crew were our friends and still are. I don't talk to Rodolfo Neri Vela that much, but the rest of [us], we get together periodically and still do lunches or dinners and things like that. …

This one that you're looking at is the unofficial crew photo, one that we just decided to pull together [for fun]. It just shows Jerry and I in our EVA spacesuits and Mary and [Charles D. "Charlie" Walker] in their lab smocks; [Brewster is the boss and Bryan is the pilot.] It's just folks wearing little name tags for what it was they did on the mission. That [photo] could not be the official one, because the Mexican government took a little bit of umbrage at Rodolfo being dressed up in a serape and a sombrero, but then post-flight, we went down to Mexico City, for some PAO work, and the first thing they did was [to take] us to the folk ballet, where everybody's dressed up exactly like that. [Refer to photo at end of transcript].

We got pretty good play out of that one; that was fun. The little lunch box is just the standard construction engineer work, and the little stuffed animal on my lap is actually a kangaroo, because we launched one of the Australian satellites as well. We were hoping to get a PR [Public Relations trip] back into Australia, but that didn't take. But that's just a little bit of what everybody was doing for the mission.

ROSS-NAZZAL: That's great.

SPRING: [Thanks]. A couple of the other stories behind that [photo] is—just some of the little anecdotes. Those spacesuits are just heavy. That's about 350 pounds of spacesuit, and you're

wearing long johns with water hose next to your body, and then you've got this big old rubberized suit on. … When they're pressurized, you can walk around in them reasonably well, but when they're not pressurized, you're carrying all that weight on you. Well, then I think I weighed 140 pounds [at the time] and was hauling around this 300-pound suit. It's [heavy].

[So we're] in a photo lab with the hot lights on, so you're getting pretty hot. And what they've got to cool you off is a big jug of ice water that they can connect up to [the suit] water umbilical, and it starts off at the small of your back and this little spider web of lines then goes [up and down your back then] out down your arms [and legs], so you go from being very warm and sweaty to all of a sudden to having ice water really right next to your skin, and it's "Oh my word!" … But, yes, those are smiles. They're really smiles. We had a wonderful time.

ROSS-NAZZAL: That's a fantastic photograph. I've never seen that photo. [Flight lithograph S86-25929]

SPRING: [That was a] whole montage [we put together which] turned out to be pretty good. The launch is [a] time-lapse photograph called "A Star Is Born." That was taken by a reporter off the Banana River, and the unofficial crew photo, [we already talked about]. We showed the satellite on the bottom left and then two Space Station construction shots and then the landing. It's [a mid grouping that shows the mission from end-to-end]. That was well over, what, fifteen years ago or so now, or getting there. Seems like only yesterday in some ways and then a lifetime ago in others.

ROSS-NAZZAL: Let me ask you a couple of other questions about the crew. There were actually two payload specialists on board your crew.

SPRING: There were. [Charlie Walker worked for McDonnell Douglas Corporation and Rodolfo Neri Vela was a Mexican national.]

ROSS-NAZZAL: When did they come into the training sessions?

SPRING: Payload specialists [usually join the crew about] sixty days or so [before launch]. … We knew we were going to be working with Charlie Walker from McDonnell Douglas and then Rodolfo Neri Vela [well in advance, but they joined us in Houston two months before launch].

You mentioned earlier about the different missions [we were assigned]. As each mission came on, [the] payload specialists moved off and on [with them]. That's one of the NASA things. The crew stays together and the payload specialists move on or off with their particular payload. [That's why we put their names on the tab.]

But we got Charlie Walker and Rodolfo Neri Vela assigned to us about sixty days out. And we integrated them into the crew, brought them on the T-38s with the flight training. They took part in all the simulations with us, literally moved to Houston and became part of the crew. They were really nice folks, very smart. Again, that's one of the special things about NASA, is just everybody's so darn smart and so darn enthusiastic about what they're doing. It's really a joy.

ROSS-NAZZAL: What was the Astronaut Office's reaction to the fact that companies or other countries could have members fly on flight crews?

SPRING: There's a little bit of mixed feelings about it, but mostly it's an appropriate thing to do. I think the current crop [of astronauts] might have a little bit [more concern]. I don't know how many people are waiting, but it's got to be 150 people waiting for their turn. Now we're down to three Space Shuttles, so your turn is going to take a long time [to arrive]. I finally left after only one flight because I'd been there for eight years and it looked like it was going to be another four or five before I got another flight. I had one under my belt and the waiting list was getting longer than shorter, so I decided to get on with my life. But these guys, I mean, they haven't even flown yet. I sympathize with their position. [I might resent giving a seat to a non-professional.] …

ROSS-NAZZAL: Some of the people we've talked to have talked about cultural awareness training that they participated in. Did you do that because you had a Mexican payload specialist?

SPRING: We did not have to participate in that. [We mostly used common sense.] Mexico is somewhat different from us, but Rodolfo spoke [excellent] English. He's an electrical engineer by trade. And that was not a particular problem for us. If you're going to work with a culture that's [very] different—the Japanese, maybe the—no Chinese yet, but especially some of the Mideastern, the [Sultan Salman Abdulaziz] Al-Saud, the Prince of Saudi Arabia flew on one of them, that is definitely a cultural [change]. I remember Shannon [W.] Lucid talking about doing a visit there [to Saudi Arabia with the crew] and they expected her to put on a chador and go into

the back room and be with the women while the men talked [with the] men. That was a [big] cultural [change]. …

ROSS-NAZZAL: Why don't you tell us a little bit about your training for this mission, especially the EVA training. What was that like?

SPRING: EVA training [became the center piece of our training and flight preparation]. Jerry was the master of EVA [and took the crew lead]. Jerry had been with NASA for three years before he got picked up as an astronaut, so Jerry knew the ropes a lot better than most of the rest of us did. … He was EV [Extravehicular]-1, I was EV-2 and very happy to learn working with him. We basically learned together, but Jerry had started on it before I had.

Together we pretty well decided that we were going to do this right and do it as well as we could. We engineered the EVAs so that they'd be successful. The astronauts are always involved in the flight data file, the choreography of what you're going to do [and we developed a final set of books on how and what we planned to do]. About six months prior to flight, we chose to do at least one WETF [Weightless Environment Test Facility] every week, and we chose to make these long-duration underwater runs [for four to six hours].

So at least once a week we'd do a four [to six] hour run underwater, going through as much as we could of the complete EVA. The [actual] EVAs we did were five and a half and six and a half hours. That's a lot of work, [so] we'd go through [the whole protocol] so we could get used to all the handling and manipulation and that's part of where the rubbing on the nerve sheath and stuff like that happened. It's a lot of work doing an EVA. It's one of the few [times] you actually get to "work" on orbit. It feels quite good and, of course, the thrill is being able to

go outside and just look up and see the Earth with just a little piece of Plexiglas between you and it. That's wonderful.

But the training itself, we had the small water tank that was adequate for our particular job. For some of the tall work, we had to go up to Marshall [Space Flight Center, Huntsville, Alabama], where they had a little bit bigger tank. That was one of our major recommendations, [by the way], that NASA build a big water training facility, and Jerry and I both worked on getting them to do that. I'm very glad to see that we have one now. We knew, for Space Station, it's absolutely essential to work with the masses and the volumes and do the choreography [exactly] as it will happen on orbit so you know what to expect. If you don't, you'll regret it. …

So the training was great. [In] the water tank is a mockup of the payload bay. A bunch of divers in scuba outfits, take you around, weigh you out so that you're neutrally buoyant--upside down, right side up, turtle, sunny side up, sunny side down. The weigh-out is interesting. Then you just go to work.

It's interesting. [Laughs] I'd have to show you on the little EVA clip I've got, but there's one shot I love pointing out, where Jerry is actually kicking his feet, just a little bit of negative training [from working in water. Have you seen that?]

