NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

STEVEN A. HAWLEY
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is December 4, 2002. This oral history with Steve Hawley is being conducted for the Johnson Space Center Oral History Project in Houston, Texas. Sandra Johnson is the interviewer and is assisted by Rebecca Wright and Jennifer Ross-Nazzal.

To begin with, I'd like to take a few moments and talk to you a little bit about your early interest in astronomy as a field of study. Can you give me some details about when and why you chose that?

HAWLEY: Well, I guess it really started with both of my grandfathers being teachers. They were both college teachers. My mom's dad taught physics, and my dad's dad taught theology, and when we'd go to visit, I remember looking at whatever books they had in the house.

At my mother's father's house they were all physics books, and so that's what I read, and got interested in science generally, I think probably astronomy specifically because I was always fascinated by how astronomers could figure stuff out, in the sense that they couldn't do experiments in the conventional sense. Perhaps in reading physics books I developed sort of an understanding at that early age for how you set up an experiment, set up a set of conditions, look for an expected outcome, and it seemed like astronomers couldn't do that. All they were able to do was look at whatever was out there and try to figure out what was going on by looking in clever ways, or different ways. How they did that somehow appealed to me, and so I started reading about that specifically. For as long as I can remember, that was what I was interested in, was astronomy.

It was also probably coincidental, but I think I was in fifth grade when Alan [B.] Shepard [Jr.] launched in Mercury, and in those days, if you were lucky, the teacher would bring a radio to school so you could listen in the classroom, and she did, and I remember getting interested in the space program back then. We can talk about it later. I wasn't at that time thinking that I would ever get to go do that, but I think the space program helped maybe keep my interest in science and astronomy going back then.

JOHNSON: So you went on into college and you majored in physics and astronomy.

HAWLEY: Yes. As an undergraduate, you really need to develop a solid foundation of physics. Even then I really thought I wanted to be an astronomer, and you could major in astronomy. In fact, I had a double major in physics and astronomy, but most of it's physics, and that's really what the graduate schools look for, is they look for a foundation in physics and math, and even then I was kind of still on that course.

I do remember, it might have been after my sophomore year where I think, if I remember right, that's the time when you have to sort of officially decide what you're going to major in, and I'd always assumed I was going to major in physics and astronomy. I probably spent the summer stepping back and thinking, is this really what I want to do because that's what I always thought I wanted to do and I haven't really thought about other options? I hadn't thought about being a doctor or a lawyer or something else. So I remember spending a little time wondering, am I making the right decisions for the right reasons, and all of that, and concluded, anyway, by the beginning of my junior year, yes, that's what I wanted to do. So off I went and never thought twice about it after that.

JOHNSON: At what point did you get interested in NASA as a possible career?

HAWLEY: Frankly, that didn't develop in a serious way as a possible career until I was in grad school. I was like a lot of kids back when I was young and we started flying people in space. I had the cardboard box that was my spacecraft, and I'd go out and pretend to be an astronaut. But you couldn't, in those days, at least, realistically believe you had a chance to grow up and do that, because I didn't want to be a test pilot, and all of the astronauts were test pilots. I wanted to be a scientist.

I've told kids since then that my vision back then was that one day we would put observatories in outer space, because that made a lot of sense, get the telescopes above the atmosphere, away from city lights, and they would need astronomers to go be the staff for those observatories in space. And I thought, so if I was a good astronomer and stayed in good physical condition, one day perhaps I would be able to be an astronomer at an orbiting observatory. So I concluded with the kids by telling them, well, part of my vision was right, because we actually have observatories in space now, and part of it was wrong because I didn't foresee the development of digital technology that allows you to send all the data to the ground automatically so you don't actually have to have astronomers in orbit, and now if you want to use Hubble Telescope, you don't go to orbit; you go to Baltimore [Maryland].

So in a sense, the dream came true and I ended up actually getting involved in the great observatories later as an astronaut. But I really didn't think it was possible for me to grow up and be an astronaut. It was an interest. I'd watched the space program when I was a kid, and, in

fact, I knew all the astronauts and all the flights they were on and everything. I don't know that now. [Laughter] If you asked me who was on STS whatever, I don't remember.

So in the back of my mind I had this notion that there might be a niche someday for somebody with my experience or background to be able to participate, but I never thought of being an astronomer for NASA. Frankly, it wasn't until I went off to grad school and was working on my Ph.D., and I was doing what everybody does.

This was the last year in grad school and you go look for a job, and that involves every day sort of checking out the bulletin board in the hallway, seeing if there's any new job openings. What happens is they typically will, if there's a job opening someplace, they'll send out an announcement, and it will come to the department, and they'll post it on the board, and so you can go look and see.

One day I remember there was this letterhead that said "NASA" on it, and I thought, wow, that'd be interesting. I looked at it, and it said they were looking for astronauts. I had no idea how they'd go about hiring astronauts, and here's an announcement saying, hey, you want to be an astronaut, here are the qualifications. You have to be between five foot and six-foot-four, and you have to have good eyesight, and you have to have a college degree, and graduate school counts as experience. You need three years of experience, and I'm thinking, well, I'm qualified. [Laughter] I've also told kids that so were 20 million other guys that were qualified.

But that was really the first time I thought, gee, this is something I could maybe do for real, because what was different about it this time was they weren't just looking for the test pilots. This was "The new Space Shuttle thing is coming and so we're looking for astronauts that are both the traditional test-pilot types, but also this new breed of astronauts called Mission

Specialists," who would be the guys that did the EVAs [Extravehicular Activity], did the experiments in orbit, worked the robotic arm. And I thought, wow, that sounds really neat.

So I probably dropped everything I was doing at that moment and set about filling out this application to become an astronaut. I didn't realize till years later that it's actually the same application you fill out to be any government employee, SF-171. You fill it out and send it in. I even remember sending it by, I think, return receipt request so that I could make sure that this thing got into the hands of the proper people at NASA, because I really thought, wow, to have a chance to apply to do that at this time in my career.

I didn't realistically think I would get picked. I was aware enough to realize there are a ton of people that had these qualifications. Why in the world would they pick me? I still think perhaps they didn't mean to, and one day they'll come and tap me on the shoulder and say, "Excuse me. You've got this guy's desk, coincidentally named Steve Hawley, and he's the one we meant."

I've told kids this, too, that the reason I applied, as much as anything, was because I knew that if I applied and didn't get picked, and then I watched Shuttles launch with people on them and building space stations and putting up telescopes in space, I could live with that if NASA said, "Well, thanks, but you're not what we're looking for." But to not apply, to not try, and then wonder your whole life, could you have done it if you had tried, I didn't think I could take that. So it was okay if they said no, but I didn't want to go through the rest of my life wondering, had I only tried, would I be able to do it.

So I applied. In those days it took the better part of a year for the whole process to occur, which meant I still had to find a job. So while my application was at NASA and they were doing

whatever they were doing with it, I was actually finding a job at that time in South America. So I was off to Chile to be an astronomer, a post-doc, and that was the job I got.

It's interesting, I learned a lesson about the government even back then, because I read in the paper that NASA was going to begin to interview for this new astronaut position, and I thought, if I go off to South America and I was lucky enough to be a finalist, they might disqualify me because it would be expensive to have to fly me from South America to Houston, and with so many applicants, why would they spend the money to do that?

I remember calling Duane [L.] Ross, or maybe I wrote him a letter. Duane is the head of the Astronaut Selection Board. And I said, "Hey, I don't mean to be presumptuous." I think this is the exact letter I wrote. I think I said, "Dear Sir, I don't mean to sound presumptuous, but I've applied to be an astronaut candidate, and if you were thinking of interviewing me, it might be to our mutual advantage if you did that before I went to South America," and I sent it to him, because I didn't want to be disqualified merely because I was out of the country.