ROSS-NAZZAL: No, I haven't seen that.

SPRING: Oh, it's funny. Most of the training in the water tank is [perfect preparation for EVA work on orbit]. It's excellent. It's just what you need to do for orbit, and it's very well designed to get it for you. [There are only a couple of minor negative training.] You don't even realize you're "cheating," but when you want to get a little bit higher in a water tank, if you kick your

feet, it'll [move] you, give you [an] inch or so [reach] to get what you want. There's one place [on our flight video] on orbit where Jerry needs an extra inch or two, and you just see him paddling his feet like crazy. [I usually get a big laugh from the audience when I show it.] That was fun stuff; you've got me reminiscing on some of the good times.

ROSS-NAZZAL: While you were working on this training for the EVA and choreographing the moves that you would be performing in space, were there any challenges that you encountered and anything that you had to change?

SPRING: Well, we [made lots of changes to develop and] work out the protocols [and make the EVAs successful]. The EASE [Experimental Assembly of Structures in Extravehicular Activity] experiment we knew was going to be a difficult [job]. That was an M.I.T. [Massachusetts Institute of Technology, Cambridge, Massachusetts] experiment. It was a time-and-motion study. In fact, both of them were time-and-motion studies, but [EASE] had weighted ten-foot beams that on Earth weighed about sixty pounds apiece [and were] four-inch[es in] diameter. The protocol for that [experiment] caused one person to be free-floating or holding on with one hand, while he manipulated [the beams] and built it from the top.

After just a couple tries in the water tank, we knew that that was not the way to build things in space, but this experiment kind of proved that in no uncertain terms. Astronauts can do [al]most anything if you've got good foot restraints and a place to work from. Add the proper handholds, [and] you can manipulate huge objects, I mean multi-ton, quite precisely, as we've done with Hubble [Space] Telescope and a number of other [missions]. That was another one of the findings from our particular mission that we came back, [and inventing work arounds was

part of the preferred changes. We also had to develop the tether protocol for these large pieces and get a waiver for the many small pieces on the other experiment.]

So we [had to decide] whether we [would do EASE] at all or do it the way it was planned. We learned to do it, but [also "learned" that] just free-floating is not the way to put things together. [For the] ACCESS [Assembly Concept for Construction of Erectable Space Structure experiment], we were [allowed] to build that [using] the remote arm; the manipulator arm [on the second EVA], boy, it went very fast. We proved out some of the concepts that we knew and right away, Jerry and I were able to apply these [lessons learned and we] recommend[ed] the big water tanks and a few [other protocols]. There were quite a few changes that came from our lessons learned on this particular flight that I think [benefited] Hubble [and] for the Space Station construction.

ROSS-NAZZAL: Let me take you back to the day of your launch. You're getting suited up and you're going out to the Shuttle. What's going through your mind before you're about to launch?

SPRING: I remember being aware of that, and I offered you before some of those voice tapes that we took with us. I was even wearing [the "y" cord] during this period. The biggest thing going through my mind was, "I hope we launch." [For our launch, it] was a perfect night. [We had] a full Moon, seven-thirty in the evening launch, the day before Thanksgiving, severe, clear, [not a cloud in the sky; it was a] gorgeous night. I'd invited all my friends and family, and a large portion of them just accepted the [invitation], just because the timing was perfect. "The day before Thanksgiving, come down and watch Woody launch and have a big old three-, four-day party and then a couple days later, he'll be home."

So [my] big thought is, "I hope it launches." I'd been part of this VIT Team and I'd seen a lot of [missions] get to the pad and right down to main engine ignition and then have it shut down again because some door didn't work fast enough or some gimble wasn't working within limits. So the biggest thing was, "I hope this thing launches."

I remember thinking a Shuttle mission [costs about four hundred million dollars] or something like that. That's funny money. … They doesn't come out of *my* pocket. But I had to fly my family at my own expense, and I was paying $80 a night for my wife's hotel room, so I really wanted this thing to launch. [Laughs] I mean, it's funny little mundane things that you think of like that.

A couple folks have asked me if [I was] worried about it or were you [were afraid] about dying or anything like that. No. That's not in your forethought. I mean, you hope you *don't* die, but then again, if you should for some reason, you're doing what you love best, what you were trained to do. You know darn well you're climbing on top of a few hundred thousand pounds of potentially explosive material. That's just—it's total trust in the folks that you're working with and around, and belief in the system. And I think [the trust is] still there, too.

ROSS-NAZZAL: And what was it like when you finally lifted off the pad?

SPRING: Just starting off, I remember going up in the elevator, and there's still a bathroom that works like two floors above where the crew goes in. Most of us took [the opportunity] to take a "last chance" up there, but from up there, the vehicle's like it's alive. … It's full of cryo, you know, cryogenic oxygen and hydrogen, so this thing's almost squealing with [demonstrates], making these squealing noises and venting off from the beanie cap that goes on top of the

external tank. They siphon off the hydrogen that [boils] off, and that goes over to the burn pond, and so there you are on a dark night, on the seashore, with the xeon floodlights on us, but it's dark in the background, but then there's this burn pond, with the hydrogen flames just burning and dancing in the background. Meanwhile, the Orbiter is just telling you, [it's ready]. This thing's alive. I mean, it's making noises, it's groaning, it's creaking, and, oh, wow. This is so cool. This is the big event!

I remember the countdown. The countdown is about an hour and a half procedure or more. You get seated and they finally pull away all the platforms. I remember doing that, and gripping and grinning with all the folks and the crew and all the launch folks, because these are guys and gals that I'd worked with for the last few years. Finally they button the hatch up and then you've got another half, three-quarters of an hour of switch-throws and waiting while things happen. The big xeon searchlights have got you illuminated, but it's a dark night.

Finally, you get strapped in and you're waiting. You go through this countdown and everybody's very, very familiar with the countdown and procedures, because you train on this thing once a week, and I'd gone through the "Cape [Crusader]" part of it, so this is just, [a] waiting [time]. And I remember going through [the countdown], "I remember a mission stopped here. I remember a mission stopped here." I said, "Oh, please make it through this one. This is another major window." And there's another one where you start the APUs in about five minutes, the auxiliary power units.

Now the vehicle's *really* alive. I mean, when they start the APUs, then the engines gimble and you can feel those things, "Oh my word. This thing is getting ready. It's getting ready." The tension builds a little bit. Of course, you know, that's also part of [it].

Then we finally get down to main engine ignition, and that just sounds like there's some lions in the room behind you, you know, just [demonstrates], just a roar. And you can feel it. I mean, this vehicle's alive. [It is buzzing and vibrating with power.] Then the main engines gimble, getting ready. From the [time of] main engine start, you get one and a half seconds where the vehicle actually swings through about [three] degrees of arc and then comes back again. Then the solid-rocket boosters ignite.

I remember hearing on the intercom before I felt it, "We have solid-rocket booster ignition." Then it's "blam!" like somebody hit the back of your chair with a sledgehammer. Not a blunt force to you, but to the platform that you're on, and just "vroom," you're just leaving. I remember watching out the window, watching the gantry just disappear very rapidly.

Then we start this roll maneuver, and, oh my word, we're on for just a barnburner of a ride. That was great. You ride, oh, you ride for almost two minutes while the solid-rocket boosters are burning, and then you get this almost weightless sensation, where the engines [throttle back] off and the solid-rocket boosters tail off, and you're just letting the pressure off all the coupling devices. Then you hear some explosions, which is the SRB [Solid Rocket Booster] separating, and then the engines [pick back] up again and they finally get up to 3 Gs, and you're pressed into your seat [at] 3 Gs [for the rest of the six and a half minutes to orbit].

Now, [to any] pilot, any pilot that's done acrobatics or something like that, 3 Gs is not much. Generally, you're pulling 4 Gs or even 6 Gs in a good loop or [while doing] acrobatics. That's not hard to sustain at all. But when you're doing it in an aircraft, it's on and then it's off again. You go through the maneuvers, [but] when you're in a Shuttle launch, the 3-G onset is there and it stays there for like another six and a half minutes. It's weird. It's funny. Everything just weighs just three times too much [and it doesn't go away].

I remember lifting my head up and my arms, just seeing what the sensations are like, and probably talking into the tape recorder. Again, I will share those with you, if you want.

Then finally you get engine tail off, [Pc less than 50], about eight and a half minutes after you started this whole process. All of a sudden, everything just slows down again. It gets very quiet. You almost forget that you've been in this roar for the last little while, even through your helmet.

Then it sounds like a couple Howitzers going off, "bam, bam," which is the [explosive bolts separating the] external tank from us. And you're in orbit. You've got to do another burn forty-five minutes later, on the other side of the Earth, to circularize the orbit, but you're in space!

I remember taking a pencil out of my pocket and [letting it go], and it floated, and "Awwooo," doing a wolf call, and I can hear Mary giggling over the intercom. Oh, that was great. [What a ride!]

Of course, the first thing you want to do is get the potty activated, because everybody's been holding it for a couple of hours. [Laughs] But that's just part of being there. And I remember being aware of taking the tape recorder around with us. (We got talked into bringing, just gathering the sounds from the Orbiter, [while] activating the various things.)

[Interruption]

ROSS-NAZZAL: So tell us about your first few hours in space. What were your activities besides activating the bathroom? [Laughter]

SPRING: … When you first get to space, it's awesome. [You are at the beginning of a very rapid learning cycle. You need to learn how to move and work in zero G. You need to learn not to use all your normal strength.]

You've got to reconfigure the Shuttle. We didn't have time for too much sightseeing or stargazing, because on the sixth rev [revolution], we had to launch our first satellite. That's a couple hours down range; you've got to get all the seats unplugged, clear up all the equipment that was [in place for] the launch. That [gets] all bagged up and all the chairs [get] folded and stored away, except for the pilot and the commander's seat. Helmets come off. Boots come off. You've just got to get yourself ready to get to work.

So there was a lot of unstrapping, [rewiring], just getting the area configured, get the payload bay doors [open]. And then there's a little bit of chance to look around. It's a thrill. I'm not picking on Mary. I'm sure she'll forgive me. But I remember Mary's first few words on orbit were, "Whoa! Whoops! Excuse me." You're used to being in 1 G. You're used to using the muscles that you've got, and you have to unlearn that on orbit. On orbit, with no gravity, or essentially in equilibrium with gravity, if you just do a tenth of a pound of a pushoff, which is almost nothing, that'll send you flying across the room. So you have to learn *not* to use all this muscle that you've got, and it's a good thing you take your boots off, because otherwise you'd be kicking people in the head with boots. We all wore slippers.

… Pretty quickly everybody gets acclimated to being on orbit. Then you'[ve] got to get to work, so [you] unload the flight data file, the ascent/entry flight data file goes away, the on-orbit books come out. [Placards] get posted where they're supposed to be, and you get ready to do your first day of choreographed work. Get the cameras out [for documentation and on you go].

ROSS-NAZZAL: There were actually three satellites on board this flight.

SPRING: Yes.

ROSS-NAZZAL: And you actually worked with two of them.

SPRING: Well, I worked with all of them, [but I had the lead for two]. Actually, there [were] four satellites but we can talk that [later]. Jerry and I were a team. I had the lead on two of them; Jerry had the lead on one. But launching a satellite is not even a two-person job; the whole crew is involved in it. Some folks are taking pictures. Brewster and Bryan were orienting the Shuttle, because it has to be pointed in the right direction, and Jerry and I had the lead or the control of what was going on for the satellite launches. I was lead for MORELOS and AUSSAT, and Jerry had the lead for the RCA SATCOM. One person works at the standard switch panel, which is in the back, and the other person works [the computer] usually in the commander's seat, once the vehicle is pointed.

I said we had four satellites. [Three were communication's satellites. One was a target.] One of the DTOs, or development test objectives, on this flight was an autopilot that we wanted to evaluate, a digital autopilot, or the DAP. And what it was supposed to do was give us better vernier control, vernier being very precise and small capability control for the Orbiter, for precise maneuvering. What we decided to do for that [evaluation]—actually I'll take credit for designing a good portion of that—is to use the remote arm and then launch a little target satellite. … [Then monitoring the Shuttle movement though the TV camera on the remote arm, we could

fly maneuvered against the target. We taped a piece of acetate to the screen and would fly patterns using both the old and new flight control system.]

So the fourth satellite that we launched was a little eighty-pound aluminum satellite that we put together. Basically, it was [copied from] a radar reflector [on] a sailboat. You've seen those little round things over the top? Those are radar reflectors to let the big ships see you. But we designed one of those. Basically I remember cutting it out of cardboard [one] night and bringing it in to them to show them what a target might look like.

"Oh, yeah. We can do that." So they designed it and showed it to us, and typically, it was probably overdesigned, but it was there. I remember going through the—anything that's introduced to the Shuttle has to go through this whole requirements list to make sure it's safe. And one of the questions was, "Well, how long will this thing stay on orbit?"

I said, "How do I know?"

He says, "Well, that's the wrong answer."

"Well, what's the right answer?"

"Well, less than five months."

"Okay. Less than five months." And so he wrote it down.

I remember about four years later, visiting NORAD [North American Aerospace Defense Command, Colorado Springs, Colorado], and the thing was still up there. …

ROSS-NAZZAL: That's great. Those are nice anecdotes for us to use.

SPRING: Okay.

ROSS-NAZZAL: How did your crew react once all of these satellites got deployed? What was the general reaction?

SPRING: [There was some relief that a prime part of the mission was completed successfully! But], that wasn't necessarily cause for celebration, because once the satellites were deployed, on the first three days, then we got a chance to do my favorite part of the mission, [which] was to do the spacewalks. I think the whole crew was pretty well [up] for that, too. The paying payload was the satellites, but the cool visual thing, the thing that would help NASA in the future was really the EVAs. So once the satellites were out of the way, then that part of the mission was done and was done [correctly]—you know, they were launched on time, went into the right orbits and all that good stuff, so we were very happy about that, [but had a lot more work to do].

We've still got four more days on orbit, so that's what you do. You get ready to do the next job. So you clear the deck from all the satellite preparation stuff and get ready for the EVAs. And for that, you've got to take the [35mm] cameras and get the little jackets on them and get your suits ready, checked out, and get ready to go. I remember Bryan had volunteered to be our batman, our dresser for getting into the suits, and that was the next stage: [reading our suit check-out switch list and protocol—a challenge and response exercise].

ROSS-NAZZAL: Why don't we talk about your EVA. Once you finally suited up and you were actually out in the payload bay, what are your thoughts? What are your memories about that first second or two?

SPRING: Well, let me take you back inside the airlock [for the start]. We got suited up. I remember being impressed with [how much] you grow on orbit. I'm not tall. I'm, what, five and a half feet tall, maybe five-seven when I was at my tallest, whatever. But you're taller in the morning than you are in the evening. You're taller when you're young than you are when you get old. It's just the little elastic disks between your [vertebrae that] shrink and contract throughout the day under gravity, and then with old age, they shrink and kind of stay there. But I grew about an inch and a half on orbit. You don't get to keep it. It goes away, unfortunately.

But they size the suits to be basically an inch and a half "too small" for you, for when you're on orbit, so you've really got to work to get in[to] those things on orbit. But it feels good. It's nice to have your backbone, your spine compressed back to where it's supposed to be. But it really took some help getting those pants up and cinched in. You've got to work to do that.