Lo and behold, I mean, it wasn't probably two weeks later I get a phone call from Duane, and he said, "Hey, can you come to Houston for an interview?" This was, I don't know, maybe it was, like, a Wednesday or something, and he wanted me to show up on Sunday, and a week from Sunday I'm supposed to leave for South America, and I haven't packed. I haven't done anything. And I said, "Yeah, sure," because I figured, what am I going to say? "No, I can't come for an interview to be an astronaut"?

So they actually did interview me in one of the first groups in—that was [19]'77, I guess. Then I went off to South America, not knowing what would happen. It turned out, first guy I met at this observatory in Chile, where I was a postdoc, had also applied for the program, and the week after I got there, he got a call to come up to Houston for an interview. So I wrote that one

in my book. There's a lesson. Don't worry. The government's not going to try to save money on that kind of stuff. He ultimately didn't get picked.

But that was really the first time that I had really thought, hey, this is something, working for NASA, that I could do.

JOHNSON: Well, tell us about how you found out that you did get picked.

HAWLEY: Well, that's kind of an interesting story, too. Maybe it is. I don't know. You guys can decide. [Laughs]

I remember after the interview, and off I go to South America, and I'm down there. I don't think they told us—they may have said something like, "By the end of the year, we hope to make a decision," or something. I should say this maybe. I was a little concerned. I was really naïve. This was a two-year job that I was going to in South America, postdoc at this observatory. What the deal was, is you have to sign ahead of time. If you stay less than two years, you might have to pay them back for the moving expenses, when they moved you down there to take the job in the first place and all that. I thought, I wonder if I ought to tell these guys that I applied to be an astronaut. Then I was thinking—you know, I wrestled with that.

I kind of thought maybe I ought to tell them, but then I thought, well, I don't want them to think that I really want to leave after just getting here, and the odds are like one in a million I'm going to picked anyway. So if I don't get picked, they don't need to know. So I didn't tell them. So that was kind of lingering on.

I was up at the observatory, and I had just gotten up after having been up all night observing and had slept till lunchtime and got up. I was having lunch, and one of the staff comes

over and says, "Hey, there's a phone call for you." The way that worked, when you're up at the observatory, if the phone call is from America, it goes to Tucson [Arizona], and then they patch it through on a radio.

So I go over to this radio shack, and that's the first time in my life I ever got to say "Over," flipped the switch. It's a guy calling from NASA, and I'm thinking, could it possibly be that—man, I was excited. I thought, wow, could it be that they're going to say that they picked me? I can't believe it.

I remember, "This is Jay [F.] Honeycutt calling from NASA in Houston." Jay Honeycutt, Jay Honeycutt. Okay, yes, Jay Honeycutt, he was on the selection board. I remember that name. His name rang a bell. I remember him. We exchanged probably pleasantries for fifteen or twenty seconds, and then he said, "Well, I was calling to see if you're still interested in being an astronaut."

And I said, "Yeah."

And he goes, "Okay, well, we'll let you know," and that was it. And I'm going, what the hell just happened? [Laughter] That was the first time that I came to grips with how disappointed I would be if they didn't pick me, because I'm sitting there thinking, could it be that they're going to ask me if I want to do this, and then they didn't. They didn't tell that I wasn't picked but they didn't—what was this all about? And I was depressed. I really was.

I didn't find out till I asked Jay several years later. I said, "What the hell was that all about?" And he told me. It turns out that I think by then they had decided who they were going to pick, but they were worried about somebody turning them down. I suspect they were worried about the timing of making this—once they make the decision and they notify people, then you probably have about a minute and a half before the papers know about it, and so they were

probably real anxious to keep all that information close. But they were worried that "What if I call somebody and he turns us down and now we've got to go pick somebody else? Except now these other people know." My guess is that they' were trying to figure out how to manage all this information.

So they were calling the people that they wanted to pick, to find out if they would take the job. But they couldn't just do that; they had to call everybody. In fact, I went back and asked this guy that had gone up and interviewed from the observatory. I said, "Hey, did you get a—?" Yes, he got a call. So I thought, well, that's too bad.

So they had to call everybody so that the people couldn't compare notes. "Hey, did you get a call?"

"I didn't get a call. Did you get a call?"

Anyway, that was in November sometime, and then nothing for the rest of the year. That was the longest couple of months. Then in January, thereabouts, and this would have been January [19]'78—it may have been late December, early January. One of the guys at the observatory told me that he had heard on the radio that they had announced these new astronauts, and I'm thinking, well, okay, so I didn't get it. I didn't figure they'd call me to tell me I didn't get it. I figured you'd probably get a letter if you're not picked. Well, I was kind of depressed, but at least I was glad that it was finally over.

I didn't find till much later that what the guy had really heard was that they had just announced some payload specialists for the first Spacelab missions, but he didn't know what they were. In fact, for all I know, they may have said, "Hey, NASA today announced some new astronauts. They're going to fly on these missions," and that's what he told me. But that wasn't

the selection. It was a totally different process. I found that out sometime later, and now so I'm thinking, well, here we go again.

On January 16, 1978, now I'm at the headquarters, which is down in the city as opposed to the observatory, which is up in the foothills of the Andes, and they come and tell me that I've got a phone call. In fact, the first thing they did was they told this other guy he had a phone call from Houston. He was, it turned out, to be in the office next to me. So he goes off and talks on the radio by way of Tucson to Houston and comes back. I don't remember if I asked him or he just volunteered, but he said, "Yeah, they didn't pick me."

Then the secretary walks in and says, "You have a phone call from Houston."

And I went, "Oh, great." [Laughter]

So I go off to the radio shack, and it's George [W. S.] Abbey. I don't remember exactly, but he said something like, "It's George Abbey."

I said, "How are you doing?"

He goes, "Good." He says, "I was calling to see if you're still interested in being an astronaut."

I'm going, oh, hell, we're not going to go through this again, are we? I didn't know that George calls all the winners. So I never asked who the other guy had talked to. It wasn't George, but I assumed that it was George and he had just stayed on the line and now he's going to tell me that I'm in the right place and don't need to worry about traveling to Houston.

Then he says, "Well, are you still interested in being an astronaut?"

And I go, "Yes, sir. I'm still interested in being an astronaut."

He says, "Well, we're going to go ahead and announce your selection today."

And I just remember being stunned. I was trying to think, did he just say that? I think I probably said something really intelligent, like, "Wow, that's great."

Next thing I remember him saying is something about "Well, we'll probably have people report here in the next month for a press day." Somewhere in the conversation he said, "Are you interested in how much money you're going to make?"

The truthful answer was "No, I'm not. I don't care." But I didn't say that. I said, "Sure," and he told me, and it was a lot more than I was making as a postdoc, anyway. We somehow concluded the phone call. I probably wasn't there anymore, and after that it was, like, what just happened? I think maybe even he told us, "You can't tell anybody till tomorrow," or something like that, or ,"We're going to announce it in the morning, so you're not supposed to tell anybody."

I don't know how you not tell anybody. Here it is, they just picked me to be an astronaut, something I've thought about all my life, and now I'm not supposed to tell anybody. So as far as I know, as far as I can remember, I didn't. But I don't think I've ever been as stunned in my life as I was when I—part of it was just the realization that they had somehow picked me. I suppose it may have been even more intense by the fact that twice before I thought I had been turned down, so the fact that now I was actually picked was such a shock. So that's how it happened.

JOHNSON: So did you have to wait till the next day to tell your family?

HAWLEY: Yes.

JOHNSON: How did they react?