I remember hanging on the wall of the airlock, waiting to go out. That was one of the two times I guess I had butterflies in my stomach; not before launch, but before I went outside. What's going through your mind is, "Oh, I hope I don't screw up." I mean, it's nothing more prosaic than that, for a couple of reasons. One, it's your big chance. Another one is, they've got all the videocameras in the world on you. Well, not all in the world, but they've got five on you, and if you screw up, your friends will have [photos and videos] ready for you at the pin party, too. …

So there's a little bit of anxiety just before we went out. Just, "Oh, I hope my training has been good. I hope I don't mess it up. I hope, I hope, I hope." And then we opened the hatch, finally. We got the pressure down to zero and we opened up the hatch, and it was just like old home week. There's the hatch, there's the payload bay, beautifully lit with the sun, and there

[in] the background, there's the Earth, just like it's supposed to be. And I remember I said, "Oh, this is great. This is all going to be wonderful." And it was.

You've got to get outside and get to the toolbox and get the payload bay ready to do work. We [proceeded to get our tools, tethers, and] went to the platforms for the two EVAs that we had to do. You've got to open up the toolbox and that's a little bit of a reach. There's handholds there. You've trained in the water tank, but you really haven't trained on orbit and there's a little bit of learning curve to doing it, but it comes very natural[ly]. … And then you get to work.

[Through training, you learn to] do your job first. Then, I remember being able to take a break, waiting for Jerry to do something or waiting for the arm to do something, a chance to just lay back in the foot restraints, with your arms over your head, because that's just a natural position—the suit wants to take that position—and just looking at the Earth. Some of those [resting] passes are the most vivid and poignant memories, just watching [the Earth float] by. It's just, "Ah, the Earth is gorgeous." You can still see the continents from orbit very readily. I mean, they're discernable as continents and they have about the right shape, although your face is pretty close to them. It's not like looking at a map, a little globe that sits five feet away. But you can see the shape on them.

I remember one whole pass—I don't even remember now whether it was the first or second EVA, but I remember one whole pass over Africa. We launched in November, which is about when the monsoons break in Africa, so almost three-quarters of that continent, [at least coastal], is just consumed with thunderstorms.

But I remember going up the coast of Africa and just seeing the lightning storms that just went on for the entire pass, probably a six- or seven-minute pass, going by. Just lightning,

ground-to-ground, air-to-air, air-to-ground, ground-to-air. Just, oh my word, what a [light] show. And it's just for me. [Laughs] It was wonderful. You know, both of us just watched that for a couple of minutes in total awe. Just special.

I remember another time [during the first EVA when] a little bit of anxiety hit me. I was up on the EASE structure. The inverted tetrahedron is the EASE structure. And I was up there and all of a sudden night fell. [It happens fast on orbit.] We train in the water tank for [EVA], but all of a sudden night fell, and I just wasn't used to [it] all of a sudden going dark. So you've got to get your visor up and get your headlights on, and then [a few] seconds later, everything was cool. But I remember [that] little bit of anxiety when the first time that night fell, because you're up on this kind of tippy structure and you're thrashing around just a little bit. If you see the pictures, you'll recognize the thrashing-around.

Then the last time I remember having a little bit of anxiety, it was on the second EVA, and my job, when I finally got to work out of the RMS, the remote manipulator system foot restraints, was to go up to the very top of this forty-five-foot-tall structure that we had built. Mary had worked Jerry first, so Mary, now, she's feeling pretty confident on moving the arm at maximum speed, and we're allowed to work the arm pretty fast. I don't remember exact rates, but like a foot a second or maybe 1.5 feet per second. That doesn't sound like much, but it's fast [when you are on the end of it].

So I get on at the sill, you know, the payload bay, and I know that I'm going up forty-five feet to take the top bay down and then put it back together again. [Now] what you've got when you get into the foot restraints [is that], you're being held in by little stirrups over your toes and there's a ridge on your heels that you just slide in[to]. That's all you've got. There's a little tether that goes to your ankle, but that's about it when you're in that [Portable Foot Restraint].

Then there's [also] a little handhold or a tool caddy in front of you, but you can click a lever and slide that around you behind you. And I did that because I knew my job was to go up there and take down that forty-five-foot-tall bay, the top bay.

So I said, "Okay, Mary, take me up." She did. She just did maximum elevation on this thing, right? She took me up at whatever the max speed was, but whatever it was, and it wasn't that much, [but] all of a sudden, everything I knew was secure and safe and comfortable was going away from me very fast, and somewhere [going through] about fifteen or twenty feet away from that payload bay, I had the sensation that I was way too high without a good handhold. I remember doing one of these—to turn the suit, I mean, you've got [this ball bearing] race around your waist, but it's not [parallel] with your waist, it kind of goes up in the back and down in front a little bit, so it's a lifting as you turn. So I just remember getting my whole [upper] body doing this [waist] turn to go back and just get hold of that [handle], just for a couple seconds. [I pause a moment], and I says, "All right. This is cool. That's right, you're cool. You're cool. Yeah, we're cool," and then I was able to let go [and work normally for the rest of the mission]. But the first sensation was, "Whoa. This is high." The fact that you're 230 miles high, going 17,500 miles an hour matters not. Your focus, your security, your orientation is the Shuttle, [a big 45 feet away].

The Earth is something [that is always in view]. It's gorgeous. You asked about the favorite pastime on orbit. It's looking at the Earth. It's absolutely spectacular. You can see the stars. Halley's comet was coming while we were up there. You couldn't tell hardly anything from it, and you're no closer to the stars than you are on Earth. … That matters not, when you're talking light years away. But the Earth, what a view. What an orientation on it. Just spectacular.

But I digress from the EVA talk.

ROSS-NAZZAL: That's great. How did the crew react when you finally finished both EVAs? What was the feeling like in the crew cabin, [now] that you had achieved all these goals?

SPRING: [Jerry and I were elated and tired. The rest of the crew was dead tired.] I remember [ingress from] both EVAs; we were the ones outside working. We were doing the physical work, the classic work. But for both EVAs, especially the second one, the crew inside was more exhausted than Jerry and I were. We were probably just sky high and elated from being out there, getting to do this. I remember that after the second one, Jerry and I were the ones that prepared supper, because everybody else looked so tired from moving the arm so they could get the pictures, holding the Orbiter, [monitoring us], turning on lights. EVA is not a two-person job. The two guys that get to go outside get the glory from it. In fact, Brewster warned us, "You guys are probably going to call me your support crew, aren't you?"

"Now that you mentioned it, sure, Brewster. Why not?" [Laughs] So I made sure I did that for him a couple times. Brewster did a wonderful job mother-henning us. I remember one time, on the second EVA, [when] we were allowed to take these big, big pieces off [and manipulate them]. The ACCESS structure, that thing was forty-five feet long and weighed about 200 pounds, and we were allowed to take these things off and manipulate them, just simulating what would be like to moving big girders for Space Station. I got this [forty-five foot grid structure] moving kind of fast. I wanted to see how [hard] it was to get it moving. I'm a test pilot, too. You want to move things and see what it takes to do impulses. But I got it moving a little bit faster than Brewster was comfortable with, and it was just, "Slow it down [Woody]."

And I just remember, "Yes, I will. Yes, I will."

So anyway, Brewster mother-henned us through all this stuff, [extensive EVA], just checking, you know, what comes next. "Woody, now you're going to go here. [Now you do this… Next comes…."] You know, the whole thing is a choreographed crew effort. Mary's flying the arm. Bryan is maintaining attitude. Brewster's got his binoculars, checking everything. "Don't you drop anything," and we didn't. We never dropped a single thing the whole time, which was nice.

I remember sliding those [struts] out. What you've got is canisters that [have] these four-and-half-foot-tall [struts] that we put together with nodes. [The struts are in two canisters, and the nodes were in a rotating drum.] The way to get [the struts] out was to just get it by the tip, just get that thing going, so it's flying on its own, and grab it about midway. We learned that in the water and it worked fine, but you've got to concentrate on what you're doing. [I remember Brewster being concerned that we were getting a little cavalier in our handling of them.]

We handled a couple thousand piece parts, or at least a thousand piece parts by the time we were done building [both structures] and taking it down a couple [or] three times, and never lost any [pieces].

ROSS-NAZZAL: I understand that you were called the Ace Construction Company.

SPRING: Yes, that's a long [history]. The Ace Construction Company is an attempt to be clever and carry on a long line of "Ace Companies" that [popped up in the Astronaut Office culture]. I don't know who started the tradition. Apparently, back in the real old days, within the Astronaut Office, there [were] a number of divorces and things like that. I mean, it happens in any

community. So the Ace Moving Company got organized, which was basically all the other astronauts helping whoever got the divorce, move the households and help both your friends, both spouses get established wherever they're going to be. So the Ace Moving Company, I guess, got on orbit at some point as a little logo. Before us, there was the Ace Satellite Repair Company. We became the Ace Construction Company. [That also goes along with that photo you were looking at where] both Jerry and I were in the hard hats for the Ace Construction Company. … You've [always] got to try to do something different.

ROSS-NAZZAL: Yes. Great, great. You know, we were sort of curious about that title.

SPRING: Yes. Just a carry-on. Got to call yourself something. Got to have some moniker.

ROSS-NAZZAL: Did you have any T-shirts that you wore?

SPRING: We flew just before they started allowing the polo shirts and things like that. We did have T-shirts. Every crew has to design their crew patch. [Our crew shirts were designed around the patch.] Our crew patch has got the little rainbow on it with the sunrise. It's not really a rainbow; it's really the way the Earth's [limb looks] from orbit. The sun rises and the sunsets happen every ninety minutes. You get one every forty-five, a sunrise or a sunset, and they're spectacular. The long rays of the light kind of fold [or bend] around the Earth and the clouds are either backlit or, if it's in morning, just the mountains are backlit [with a red glow]. It's spectacular.

But the sunsets are particularly interesting because you have the clouds that stand off and you get this almost rainbow of color, the reds fading into the deep blues and the ultraviolets, and you can see all the different colors in there. It's spectacular, I mean. So the theme for our patch was the sunrise and the sunset just because it's beaut[iful], and it is. … Our T-shirts simply had a rainbow across the chest and then the crew patch in the corner and that was all there was to it. Later on, crews got to have these nice warm shirts. …

Meals were different. I don't know if anybody's talked to you about the meals, but before a flight, the whole crew gets together and you go have a food-tasting party. You'll do it a couple different times, to taste the various different meals that are offered. In fact, Jerry'll probably talk that at length. His wife, Karen, is actually part of the crew kitchen. She prepares some of the meals. But you get to choose from a whole bunch of standard meals, and you can ask for special things if you want; turkey for Thanksgiving, which is what we had. Rodolfo had some special breakfast foods that he wanted. If they can accommodate you, they will.

So you get to taste all these different foods. They won't let you eat too much junk food. They want you to have somewhat of a balanced diet, with the right amount of electrolytes and carbohydrates and all those good things. You taste all the food and you try them, and they pack way more food than you'd actually want to eat on orbit [You build your own menus, so you have a pantry to graze on too.]

Your sense of taste changes a little bit when you get to orbit. I remember some of the foods that tasted great during these food-tasting parties, like the shrimp cocktail, that was pretty good on Earth. On orbit that tasted like battery acid in sawdust. It was pretty bad. I mean, the spicy things didn't go so well. Grapefruit juice. I love grapefruit juice and orange juice and stuff

like that. Grapefruit juice on orbit was—just didn't do it for me. For other people, it may have, but your taste changes a little bit.

ROSS-NAZZAL: Did you usually eat meals together as a crew?

SPRING: Every crew is different on that. We as a crew did eat [all] our meals together. We enjoyed that. It was a chance to talk over the day; or the next events. The Orbiter is a very small environment. The size of this office, fourteen-by-twelve or something like that, [is] about the entire volume of the crew compartment, maybe a little bit bigger than this, you know, separated into two decks, so you're not that far from each other. But it was just something that we decided to do and we liked to do. If you had work that you had to do, you might take your lunch or whatever and just go on over and keep working, but you're still part of the conversation. It was a chance for some downtime to just talk and enjoy each other. And, of course, we took photos of part of this.

I assume you know that every crew pulls together a little crew video, flight video. There's one that's done for a press release almost immediately, but then there's one that you do for yourself, the way you're going to talk about it. Jerry's and mine talks a little bit more about the EVA. Mary may not talk so much about the EVAs, and, of course, she got a couple flights, so she'll probably combine them.

But, just taking pictures of the meals and things like that are part of [documenting the flight], because what you want to do is be able to relate to the folks that you're going to be talking to. I still get asked to do astronaut presentations periodically, and kids are just totally fascinated. Adults are, too, but kids are especially fascinated by [spaceflight] and they want to

know all the basics. How do you eat on orbit? How do you brush your teeth? How do you go to the bathroom? You know, all the standard questions, and they're good questions.

ROSS-NAZZAL: You mentioned that the day after launch was Thanksgiving. Did you do anything special? You did mention that you had turkey.

SPRING: No, nothing really special. [We had turkey, but no one was eating too much the day after launch.] I think we probably had some kind of a press conference. Those happened periodically. But we had the meal together and started joking and having fun. [You know], the first couple days you're on orbit, you don't feel that well. Some people get sick; some people don't get sick, but nobody feels 100 percent. It's like, you know, [we]'ve all felt the mild case of the flu, or maybe coming down with something. [That's what it's like. You can function, but you're a little ill.] For me, it didn't get much worse than that, but you still get a little bit ["not right"]. You know that you're in a provocative environment, like [in] motion sickness. You can feel the onset. You just know that you could be perturbed if you went too much further, so people just tend to move their whole upper body and not a lot of head swings and things like that.

But about the end of day two is when most people come out of it. Some people don't [feel good] the entire time on orbit. But [for] most of us, by the end of day two, you're back to normal; your body has acclimated itself to the zero-G. I remember Bryan starting to crack jokes again halfway through day two, and I just knew from then it was going to be a great mission, because Bryan was the crew jokester. We all had a pretty good sense of humor, but Bryan was the official jokester. He is a funny guy. But he started—I'd rather not say what he said.

[Laughs] But he just cracked a joke and it just had the rest of us just in stitches, and from that time on, everybody was feeling good.

Then you start getting more comfortable. I mean, pretty soon you're going down the hatches head first, and then head first with a twist, and then a couple flips, and what's this. But the first couple days, you're being very quiet, so the Thanksgiving meal on day two was a pretty subdued affair still, because most folks are off their appetite. But later on, we made up for it. About day three or four, you're going through all the past meals [in the pantry] and seeing what you wanted to scarf down.

We take a lot of fresh food up for the first few days as well. You know, carrot sticks and things like that are great.

ROSS-NAZZAL: Do you have any other memories of the mission that you want to share?

SPRING: The mission lasted about a week and every day unfolded as it was supposed to. If I kind of walk myself through [the flight], there'll be anecdotes or things to discuss from every aspect of it. [You and I already] talked [about] most of the first day in launching the first satellite. Then [we went] to [activating] various payloads [and experiments].

I remember nighttime [or bedtime]. You get some quiet time just before you go to bed. Another deal we made as a crew. There were a couple deals we made as a crew, kind of pacts. You're so good, [well-trained], by the time you launch, that you've got all the procedures memorized; you know everything to do. You're so good; you're so cool. We made the deal that everyone will use a checklist, and for important things, you'll also be watched while you do the checklist, just to make sure that we don't screw the mission up. Because it's too easy to [get]

cocky. And we actually found that that helped, so one of the rules was, you would use a checklist, even though you know it by heart, and follow it up.