HAWLEY: I think they were pleased. They were probably surprised. They kind of became interesting celebrities in the town where I grew up, which they enjoyed. Years later I think they enjoyed it less when they found out it meant being launched into space on a rocket. [Laughs] But, no, I think they were excited and they were very happy, and I think they enjoyed the time in the spotlight that they got.

It was probably even more so for them than it might have been for other guys' parents, because I wasn't there. I was in Chile. So there wasn't any way anybody could talk to me. So the only thing they could do would be to talk to my folks. So they did, and so the articles in the newspapers at the time were all about my parents. There are pictures of them, interviews of them, nothing to do with me other than what they said, which was—I don't remember, but anytime your mom's talking to the newspapers about you, it's not too good.

JOHNSON: So did you report that following month?

HAWLEY: Yes, we had a media day where we all came up and got introduced to the press. I think that was in February. I realized actually shortly after the phone call with George that I guess I'm going to need to tell them that I applied to be an astronaut, at the observatory, because they don't know I'm leaving. But they were nice about it and didn't make me pay back the moving expenses.

So, yes, we went off to Houston sometime in February for a couple of days of orientation and press events, and then I turned around and went back to Chile and tried to concentrate on doing my job there until June. It didn't occur to me some of that—I remember [Dr. Judith A.]

Judy [Resnik] reported early for some reason. I don't remember what—maybe she was finishing up an assignment, but I think she came in April or thereabouts and got a head start on everybody. It hadn't even occurred to me to ask, "Hey, what if I just showed up week after next?" But they had said June. So I said, "Okay, June," and ended up showing up sometime in the middle of June with everybody officially to start.

JOHNSON: Well, if you will, share with us some of the early training and some of the things that you did at the beginning and how that compared with your expectations of what you thought it would be like.

HAWLEY: I think it turned out to be pretty similar to what I expected. What was unknown to me was how well I would do. I realized that there are a lot of things that I didn't have any experience in that they were going to expect me to be able to do, like fly jets. Frankly, even when I applied and when I was selected, my biggest concern was whether or not I would be able to make it. We still say today, as we did then, this is a probationary period. You're called "candidate" for a reason.

In previous selections they had had some people that didn't really particularly care for the job and maybe didn't know what the job entailed and left. I think to avoid whatever embarrassment that might cause NASA or the individual, they established this plan which you come in for a couple of years and you go through training and evaluation. Then at the end of that period you either become no longer a candidate, and now you're an astronaut, or it's decided either mutually or by one party or the other that, yes, this probably wasn't the right move, so we agree to part company at this point. No hard feelings.

In the twenty-five years since, more or less, we've never had anybody not progress beyond the candidate program, but I realistically thought there was a chance in a couple of years they might get rid of me. So I was concerned about that. I knew this was going to be an interesting mix of people, and I knew that there were going to be people that knew a lot more about stuff that was important than I knew, and there were going to be these pilots and all that other stuff, so I was a little concerned how we would all get along. But I think primarily I was just concerned about would I be able to really do the things that would be expected of me. So that was the big unknown.

The training itself, they may have even in the indoctrination period in February kind of told us what the training was going to be like. So my recollection is, it all kind of progressed the way I expected it would. A lot of it was about learning to be aviators, and there was science training and there was Shuttle training. I think, in my mind, the biggest question was whether or not I could be an aviator, because I'd never done that before. It turned out I did okay, and that didn't end up being a problem.

So a lot of that training during the first two years was focused on the airplane, the science training. Everybody got the science training, not just the mission specialists, and the Shuttle systems, so that we had a foundation to build on once we graduated from candidate status.

JOHNSON: This was the first time that astronaut candidates were coming in that were civilians. As you said, they weren't pilots.

HAWLEY: Yes, I may qualify that as sort of true civilians. NASA did pick civilians in earlier selections. One of the first things they did was send them off to military pilot training and teach

them to be jet pilots. [Dr. Harrison H.] Jack Schmitt, for example, was a civilian, and [Dr. Edward G.] Ed Gibson, and [Dr. William B.] Bill Lenoir, and [Dr. Joseph P.] Joe Allen [IV], and all those guys. But they all went off and learned to fly jets. This is the first group where we were accepted as scientists, engineers, doctors, and they didn't try to make us pilots. So in that sense that was unique and different.

JOHNSON: And it was also the first group that had women and minorities in the group.

HAWLEY: Right. Right.

JOHNSON: And the astronauts that were already here, did you have a lot of interaction with them at the beginning?

HAWLEY: I don't remember that there was a lot at the beginning. We pretty much stayed to our group. I actually don't really remember what they thought of us. It may have been that since we hadn't really been flying a lot in [19]'78—we had flown ASTP [Apollo-Soyuz Test Project], but that was one crew that got to do that, and Skylab and that was three crews, so since we'd landed on the Moon, there'd only been like four crews to get to fly, and here's this new bunch of guys walking in the door.

I could see how some of the guys that had been around for a while waiting to fly might have been a little resentful. If they were, that didn't come across in any way, because our training was separate from what most everybody else was doing. Everybody else was doing mainstream support of Shuttle and development of everything that needed to be done before

STS-1. We would cross paths at the Monday morning meeting or you'd run into them at the gym or something like that, but mostly we did our own thing.

But we did have some interaction with them in the context of the training that focused on kind of the history of the program. They thought it was important, and I think it is, that we hear from people that had flown Apollo and had flown Skylab and ASTP. So I remember we got lectures from some of the guys that were still there, some of the guys that had left but came back to talk to us about their flights and what it was like back then. So we had that kind of interaction, which I thought was—I mean, these were my heroes, and to actually get to sit in a room and listen to them talk about their flights was pretty awesome.

JOHNSON: It must have been interesting. You mentioned that you didn't have a lot of flight experience before that, and then you were in T-38s doing some training. One of the things you did was to take a photograph of a solar eclipse.

HAWLEY: Yes, there were several of us, [Dr.] Sally [K.] and me and [Robert L.] Hoot [Gibson] and [Michael L.] Mike Coats and [Dr. George D.] Pinky [Nelson]. There may have been one other; [Dr. Jeffrey A.] Jeff [Hoffman], probably. As part of our science training, we concocted this boondoggle trip for—we would go chase the solar eclipse and take photographs of it from the airplanes. I guess we did a good enough job selling it that they let us go do that.

So we actually did go, and we flew up to North Dakota, I think, because the path of totality went through the northwest part of the U.S., through North Dakota and Montana and Wyoming. I don't remember exactly, but we went up there and do the calculations for where the shadow would be, because it's actually—you know where it is on the ground, because you can

go look that up, because people do that. But it's not exactly, if you're at 30,000 or 40,000 feet, it's not exactly in the same place. So you can figure that out and figure out what flight path you have to fly. And actually it was pretty good training, and we did get some pictures.

The thing I remember about it, and it was sort of humiliating, is that I think the best pictures were the pictures that Hoot took, and he was flying one of the jets. Sally was in his back seat, I think. I was in Mike Coats' back seat. So we had the cameras, and we had the time, and we could do all this. He was just flying along and taking pictures out the canopy, and he ended up with the best eclipse pictures. I'm not quite sure how that worked. He thought it was skill. I think it was luck. But that was an interesting trip.

JOHNSON: You also had to be trained with the KC-135.

HAWLEY: Yes. It's probably a little bit of a reach to call that training. [Laughs] But it's good exposure to what it might be like to be in zero-G. Of course, you don't get it for more than twenty or thirty seconds at a time, and how pure a zero-G it is is a function of how well the pilots up front can fly the trajectory. But it's a lot of fun. Everybody enjoys doing it, and I probably only did it a couple of times, but, yes, that was fun.

JOHNSON: Well, some of your early on-the-job training assignments, you worked with payload software in the SAIL [Shuttle Avionics Integration Laboratory] and with some vehicle integrations.