Another thing was that everybody will sleep at the designated nighttime. Whether or not you sleep or not, you will be in your sleeping bag; no staying up twenty-four hours to do Earth obs [observations] or anything like that, because then you'll be overtired the next day. It's just like managing kids, but we kind of knew that we had to manage ourselves, because we were a bunch of kids on orbit at the same time we were mature adults.

Interesting, on the rule on having to have somebody else check you, because when you're on Earth, you're still looking at switch panels from a 1-G orientation. I don't know the exact number, 1,500, 2,000 switches and circuit breakers in the cabin that you have access to, a large percentage of which you may have to touch [during a mission], depending on what's going on. So on Earth, the labels are underneath the switch, you know, standard switchology that you'd expect to see. On orbit, you can approach these panels from any orientation. I mean, the ceiling's as good as the floor and left is as good as right and upside down, it matters not. So, even though you learn to read upside down and backwards, you've got to make sure you're also [oriented]—you read the title, you're used to grabbing the switch above it. But if you happen to be upside down, you grab the switch below it instead of the one "above" it. So [using the two person procedure helped]. A couple times, [I said], "I'm going to turn this switch now. No, that's the wrong switch." So that was a good thing to do. Just being careful on orbit is a very good thing to do. Again, Brewster had a lot of lessons learned, and we talked about it. I mean, it was so important to everybody to make sure you do things right on orbit.

Going to bed. So you have a little bit of downtime just before, you know, some quiet time. It's a chance to write in your diary. I've still got my diary, and it's almost [like] watching

a child's scrawl improve over five years or something like that, because I started writing in it almost immediately. "Wow, it's so cool being on orbit," just, "Golly, gee, it's wonderful." Just a whole bunch of gushing on how cool it was. In big, almost childish scrawl, because I'm trying to learn to hold myself in position and write with the pen and get everything managed. Then by the end of maybe the second or third day, you can just see my penmanship is almost back to where it is now, kind of sloppy, small, and tight, where I'm getting a lot more on one page. It's kind of interesting just to notice that.

And it's time for bed, so you get your sleeping bags out. That's something that everybody has to [do]: get out the sleeping bag. Well, maybe not, because for some of the Skylab missions, they got these little cubicles that you go into. But for us, you need to get out a sleeping bag, and you've got to decide where you want to tie it. That's not something we really decided ahead of time. It was just everybody grabbed a spot, kind of like hitting a camping spot, you know, "Okay. I'm going over here." I remember Brewster and Bryan—no, Brewster and I think it was Jerry slept on the flight deck. Brewster stretched himself between the two seats up there, and I forget where Jerry put himself. But that was crowded enough for the flight deck, so the rest of us were down in the middeck. I slept on the ceiling, and I remember Mary was beside me and then Bryan was right beside [her on the wall].

Here's another anecdote. Bryan will probably remember this one. Back in the good old days, we were allowed to bring Sony Walkmen with us. Regular [cassette] tapes. You could bring your audiotapes with you. I think we were allowed five or something like that, so you'd get whatever you wanted to prerecord and you'd bring that which made you happy, and you'd put it in a little central area there [in the Astronaut Office. For flight], we'd carry the Sony

Walkman with you. So you could wear your earphones just to feel good about whatever. I remember bringing some Peter, Paul, and Mary. Just the good old stuff that made you feel good.

But what Bryan O'Connor did, our crew jokester, he had taken one of my tapes—I think it was a Peter, Paul, and Mary—and about song three, he recorded the Navy Glee Club singing *Anchors Aweigh*, because Bryan was Annapolis [the U.S. Naval Academy, Maryland], I'm West Point, and Thanksgiving is right about Army-Navy time. Well, he'd forgotten all about that and I didn't know about it and I didn't listen to the tapes all that much on orbit, but I remember day two or three, I'm just there listening to the tapes, trying to relax, because sleeping is hard on orbit. I mean, you're not that tired. You're excited; your spine is stretched; there's really no comfortable position; you haven't done any "work" all day, not any physical work, so you're just really not tired. You'd just as soon be up, but we agreed that when it was sleep time, you're going to try to sleep. So I'm listening to Peter, Paul, and Mary and all of a sudden it breaks into *Anchors Aweigh*, and I remember just shouting, "O'Connor, you son of a bitch!" [Laughter]

And Bryan had no clue what I was talking about. He didn't know what he had done. So when I finally told him what it was, he says, "Oh, yeah, yeah. That was cool." And I hadn't done anything to him. … But that was just one of the other anecdotes.

We slept as a crew. Sleeping is [different], you know. You put on these little blinders, because the Shuttle is bright most of the time. You shut the lights down, but you're still going around the Earth and there's bright sunlight and, boy, when it comes in bright, it is bright. So the Shuttle is just light, dark, light, dark, every hour and a half. So we wear these little blinders and you wear earplugs; if not, the Sony Walkman, just so you can sleep. But I remember spending a lot of time just wishing I could go to sleep. It's almost like a kid the night before Christmas. You're just totally wired. You're just thinking about—and you're trying to burn everything into

your brain. "Oh, I hope I can remember every aspect of this." You can't. You can't. But, keeping a diary and going through things like this are very nice to do.

ROSS-NAZZAL: That's great. What did you think of landing?

SPRING: Well, let me take you through a couple things [before] that. I assume you're just doing this to jog my memory or bring me into it. The last day on orbit is very bittersweet. It's sweet because you're still on orbit, but, you know, "Oh, no. We'd launched our satellites, we'd done our spacewalks, and we had another night and a wake-up before we had to come home." And I remember the last day before we did the deorbit burns and all—no, it was the night before this—that all of us are gathered around the overhead hatches. Seven heads can fit there. You really can.

It was over North Africa, that was particularly beautiful, and your orbit track precess is 1,100 miles for each orbit. So we started off basically over Saudi Arabia with late afternoon. So there's this gorgeous portion of the Earth, [at least from orbit. In] just in one eyeful, you've got the history of the world as we knew it. Egypt and where Moses did his thing, and there's the Holy Lands, and in one eyeful, the eastern side of the Mediterranean. It's absolutely gorgeous. It's a pretty place on orbit, because it's almost always free of clouds because of the deserts, and the sand dunes are reflective, and the translucence of the water. You can see the sand dunes under the water. It's a gorgeous area.

And we'd shot almost all our film up, so there's no photo ops [opportunities] to take. It's just, "Wow, this may be our last—," and for me, it was my last shot or my last time to look at the

Earth. Again, you're trying to burn it into your mind, your memory, and just oohing and ahhing on what a wonderful view.

Then you go into the night pass and then daylight comes back up, and now it's 1,100 miles further west from there, so from Saudi Arabia, now we're right over Egypt, and it's another hour and a half later for them, so from mid-afternoon now, it's dusk, and then later on, an hour and a half later. So [the whole crew was] just watching for four hours. The mission's done. We're just kind of watching and [pointing things out to each other] and, "Hey, we're coming back up on it again." So we watched the sunset there and, again, sunsets are particularly spectacular. [Then we] approach Gibraltar and that's got clouds because it's ocean, then you're over Egypt [again] and that's got these long red light rays that are just highlighting the mountains. God, it's beautiful. It really is. And no pictures. I just remember seven heads at the overhead window, just looking at this, and, "Wow." Just, "Wow."

So then you go to bed, and the next morning you get up and you drink your thirty-two ounces of saltwater; salt tablets and water. We got a weather report, looked like we were go for entry, so we took the saltwater, and then they had some discussions about waving us off because of the weather. [Laughs] So that's an ugly thing to do, because that salt water's not particularly nice, but you need that to help rehydrate yourself.