HAWLEY: Yes.

JOHNSON: Can you share some details about some of those assignments?

HAWLEY: Yes, the thing I remember, I worked on something, which actually we're finally getting around to today, twenty-five years later. One of the problems that we had then and still have today in flying payloads on the Shuttle, at least sophisticated payloads that require that kind of software support, is the very long lead time to integrate the payload and its requirements into the Shuttle software. Obviously the Shuttle software is critical, and if you want to have it perform some function in support of your payload, you're talking two or three years' lead time in order to get that stuff in. That's not very convenient for investigators.

I was working back in those days on a module that would still be part of the onboard computers, but it would be a reconfigurable module that was somewhat isolated from the other software, that you could on a mission-by-mission basis reconfigure this thing to support payloads. It was going to be a way to, without having to reconfigure the whole software, which is a very expensive and time-consuming process, you could support payloads in a quicker, easier way that hopefully would be to everyone's benefit. It actually never got—it got approved at some point, but it never really got implemented.

Today we're finally getting to where we can now develop a system to control payloads with a PC [Personal Computer], a little laptop computer, which the investigator can configure with the software appropriate for his payload and they don't have to be part of the Orbiter software. So we're finally getting there, twenty-five years later.

But that was an interesting job from the perspective of getting to understand how the software works and what payloads require, and for a mission specialist in training, that's good experience.

SAIL was interesting. That's the Shuttle Avionics Integration Lab, of course, where we test the flight software before it goes on the Shuttle. So that was really helpful to me because I learned a whole lot about the software. This is before STS-1 when I worked over there, and by helping develop the test cases and running the test cases in the simulator and evaluating the results that came from the test cases, you learned a lot about how the software works. I didn't realize how important that would be later to me going through training as a crew member, but for five flights one of the things that really helped me was I had a good solid understanding of how the software works, which is critical to how the whole Shuttle performs.

So it was a kind of an inefficient way to spend your time. You'd sit around and wait for two or three hours, and then you'd hurry up and run a test case, and maybe then go off and wait two or three more hours before you ran another test case. It was one of these things where, my experience over the twenty-five years has always been that—I was in the second group of astronauts that ever went over to do that job. The first group of astronauts, all I remember them talking about is "What a waste of time this is. It's so inefficient."

I really didn't want to do it when they assigned me to it, but off I went, and I found, hey, you really learn a lot over here. So all of us in the second bunch that went over were telling people, "Man, this is great. You learn a lot about the software. You learn how the Shuttle works." Now everybody wants to go to SAIL.

So the third bunch they sent over there, they thought, "Well, yeah, you learn some stuff, but, man, this is a real waste of time." So all they do is talk about how much time they waste,

and now nobody wants to go to SAIL anymore. So my experience is that it's one of these cyclic—every other bunch wants to go and every bunch other than them doesn't want to go. It's whatever your expectation is compared to what the reality turns out to be.

But for me it was extremely important to fill that gap in my experience. So that was a good experience, and that was where I was working when STS-1 was trying to launch. When STS-1 didn't launch the first time, it was because of a software problem. Eventually they figured out kind of what they thought was causing it, and we at SAIL had the job of trying to replicate what had happened on the Orbiter, and I was assigned to that.

The problem had to do, as I recall, with when you load the computer. Maybe this isn't—I don't know how interesting this is, but what happened when they activated the backup flight software, I think this is April 10, 1981, it wasn't talking properly with the primary software, and everybody assumed initially that there was a problem with the backup software. But it wasn't. It was actually a problem with the primary software, and the problem had to do with when you bring the software up, it goes out and grabs the time reference from a box called a PCMMU [Pulse Coded Modulation Master Unit]. Every once in a while it can do that in a way that because the timing funnies—has a little bit different time base than when the back-up software gets loaded, and if they don't have the same time base, they won't talk to each other, and that's actually what had happened in that case.

So what we had to do was to load the computers over and over and over again to see if we could find out whether we could hit this timing window where the software would grab the wrong time and wouldn't talk to the backup. I don't remember the number. It was like 150 times we did it, and then we finally recreated the problem, and we were able to confirm that.

So that was nice because that meant the fix was all you had to do was reload it and just bring it up again. It's now like doing the old control-alt-delete on your PC. It reboots and then everything's okay. And that's what they did, and then they were able to launch on April 12th. That was kind of interesting.

JOHNSON: So did everyone have to rotate through SAIL?

HAWLEY: No. Many people do. We actually have more jobs that we support than any one individual can do in a career. All of them have training value of some kind. All of them are important to the program in some way, some of them probably a little more fun than others. I never got to be a CapCom [Capsule Communicator], for example. But that's a job that lots of people get rotated through.

The other one that you talked about was vehicle integration testing. We still have today guys that go down and support testing on the vehicle after it lands and before the next launch. Back in the old days, we did a lot more testing than we do now, at least at the integrated level, that involves things the crew really cares about. We still do a lot of subsystem testing as a consequence of the normal turnaround. So I got to go down and do that. That's one of the jobs where you get hardware experience, and you get to see how the Cape [Kennedy Space Center, Cape Canaveral, Florida] works, and you get to go through a countdown and see how all that works, and that's useful, of course, before you ever get to do it yourself.

In those days at least, there were a lot of subsystem jobs. We had guys assigned to the main engines. We had guys assigned to the solid rocket motors. We had guys assigned to the auxiliary power units, that would spend time actually at the plant where the things were

developed and tested. Now, of course, we've got twenty-some years of experience with those systems, we don't need to be involved with that level so much anymore, but back before we had flown anything, this was all new.

We had guys working on tiles back then. We had guys working on software requirements. We had guys working with customers on how to get their payload requirements integrated into the program. We had guys working EVA, had guys working on the MMU [Manned Maneuvering Unit] back then, spacesuit design. Still have that to some extent today, although the spacesuit design's pretty mature now.

Hopefully, the way we do it now and hopefully the way they did it then was that they could look at a couple of things. One is where you could contribute something, but also where perhaps your experience may be a little deficient and this job assignment might fill in some of the gaps in your background that would make you a better crewmember when it was time for you to get assigned. So if you're lucky, you get to do a lot of those jobs.

The other interesting part of that, I suppose, is to balance the time that you're in there, in these assignments. From the point of view as training for you as an individual, future astronaut, ideally probably six to twelve months is a good time, because you're there long enough to get past the steep part of the learning curve and so now you've really come to understand what this job's all about. From the point of view of the organization hosting you, probably two years or maybe even three is a good time, because, yes, they spend the first year teaching you everything and they don't get any work out of you. [Laughs] So in your second and third year, you're actually a contributing member of their team.

So, management's challenge is to always try to balance the training value versus the value to the organization, and it always seems like twelve to eighteen months turned out to be

kind of the right compromise. So I think typically those would be the durations you'd expect to see in these assignments, and you'd probably get—if the template's still kind of the same today, you'd probably do a couple of those jobs, maybe three, before you get your first assignment.

Then after your flight you don't normally immediately get assigned to another flight. You'd go back and do another one or two of those assignments, and then you'd get another flight. Hopefully, now that you're flight-experienced, the number of assignments that might be available to you will be a little bit bigger because your experience is now a little more unique and you bring that perspective to the job. That was kind of the model, how it worked, and I think I also got to work crew training before I was assigned to my first flight. So I think maybe I had four jobs before I got my flight assignment.

JOHNSON: But during that time you also received a nickname of the "Attack Astronomer." Can you tell us about that?

HAWLEY: Yes. Do I have to? [Laughs]

JOHNSON: Well, you certainly don't have to if you don't want to.

HAWLEY: As I remember, part of your astronaut candidate training is, as a group, you go to the different NASA centers, and you're culturally broadened by seeing what other people do within the agency. We were down in Florida at Kennedy [Space Center], and I think by coincidence, as I remember, Senator [Adlai Ewing] Stevenson [III] was there, and I don't know why. There may have been an expendable launch that was taking place that he was coming down to watch or

something. But for whatever reason, we got all herded into an auditorium where he addressed the group of new astronaut candidates.

As I remember, we had to go around the room and all introduce ourselves. It would be "I'm Sally Ride, and I'm a physicist," "I'm [Dr.] Anna [L.] Fisher, and I'm a doctor," and "I'm Mike Coats, and I'm a pilot." They got to Hoot Gibson, and Hoot said, "I'm Hoot Gibson, and I'm a Navy fighter pilot." [Daniel C.] Dan Brandenstein was next, as I recall, and he said, "Well, I'm Dan Brandenstein, and I'm a Navy attack pilot."

So it seemed natural that when it got to me that I would be the attack astronomer, and unfortunately it stuck. [Laughs] That's how that came to be.

JOHNSON: Oh, that's pretty amusing.

Well, you mentioned with STS-1, you were still in the SAIL. But you served as a member of the astronaut support crew for the Orbiter test and check-out for STS-2.

HAWLEY: Yes, that was really the Cape job. We worked with Joe [H. Engle] and [Richard H.] Dick [Truly] on the testing that they were doing on *Columbia* before their flight, and I was down there for the rest of OFT [Orbiter Flight Test]. So I was working with Joe and Dick and [C. Gordon] Gordo [Fullerton] and Jack [R. Lousma] and [Thomas K.] T.K. [Mattingly, II] and Henry [W. "Hank" Hartsfield] on STS-4.

One of the things I remember back then on STS-2—they still do the test, although we don't do it with astronauts anymore—when they mate the Shuttle to the solid rocket motor on the external tank in the vehicle assembly building, they do something called the Shuttle interface test. They exercised the integrated system, making sure the cables are hooked up right and the

hydraulic lines are hooked up properly and the Orbiter and the solids and all of that functions as a unit before they take it to the pad.

In those days, we manned that test with astronauts, and for STS-2 the astronauts that manned it were me and Ellison [S.] Onizuka. We were in the *Columbia* in the middle of the night hanging on the side of the ET [External Tank] in the VAB [Vehicle Assembly Building] going through this test. One of the things you do is you exercise at least a portion of what they call the flight control system check, which is something that we also do on orbit before entry, just to make sure all the surfaces are working and the displays are proper and there's software in the vehicle that supports all that, specially designed test software that lets you look and make sure all the devices are performing properly.

But, anyway, it turns out when you do part of this test and you bypass a surface in the flight control system, it shakes the vehicle and there's this big bang that happens. Well, nobody told me that, and Ellison and I are sitting in the vehicle going through this test, and I forget which one of us threw the switch, but the vehicle just goes—there's this "Bang!" and the whole vehicle shakes. We're going, "Ah-oh, I think we broke it." [Laughs] But that was actually normal.

So I took delight years later in knowing that was going to happen and not telling other people, so that they would have the same fun of experiencing what it's like to think you broke the Orbiter. So I got to do that, and Ellison was the prime for strap-in for STS-2, and I was his backup, and then I did the strap-in for STS-3 and STS-4. So I was there when the crew got in, and we made sure they were ready to go and shut the door and waved goodbye. But that was a lot of fun. Except for flying, that was probably the most fun I ever had, was working the Cape job.

JOHNSON: So as part of the close-out crew, other than strapping them in, what else were you responsible for?

HAWLEY: Well, generally you're the representative of the flight crew for all the testing that's going to take place on the vehicle prior to its mission. In those days, again, we were a lot more involved than we are today, because things are more mature and it's fairly standard now. But a lot of it was kind of being invented back then, and so we were involved in what tests were to be done on the vehicle, and of the tests that were to be done, which needed to have astronauts' participation.

The prime crew's not going to be able to go do that. So we were their representatives, and if problems are discovered, somebody needs to look and make sure that if it's important enough that the crew needs to know about it, that the crew's informed and the crew can be informed then of how it's resolved, when it's successfully resolved. So we did a lot of that.

Really, I pretty much spent the full time down there during those, whatever that was, after STS-1, which was in April, till after STS-4. So it was about a year and a half, something like that.

For the launch specifically, you get out there after tanking but before the crew arrives, and you make sure all the switches are proper, that nothing's been bumped, and that the seats and the rest of the Orbiter is configured for the crew when they get there. Then when they get there, you help them in, and then there are some other switches you have to throw and do comm [communication] checks and make sure all that's working. And if they need anything, make sure they've got it before you close the door and run for cover. [Laughter]

JOHNSON: Did you have any other assignments between that time period and then when you were chosen for your first flight?

HAWLEY: Yes, I think I worked with Judy on training. We have—in fact, we still do today, have an astronaut—in those days we had a couple of us that were involved in different aspects of working with MOD [Mission Operations Directorate] on crew training. Back in those days, I'm trying to remember, I think part of what we were working on was how could we get more simulator time. Is there a way that we can juggle the facility maintenance schedule or bring up a different facility, which is ultimately one of the things we did do, not we personally, but the system did, to make more time available for crews to train, and how can we structure the syllabus to make that we're training the right things.

It seems to me like we were working a ton of issues back then about training. I don't remember what they all were, but training, the facilities are a lot more reliable today than they were back then. Of course, even back then we had all of four flights behind us, so we still probably weren't exactly sure that we knew all the things we should train for.

Today, with 112 flights, we're a little more comfortable that we know what to train for. But that was interesting. I still didn't get any simulator time out of that, but it was kind of an interesting job, to understand how the training process works. Particularly, not only is it done by a different organization than ours, but it's, by and large, done by people that have never actually done it themselves, which is a little bit unique, at least in a flying organization. In the service, when you learn to fly, the people that teach you have done it, and even privately, I guess, if you

learn to fly, the people that teach you are flyers themselves, and the people that teach us how to fly the Shuttle haven't ever flown the Shuttle.

JOHNSON: When and how did you learn that you were selected for your first Shuttle flight? It was, I believe, STS-12, which was renamed 41-D.

HAWLEY: Right. Well, the way it worked in general was you got a call to go to Mr. Abbey's office, and if you showed up and there were other people there, it could mean that you were going to be on a crew. I guess if you showed up and you were the only person there, it probably meant you were in trouble. [Laughs]

But I got a call that Mr. Abbey wanted to see me one afternoon, I think it was in February of [19]'83. I don't remember exactly. I don't now remember if I had wandered around trying to find out who else might have gotten a call that they were supposed to go over to see Mr. Abbey that afternoon. But as I remember, we all showed up over there; it was Hank and Mike and [Richard M.] Mike [Mullane] and Judy and me. And George told that he wanted us to go be on the flight.

I remember that was another one of those where you can't tell anybody till tomorrow, or something, because the press release hasn't gone out. So Judy and I went out to dinner together, because we needed to—I think we needed to talk about it, but we didn't have anybody else to talk to. And we were both single then, so we went out and had dinner at the Longhorn Steak House on NASA [Road] 1, which, I guess, I don't even know if it's there anymore, but we did that that night. We were both very happy and probably a little frustrated that we couldn't tell anybody.

JOHNSON: And the other people that you were selected with, it was pretty much a rookie crew.

HAWLEY: Well, in those days, you almost had to. Everybody was. Nobody had flown.

JOHNSON: How did the flight dynamics work between all the people that were selected? Was it a good mix of personalities?