What you do is you actually get rid of a lot of the liquid in your body [during the week on orbit]. Because you're floating around, your blood distributes itself equally throughout your body and your blood censor in the midthorax region just says, "I've got too much blood for this environment," so it starts to break down the blood, but it gets rid of the liquids first. So you've got to rehydrate yourself, otherwise [you can pass out during entry]. Almost everybody's had that feeling, the sensation when you sit up too fast, you get this ding-out sensation a little bit.

[That is because you are having trouble supporting the column of blood to your brain.] Well, that's what you'll get going through the two-and-a-half-, three-G entry, if you don't rehydrate.

So you go through that. You plug back all your chairs, [communications and other equipment, do your checklists], and you finally do your reentry burn. We did ours right about over Australia, because we were landing at Edwards [Air Force Base]. We hadn't been doing any landings yet at the Cape. It was a wish, but it wasn't a safe thing to do yet. So we did our deorbit burn. Everything was all plugged in and all the goodies and things were stowed right. I remember carrying a camera with me to take pictures at the last minute.

And then finally sitting down at about a tenth of a G. There's a big G meter. We only [knew] where we [were] in the entry [based on the deceleration or G's]. Now we've got GPS [Global Positioning System], but then we knew where we were by basically the drag. There's a model of the atmosphere and then how fast you're slowing down gives you the approximate altitude. So at a tenth of a G, I remember sitting down, thinking that this felt about normal. [Laughs] I had a long way to go. I had left the camera on one of the back shelves, attached by the Velcro, and it was happy at a tenth of a G [too]. Somewhere about three-quarters of a G, it departed and smashed to the deck. "Ugh oh." I remember Jerry kept the videocamera going the whole time. Actually, it was a sixteen-millimeter camera. Sitting down at a tenth of a G and feeling that was normal.

We had a full daylight entry, and even then, you can see the plasma [burning out the windows], recombining, you know, the swirling fire of reentry out the overhead windows. That was cool. That was something that would give you instant religion if you didn't have one. You knew what you were going to go through, because all the crews come back and [talked about it.] That's one of the things you do is talk to the rest of the office about what went right, what went

wrong, what would you do differently, how do you perceive this, and what to expect, because you want to desensitize yourself to as much of this as possible. But that was awesome.

I remember in broad daylight, when we're going through these back turns, you can just see this orange glow just flashing up like a little low fire up under the tiles, and this huge swirling vortex over the top of the Orbiter, of some flame, with this little delta shadow on it, which was, you know, that's you. [Laughs] So that's just so cool, "Tile, please hang together."

Going through entry is interesting. Brewster did a wonderful job announcing the various milestones. "Entry interface." Entry interface is an artificial [point], where we change the software, but it's 400,000 feet or thereabouts, and that's when you're getting into the "sensible atmosphere." That was about a tenth of a G, if I recall; something like that. So now everybody's supposed to be in your seat, just ready for the big onset of G. It never gets above two and a half Gs, but it feels like a lot, because you're used to zero Gs.

I remember it feeling so weird, looking out the windows and being in like a seventy-five-degree bank. From flying an airplane, you know that if you're in a seventy-five-degree bank, you're either going to fall or you're turning like crazy, but we're not. We're still hanging there. You're still in space, or essentially in space. Not enough molecules are hitting the wings to give you any lift yet, and it took, oh, I think the first turn, it took "forever," [maybe twenty minutes], to make that turn, just get enough lift or get enough molecules beating on the wings to make you do your turn.

As you get closer to the Earth, the sensation is that you're going faster and faster. Of course, you're slowing down, but the sensation is you're going faster, because now the clouds are closer and so they're just whizzing by. That's fascinating.

Finally you come over the coast of California, and the weatherman had lied, or misspoke. Well, it was supposed to be severe clear. I mean, typical Edwards Air Force Base, high-desert clear, but it wasn't. It was absolutely, totally covered with clouds, but they'd made the call that we were going to do our reentry and we did. We had to go through a layer of clouds to see the runway, but it was just like [the runway] was painted on the heads-up display, the little HUD there. Wonderful landing.

Brewster did another good job calling out all the milestones, as I said, and a big one was, "Okay, guys, we're going to have a little bit of vibration here, a little bit of bumping." And I'm glad he called that out, because as you go transonic for the first time [during entry], you're actually in the sensible atmosphere, where the air is thick enough to start beating you around a little bit, and we did, we got quite a bit of vibration and a little bucking for the first time in well over a week. We actually got some real perturbations from the vehicle, but Brewster had called it and he said, "Now, as soon as we pass transonic, it's going to go away again," and it did.

"All right, Brewster!" And [he] did a perfect landing. I mean, we had to check the computers to see that we got weight on wheels; that's the WOW. You know, all the acronyms, yes, WOW and WONG, weight on wheels, weight on nose gear. But Brewster's touchdown was just so gentle, that the computer had to tell us that we had the WOW and WONG on display.

Then you roll out. We used almost all of the 15,000-foot runway [at Edwards]. We had a slight tailwind, but basically back then, the nose wheel steering was a little bit iffy and the brakes [were too]—we were destroying a set of brakes on almost every landing. We were still going through understanding [the learning process of] how to make them work, or how to make them properly. [We] came to a dead stop right on centerline.

Then we had another forty-five minutes or so of switch-throws to safe the vehicle. We're venting all kinds of dangerous things, ammonia, [nitrogen, tetroxide], and stuff like that [from the various systems].

Then came one of the hardest physical things of the whole mission; that's to stand up. That became just the big joke. Just getting up out of your chair was a laughable, funny thing to have to do. You first go, okay, "Stand up." And you go to stand up and you cannot move yourself out of the chair. You are so attuned to the right amount of strength to put into things for zero-G, that all of a sudden this onset of a thousand times what you're used to—

[Interruption]

SPRING: So, just trying to get out of the chair. I remember trying really hard and not being able to budge myself out of the chair. Mary's looking at me like I'm weird. "So you try to get up, Mary." And she tries and she can't, and we're both kind of giggling. I can't believe I can't stand up. You just had to learn to tell yourself how much energy to put into it.

[Interruption]

ROSS-NAZZAL: You were talking about the difficulty standing up.

SPRING: So after about thirty minutes—I don't know, probably not even that long—you were able to stand up, [but] you want to hold on [to something] at first. As we look at the crew [movies], each of us held onto the rail, [some down the stairs]. Brewster warned us that we

probably ought to do that, just so you don't go falling flat on your face. Your sense of balance is a little bit—scientific term—catawampus. Your sense of balance is a little bit off, but we all were able to walk the stairways just fine. I think the crews that are up there a lot longer have a harder time, because your muscles do tend to atrophy.

I remember taking a physical right after we got back. They do that one heel to toe, where you put your feet one in front of the other, the old drunk test or something like that. I remember just wind-milling my arms like crazy, trying to keep my balance. Your sense of balance is off. They have you do some stair steps, where they've got the blood pressure cuff on you, and your blood pressure's just skyrocketing up and down as your body tries to adapt to all the gravity.

We got a nice cold beer for the first time [in a long time when] we were [done with the physical]. Our families were there to meet us. NASA flew my wife out, I recall, and a bunch of friends [came] to watch at the landing at Edwards. Then we climbed [aboard] the STA, the Shuttle training aircraft, and flew back to Houston. … I got a ride home with the bus.

[When I got home], all the neighbors had taken a bunch of scaffolding from [a] construction site, and they'd put a whole bunch of those together in my front yard. Looked very much like the EASE ACCESS things. Put an American flag on it with all kinds of posters. That was a very nice welcome home. [Then I] went to bed.