HAWLEY: It was. Yes, we were lucky. I subscribe to the theory—I don't know that I said it first; maybe I heard it from somebody. But I really do believe that from a personal point of view, it's more important who you fly with than what your mission is, and we really had a good time. We all got along well. I thought we all had respect for each other's capabilities, and it was just a good mix.

It's always a little bit of a challenge to find the right mix. Maybe it was just luck. But we enjoyed that crew, and we all got along very well. It probably did help back then four of the five of us were from the class of [19]'78, and if you can put together crews that are composed primarily of people from the same class, that maybe does tend to work well. Anymore, that's very rare just because we've got a population that represents a whole bunch of classes since then. I don't even know how many we're up to now. So the odds of getting a whole bunch from one class aren't as good as they were back then. So we obviously knew each other and had been working close together for five years before we were assigned, so maybe it's not that surprising.

JOHNSON: At what point was Charles [D.] Walker assigned?

HAWLEY: I think we knew he and his payload were going to be on that flight. He was probably—I don't remember if we knew it was Charlie, but my recollection is that we knew STS-12 was going to have the CFES [Continuous Flow Electrophoresis System], and it was going to have the first payload specialist, and so we knew we would be a crew of six. I don't remember when Charlie was designated to be that individual, but we knew that was going to be part of the deal.

JOHNSON: How did that work as far as—

HAWLEY: Actually, that worked well. I was very pleased how that worked. Charlie was a good guy. He fit in very well. We enjoyed having him as part of the crew. From a personal standpoint it worked well. From the whole issue of flying a commercial payload specialist, there were some issues, and I remember we talked a lot about this is a McDonnell Douglas [Corporation] payload, and a lot of it was proprietary, and Charlie was responsible for it, so to what extent should NASA commit resources to help make this successful? I remember we had lots of discussions about the pros and cons of, hey, it's their experiment and he's doing it, and we shouldn't waste time working on and helping to develop the procedures or training a backup or anything like that.

The other point of view, which ultimately was the point of view that carried the day, was the guy in the street's not going to know the difference. If it fails, they're going to say NASA screwed it up, or here's a NASA payload that didn't work. In fact, that's still true. If [The] Boeing [Company] goes up and launches a Delta [rocket] and it blows up, everybody assumes it

was NASA. So with that in mind, we ended up deciding that somebody on the crew needed to be Charlie's backup and learn about the CFES and be able to help develop the procedures and be available to help do the experiment, just to do everything we could think of to make it successful. That's what we ended up doing. Judy ended up being the backup for Charlie for the CFES work.

In retrospect, that was probably the right decision, although I don't remember Judy being involved a lot in flight other than helping Charlie some. Charlie did fine and didn't need much help, but it was probably the right thing to do, to commit the resources to try to make it successful.

JOHNSON: Hank Hartsfield said that you called yourselves the "zoo crew."

HAWLEY: Yes, we did. I don't remember why. [Laughter] I don't think I was responsible for that. Somebody else came up with that.

JOHNSON: Can you talk a little bit about the training for the payloads and for that flight in particular? Is there anything about any of the training that you'd like to share, and how much time you spent?

HAWLEY: Well, I don't remember anything that was particularly remarkable. For a while we had an IUS [Inertial Upper Stage] on STS-12. In fact, initially, as I recall, it was TDRS-C [Tracking and Data Relay Satellite] on the IUS, and then STS-8 had their TDRS go end over end after they deployed it, although it ultimately ended up, it was a great save and ended up in the right orbit. The IUS community had to go off and rethink their—they had a nozzle problem, as I

remember, and they had to go redo that, and so then we ended up inheriting TDRS-B, with not too much certainly that we'd even get to have that. So we ended up training for IUS for a while and then ended up not even having an IUS on that flight.

In those days, one thing that was different back then compared to today is that when you were assigned to a flight, there was no guarantee you were actually going to fly that complement of stuff when you actually flew. We ended up being assigned to STS-12 when it was a TDRS flight. We didn't end up flying TDRS; we flew this other assortment of satellites.

On my second mission, we were assigned to three or four missions before we finally settled out on what ended up being 61-C. Anymore, that's not so much true. There's a lot more stability in the manifest, and if you're assigned to a flight, you can pretty much count on flying that, maybe not on the date you expected, but you can count on flying that payload. With [International Space] Station assembly, that's actually extremely important because, with some exceptions, probably, the tasks are unique enough that once you've committed to a set of assembly tasks and assembly hardware, you're pretty much going to fly that stuff when it's ready to go.

One thing I remember about training back then was, you had to be versatile. In fact, we didn't, of course, launch the first time we tried, and they ended up changing out the payload even after we were on the launch pad. Well, actually, they took it back to the OPF [Orbiter Processing Facility] to change it out. But when we had tried to launch and then we didn't, then they did change out some of the payloads.

But I enjoyed a lot doing satellite deploys. We did a lot of those back in the early days, and we were the first flight to have three satellites. We had two PAMs, which we called them, Payload Assist Modules, and one SYNCOM [Synchronous-Orbit Communications Satellites]

Leasat [leased satellite], which was a unique Hughes [Electronics Corporation] satellite that had its own stage in it. But, man, I loved that. I loved doing satellite deploys. I loved digging into how all that stuff worked. I really think I became something of an expert on the PAM system. Then, of course, after *Challenger*, we didn't fly satellites anymore on the Shuttle. So I didn't get to do any more—well, Hubble and Chandra [X-Ray Observatory], but that was different, and we didn't get to launch the communications satellites, the commercial satellites, like we did early in the program.

JOHNSON: Well, how did you train for those satellite deploys?

HAWLEY: A couple of ways. The way people probably commonly would think of that is in the Shuttle simulator they have the model of the satellite and the stage it launches on, both in the software so that the instruments replicate what you would really see in doing the test, plus individual scenes, so you can actually see the little cartoon of the thing spinning in the payload bay, and when you launch, it departs.

I'm getting ahead of myself, but I'll probably forget this story if I don't tell it now.

JOHNSON: Go ahead.

HAWLEY: In those days, in the simulator you could have either the aft set of visuals or the forward set of visuals. We did, of course, a lot of training with the satellites in the bay, and so my station during the satellite deploys was to sit up in the commander's seat and operate the software. Mike Mullane operated the switches in the back.

So for the training, I didn't have a scene out the front, because it was in the back. That was no big deal, except when we got on orbit, and now I've got a [scene] out front. [Laughs] I remember we're forty-five minutes or something from deploy of the satellite, and I think it was flight day one, and I'm sitting there trying to figure out now that we're in attitude and forty-five minutes later we're inertial. I'm thinking the horizon's not going to be in the right place, because I knew what the horizon was supposed to look like out the aft, because we'd seen it in the simulator. In my brain I'm thinking, okay, forty-five minutes later, what's this going to look like, and it's looking like it's off. I asked Mike Coats. I said, "Are we in the right attitude?" and he looked at the numbers and said, "Yeah."

I said, "Boy, this doesn't look like it's working out," and I'm trying to figure out inertial, in forty-five minutes. So finally, I remember calling the ground, and I said, "Hey, can you guys confirm we're in the right attitude?" They came back and said, "Yes, you're in the right attitude."

"Okay."

Well, I found out after the flight, purely by coincidence, the ground was having a conversation about whether we were really in the right attitude. The problem they were having was the numbers they got from the customer were different from the numbers that were generated in the control center. It had to do with [precession] and the year that you actually developed the coordinates for. It's kind of technical, but the upshot was, the difference was miniscule, but it was there in the data they had versus the data—I mean, it's nothing you'd see onboard, and they were just trying to figure out how come this is off by a little bit.

Well, suddenly the crew comes down and says, "Hey, are we in the right attitude?" and everybody's going, "Holy cow! How could they tell?" They had no idea I was worried about

whether I was ninety degrees off. They think I'm a genius because I figured out somehow we were a couple of tenths of a degree off of where we thought we were supposed to be. I think until today I've never told that story publicly. So anybody that's left from that day probably thought I was a genius at the time for being able to recognize that they were a couple of tenths off, when we were really using [epoch] 1950s coordinates when we should have been using [epoch] 2000 coordinates.

But the other thing we did in terms of training was we spent a lot of time at the satellite and the upper-stage manufacturers. We went up and spent time with the guys that built the satellite. Actually, Mike and I got to be pretty good friends with one of the guys that was kind of the lead engineer for the Hughes satellites. By really kind of getting down and dirty with those guys and seeing how the thing was designed and what their real requirements were and helping develop the procedures with them, I think that's really how you learn the stuff. You can go over and practice in the sim, but unless you really understand it, you're not going to be as good as you could be when things don't work like they're supposed to.

So both Mike and I felt it was really important to understand the kind of depth you get from actually talking to the guys that built it. I always felt that when you're on orbit and you're responsible for this task, whether it's a satellite deploy or whatever, you need to be the guy that knows more about it than anybody in the world, because ultimately you're the guy that's there and responsible.

Fortunately, I enjoyed that and enjoyed getting to meet the people that built the satellites and getting to work through the procedures and suggesting, "Now, here's a better way to do it," and if they thought there was value in that, they'd accept that. We had a good team back then for those deploys.

The other thing I remember is that one of the satellites was for AT&T, and the tracking site for that satellite was a place called Hawley, Pennsylvania, which I'd never heard of, but it's spelled the same way. After the flight I got to go to Hawley, Pennsylvania.

JOHNSON: Oh, how neat.

HAWLEY: It's not much. [Laughs]

JOHNSON: Well, that flight had, as you mentioned, some delays. The first attempt was stopped at the nine-minute hold because of a malfunction.

HAWLEY: Right. The BFS [Backup Flight Software] failed. I remember we had a GPC [General Purpose Computer]-bite indication, and we kind of knew that was the end of the show for the day. The thing I remember being surprised about is they could change it out overnight. So I think we tried again the next day.

JOHNSON: Of course, the next day, it stopped at T-4 seconds, and it was an abort after ignition.

HAWLEY: Yes.

JOHNSON: Can you describe exactly how that felt and what was going through your mind?

HAWLEY: Yes. It's kind of interesting, because my first reaction, frankly, was, it's just like the sim [simulation], because in those days it seemed like every time you'd go over and do ascents, you'd end up doing an abort, and it would be because the sim in some turnaround had not configured itself properly. There's a hundred and one things that'll stop the countdown, and if the model doesn't set it up just right, that's exactly what the software will do. It'll start the engines. It'll quit. So we did that a lot in training, occasionally on purpose, but most of the time, as I remember, it just was a quirk of the simulator, that it would do that to you.

So in the first like tenth of a second, I remember thinking, jeez, that's just like the sim. Then I'm thinking, yes, except it's really not supposed to do that in real life. But we had been through it so much in the sim, my recollection is that there isn't a lot for the crew to do in a situation like that initially. A lot of the initial reaction is on the part of the ground team, but there are some things, and I remember going right to that page in the checklist, because we had done that a bunch in the simulator.

I guess the next thing you think about is, what really happened, perhaps not so much in a safety sense, but rather if the back end of the vehicle's not there, then it may be quite a while before we get to try this again. So you don't know what the effect is going to be on the mission. The next thing, I guess, is that you really want to be quiet and listen to what's going on on the loop so you can get some sense for what happened, if somebody knows, and what the situation is, because you can't see very much. There was a lot of talk. As I recall, it was handled very well by the ground team. I don't think they knew exactly what had happened initially.

Then after a while, we did hear them talking about fire. It turned out that there was, in fact, there had been for quite some time. Fortunately, that was one of things that we were able to improve upon after our abort. But hydrogen tends to burn without a visible flame, so the engines

were still leaking some hydrogen which had ignited and was burning, but you couldn't really see it until it started to ignite the things on the Orbiter, like the gap filler that's part of the TPS [Thermal Protection System]. Then you could see things burning. Then we heard people talking about fire. That kind of got our attention.

I remember we talked about the baskets. Nobody had ever used the baskets to escape from the launch pad. They have a set of seven baskets that are hooked to the pad at the 195-foot level, and in an emergency if the close-out crew isn't there and you need to get away, you leave the vehicle and you run over and jump in the basket, and it goes down a wire to the bunker. Then you can go get in the bunker. But nobody had ever actually done that before. There was some talk about whether we ought to do that, and we said, well, we would do it if they told us to do it. You would do that on a call from the NASA test director, and he hadn't said that. But we were listening to talk about fire, and I remember thinking, well, fire's not too bad because then you're sitting inside this structure that's designed to take several thousand degrees during reentry. It's well insulated. Then I got to thinking, on the other hand, it's attached to millions of gallons of rocket fuel, so maybe that's not so good. [Laughs]

But eventually they came and got us. I remember Mike Mullane was real concerned that they were going to cancel our flight. I really didn't think they would do that. But I remember him being very concerned about that, probably more concerned than the incident itself. He was concerned about the effect it would have on his flight assignment.

It was a couple of months before we got to try again, and, of course, they did reshuffle the cargoes, and we ended up actually—well, [Karol J. "Bo"] Bobko's flight got sort of cancelled, and we took his payload. He and his crew ended up going into the next year. So we

ended up launching finally in August with a different set of payloads. It wasn't a big difference, but it was a small difference.

JOHNSON: Yes, in fact, in August, there was another postponement for the third time, and then you ended up, I believe the next day, and there was a slight postponement for a few minutes when a private airplane got in your air space.

HAWLEY: Oh, yes, it was the—first postponement, was that—that was probably the software.

JOHNSON: I think that was the flight software.

HAWLEY: Yes, I remember, they came and told us that they had discovered this timing peculiarity in the software because of how the different software modules were prioritized, and there was something like a one-in-thirty chance that the primary software wouldn't separate the solids, if it didn't get around to issuing the command to the master events controller to send the command to separate the solids. There was some chance based on what it was doing in the priority of the stuff that—that software runs during a period of time when it expects the solids to be separated and then it stops running, and if it doesn't get the command while it's running, you can send the command forever after that and nothing will happen. Anyway, the upshot of this was there was some one-in-thirty or –forty chance that the solids wouldn't separate.

I remember Henry got the crew together, and we were being briefed. I think we were aware of the problem at the time, because somebody else had briefed us, and he wanted to know kind of what the crew thought the options were. You could accept the risk and fly as is, or if

they could develop a software patch, they could fix it. I don't know if we knew how long that was going to take when we were talking about it, but I remember there seemed to be some sentiment on the crew that this was okay to go, just accept the risk. I remember thinking there's a lot of risks that we have to accept. This is one they can fix. So I think we ought to make them fix it.

They were actually able to do that. In fact, yes, it was overnight, I guess, they were able to develop a patch that fixed that problem. So then we were able to try again. Yes, that's right. We got down to—and then there was a plane in the restricted area, and I think the sentiment was unanimous on the crew that we ought to just shoot him down and proceed.

JOHNSON: By that time I imagine there was some frustration. [Laughter]

HAWLEY: Yes, we were pretty much ready to go by then.

JOHNSON: And, as you said, there was a couple of months where they reconfigured the payloads and you took over 41-F's payload, and you ended up not flying the TDRS. How did that affect the training? You had said that you did multitask pretty well. Did you spend those two months then training for the new payloads?