Then the next morning, I remember waking up. I did sleep, because I was quite tired. It was a long day. The next morning, my little daughter [who was four at the time]. … She kind of tiptoed into the bedroom, because Mom had told her I was going to be home. From the foot of the bed, she says, "Daddy!" and she just launched herself, you know, like three or four steps and just launched herself, dove onto the bed. I just knew she was going to impact the ceiling. That

much energy—I'm still used to being on orbit—I knew she was going to impact the ceiling. But no, she perfectly landed right on my chest. [Groans]

I remember the phone rang, and I wanted to float over and get it. [Laughs] And I remember the first thought[s] of want[ing] to get up, is, "Oh, my god. Just get in the car and get to NASA and show me some pictures. Tell me this really happened. Prove it's real." They fly [film] back [immediately] and get it processed. …

It takes a little while to get back to normal; [you wake normally right away.] I was back to jogging in two days…

I still stay actively involved in just talking, you know, the PAO work. Once a month get the chance or get the offer to go talk. In fact, I'm going to go talk at a good friend's Navy OCS [Officers Candidate School] graduation, so they're going to let an Army guy talk at a Navy OCS graduation, but it's because I was an astronaut and the Navy knows that a lot of jointness is important. In fact, Hoot Gibson talked just a couple weeks ago. There's a lot of that goes on still. People are still fascinated, and the IMAX keeps coming out with new pictures that they want to have people talk about. My wife's an elementary school teacher, so [I] don't get away from it. [The kids] still want to hear the basics.

ROSS-NAZZAL: Great. If you don't mind, I'm going to change the tape.

SPRING: Oh, I think we're basically done.

[Tape change]

ROSS-NAZZAL: Why don't you talk to me a little bit about your involvement with the *Challenger* Tiger Team.

SPRING: Sure. First of all, for the *Challenger* accident, I was on the Transatlantic Landing Team, or the TAL team. I was over in Dakar, Senegal, and we manned, oh, a couple different TAL landing sites, just in case the Shuttle had a major problem, that it could land. I was in Dakar, Senegal, and somebody else was in Rota, Spain.

So, following the *Challenger* accident, of course, we heard about that remotely through the radios and, you know, "What's going on?" because we had no video, no nothing, and you're flying back, pretty morose. Those were very good friends on board that.

I was named to the Tiger Team that was at the Cape, following the accident, because I'd been a member of the VIT Team. So the processing, the paperwork, basically how the vehicle was processed from start to finish, the solid-rocket boosters, the engines, the vehicle. We, at the beginning, did not know what caused the accident, so we had to check everything.

Got to work with—let's see. Hoot was part of that team. "Crip" was down there working a lot of it. I got to work with his current wife, Pandora [L.] Puckett, on that particular team. Basically, we just went through all the paper work. The Cape was—everybody was totally devastated by the tragedy of it, like I'm sure they are again, and just more than willing to 'fess up or show everything that they could to help understand what the problem was.

The biggest thing we found out it is that in the effort to do these launches so fast, that a lot of times the paperwork didn't get done, but that the work did get done. These guys are just very professional and very caring, very concerned. So the paperwork ended up being one of the indictments, and we were basically a paperwork drill on the Shuttle back then, and I think we've

gone to a lot more digital process, using computers to help track things. But then, I mean, it was just huge volumes of paper and sixteen signoffs. And every tile has its own serial number and gets inoculated with water and, oh my word, there's so much that went on with it.

So we did the research on that; did a lot of interviews with folks; had voice tapes from folks that had walked down the pad before launch and things like that. Just a lot of very interesting things that came out of it. I don't know if I'm at liberty to talk about a lot of the details of them. But, yes, we found a lot of things that we subsequently fixed and changed, a lot of processes and procedures, even though that wasn't the cause of the accident, that we were cutting some corners that we tried to go back and fix and make as good as we could.

Of course, if you recall, when we had the *Challenger,* I guess we'd done almost twelve, almost a launch a month. I don't know the exact number; it may have been only eleven or ten, but we were doing about a launch a month for a while there. It was a pretty hectic pace and those guys were working a lot of overtime and just really working their hearts out trying to get this thing ready to go.

ROSS-NAZZAL: How do you think the *Challenger* accident impacted the Astronaut Office?

SPRING: Any major thing like that impacts the Astronaut Office in many, many ways. For me it meant that I left after a while. I mean, I wanted to stay around and fly again, but two and a half years after the *Challenger* accident, I still hadn't been named to a crew, and three crews had been named, and those crews were going to fly in six months, and then another six months. Just a long, long wait before I got to fly again.

It was a time to hunker down, a time to keep faith and just figure out what the problem was and do the best we could to correct the problems with it. This latest accident's another tragedy. Everybody's trying to do the best job they can. It's just what folks need to realize is flying airplanes and flying Space Shuttles is a dangerous business. We are going to lose one occasionally. You don't want to. You hope it never happens, but you know it will. And now we've got three. We really need to be able to put the money into getting some more, or a replacement.

ROSS-NAZZAL: Shifting gears a little bit, let me ask you, what do you think was your most challenging milestone while working for NASA?

SPRING: My most challenging milestone. I don't know if I've got a particular one. I mean, every job has its challenges. As Robert E. Lee said, duty, the most sublime word in the English dictionary. "One cannot do more; one could not wish to do less." If you believe in the Shuttle, the space program, every job that you've got is a challenge and you put as much as you can into it. So, every job has got its own challenge. [If I had to pick one, it would be getting named to a crew.]

ROSS-NAZZAL: What do you think has been your most significant accomplishment while working for NASA?

SPRING: … [I believe my most significant accomplishments have to do with the secondary purpose of my only mission. This is to help pave the way for successful assembly and

maintenance of the International Space Station, at least from an EVA perspective. In the training process for our flight, we kept good notes on lessons learned and how best to train and perform EVAs. Following our mission, we made a large number of specific recommendations to NASA about the spacesuits, the pre-breathe protocol, the requirement for hand holds and foot restraints, tether protocols, and the need for a trolly or rail system with a robotic helper and the absolute requirement for a sufficiently large Water Emersion Training Facility (WETF).]

[After my mission, I was given the job of EVA lead for the Astronaut Office, and between that job and the *Challenger* Accident Tiger Team I stayed quite busy for the next two and a half years. We managed to baseline improved gloves and developed the requirement for a suit heater. I worked with flight medicine and hired some consultants to begin the development of improved pre-breathe protocols for rapid egress on EVAs. In fact, Mike Gernhart was one of our consultants, who was later hired as an astronaut, finished most of that work. We established a baseline requirement for hand holds and appropriate foot restraints on the Space Shuttle and all large structures on which astronauts are expected to work such as the Hubble Space Telescope. We improved the design and usability of the Station components for EVA, tool access, and ease of working.]

[One of the largest contributions was a full scale water tank for the Space Station assembly. Jerry Ross and I both lobbied long and hard to get that approved and built. I was very happy to finally see the Sonny Carter training facility. We needed it.]

But in all honesty, maybe my biggest contribution would be the work I've done with the elementary schools and the kids that I've talked to, inspiring them to take up the challenge to get into aviation, to follow their passions and to believe in the big dream that there's almost nothing you can't do if you really want to. The only way to make sure that you don't get to do it, is to

give up. That's a message I make sure that I put out there when I talk especially to elementary kids, and they love it. I mean, they go there. Elementary kids are cool. I mean, if you ask an elementary kid, "Who here knows how to sing?" the hands all go up. "Who knows how to dance?" The hands all go up. Try that with a high school group. "No way, Jose." The hands don't go up. Back in college, again, you might get some, if you're talking to a drama class or something. But these guys, they have it all, and you can do it if you'll study and apply yourself.

ROSS-NAZZAL: That's great that you're still committed to that message.

SPRING: I think that's part of the job.

ROSS-NAZZAL: I appreciate you taking the time today. I know you have a busy schedule.

SPRING: My pleasure, Jennifer. I mean, it's good stuff.

ROSS-NAZZAL: Great. Thanks again.

[End of interview]


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