HAWLEY: Yes, it actually wasn't too much different. I know on the original 41-D manifest we had something called the large-format camera, which was a casualty of the new manifest. It didn't fly. I, frankly, now don't remember what took its place. Both flights had a SYNCOM, although the SYNCOM that we launched when we actually flew was different than the

SYNCOM we had in the bay when we scrubbed, as I remember. Oh, I guess maybe we got the solar—

JOHNSON: The OAST [Office of Aeronautics and Space Technology] solar array?

HAWLEY: No, we had that initially. Now I don't remember.

JOHNSON: You had the IMAX camera.

HAWLEY: No, the IMAX camera, I think, was always there. We lost the large-format camera, and I don't remember what we picked up instead. It might have been a second PAM in a Hughes 376.

JOHNSON: The Telstar?

HAWLEY: Yes. I think maybe that was it. So maybe we got a third satellite instead of the large-format camera, which—let's see. I'm trying to remember who was—maybe Judy was the large-format camera person. It wasn't me, I don't believe, and therefore the fact that it was not there anymore wasn't a training consequence for me. If they added a satellite, it was similar to the satellite we were already flying, so that also wasn't a training consequence. I don't remember that being a big deal.

In fact, I remember John Getter at the press conference we had before the second attempt, he asked about the training and how much more training and could you really do that. I

remember telling him it wasn't a lot more training. It was a little more training, and so it wasn't a problem.

JOHNSON: Well, you finally did launch.

HAWLEY: Finally, yes.

JOHNSON: Could you describe that experience to us and how it felt in relation to your training for that?

HAWLEY: Yes, it's interesting. I remember that in my first thought at MECO [Main Engine Cutoff] was—this is probably the sort of thing that gives astronauts a bad name, but I remember thinking, wow, the simulators are really good, because obviously, except for the motion and the Gs, the ascent was very much like the simulator, what I expected to see, until we pitched over and saw the Earth's horizon for the first time.

I remember Judy was on the mid-deck for launch, and in the sim I guess we got in the habit, you know, things always were going wrong in the sim, and sometimes she wouldn't always have to be there for the ascents since she didn't have a real role in the ascent. She was the flight deck for entry, so she was there for all the entries, but sometimes she would come over and sit there when we were doing ascent training, and she'd hear us go, "Oh, 'blank'." [Laughter]

She told us in real flight, she said, "I don't want to hear any of that. I want to know what's going on. You need to tell me what's going on, because I'm going to come up there if you guys—."

So Henry did a good job of sort of explaining as we were going uphill, "Okay, we're going. We're going Mach 10. We're doing this. We're doing that." I remember we got up there and had MECO, got off the tank and then the Orbiter pitched over and that was the first time we got to see the Earth's—we were actually upside down, but we got to see the Earth's horizon out the front window, and I think we said, "Holy sh—," and Judy said, "You knock that off. I'm coming up there." [Laughter]

And we said, "No, no. It's a good thing." But until that moment it was like being in the sim, really. Then when you saw the Earth the first time, I'll never forget what it was like looking out the window and seeing the Earth for the first time. I thought—that is hard to describe, what that's like. Maybe it sort of does look like the pictures you see, but to think you're really there looking at it is—and the engines didn't quit on the pad and all the things you trained for in the sim, 90 percent of your training's now irrelevant. But that was special.

JOHNSON: And you were able to share that experience with a large group of other people that hadn't experienced it before, too.

HAWLEY: You mentioned the IMAX. The IMAX was almost like having another crewmember. The camera's huge, as cameras go. It's fully manual, at least the one we flew was fully manual, and, frankly, it was a pain to have to operate it. We had this scene list of all the things we had promised that we would get, including, I remember, one we had told them, yes, we'll film the

crew having dinner together one night. Well, for whatever reason, we either never had dinner together or we never filmed it until the night before entry when somebody remembered that we had promised to do this and we hadn't done it yet. So we had to set up this—anyway, the point of my story, I guess, is that it was tremendous overhead and a tremendous pain, but having seen the movie, this movie was [*The*] *Dream Is Alive* [1985], and the footage for *Dream Is Alive*, but it was really worth it. It's tremendous stuff, and I feel very fortunate to have been a part of helping create that movie, even though at the time I remember, you know, what a colossal pain.

I remember, I don't know, I shouldn't tell this story either, but this camera, it's a huge camera, and it's got a belt drive on it, and they made a belt guard. But for whatever reason, we decided we didn't need to fly it. I don't know if we were trying to save weight or what, but we decided we didn't need this belt guard.

So I'm up there doing something, and all of a sudden I hear this blood-curdling scream. I go floating upstairs to see what had happened, and Judy had gotten her hair caught in this belt for this IMAX camera, and there was film and hair all over the Orbiter. It jammed the camera and the camera blew the circuit breaker that it was plugged into. I guess the ground maybe noticed the circuit breaker had popped and asked us. We said, "Well, we had jammed the camera," and Judy had made us promise never to tell anybody what really happened. [Laughs]

Mike was cleaning the camera. Mike Coats was the camera guy. I always kidded with him that the sign of real respect is when you're the guy always asked to take the group picture. [Laughs] He was the guy that was responsible for taking all this stuff, and he knew how to load the camera and take care of it, and I remember him spending hours trying to clean little pieces of film and hair out of the camera. We did get it working again finally. But it turned out, all said and done, that it was a great thing to have.

The thing pulled so much film so fast, and it's [so] big, that in zero-G, it will actually torque you like a gyroscope. To use it, you really have to be affixed to something, because it will rotate you. I didn't think of that. When we started using it, we were, "Hey!"

JOHNSON: It's not necessarily one of those things you train for.

HAWLEY: Yes, I didn't know. I guess we didn't think of it ahead of time, and nobody thought to mention it, if they had thought of it. But in zero-G, it's enough of a gyroscope to—it was kind of interesting.

JOHNSON: Well, I think we're going to stop for a minute and change out the tape and take a little break.

HAWLEY: Okay.

JOHNSON: You were talking about the IMAX camera and how it did make you move in that weightless environment. How was it the first time when you unstrapped and you found yourself in that weightless environment?

HAWLEY: That was a little bizarre. One of the things that happens that I think is pretty typical is you really almost think you're in minus-G, because on the ground you are so used to pushing off when you move. It's so natural. You think you're not in space, but you really still are to some extent. What happens is you end up on the ceiling, and you're very uncoordinated for a while.

Zero-G is fun, but I never—I remember particularly on that flight not thinking it was the euphoric, wonderful experience that everybody must assume it is, because it's a very inefficient way to operate until you get accustomed to it.

Like I say, you're out of control and you're trying to work on something, and somebody on the crew goes tumbling head-over-heels into you because they lost control, or your book has floated away and now you can't find it, or your pencil's floated away and you can't find it. You have to learn how to do work in that kind of an environment.

It's interesting because what we've always done and we still do it today to a large extent, is plan the mission so that the most important things happen first. That goes back to the days when we'd not flown the Shuttle before, and everybody was concerned that it was going to fall out of the sky, and so if you got up there, you needed to get rid of the satellite or whatever it was right away, so that when a problem happened, you'd have the mission accomplished.

But the Shuttle is very reliable, and so what you end up doing is doing the most important, most challenging, most difficult tasks when the crew is the least prepared to do it, because they're inefficient and they haven't adapted yet. For Station flights today, that's not quite so bad because of the way the orbital dynamics works. We tend to launch and do a pretty short flight day one. Then they go to sleep. Then the next day they get up and check some stuff out. So your first major task is doing the rendezvous, and that's not till flight day three. But back in those days, we were launching satellites five hours after we got on orbit, and we were still trying to figure out how to stay right-side up.

So it does take several days of getting used to it, and, yes, it isn't uncommon to see people fumbling around, being on the ceiling, because they didn't mean to push off and they really did. It just takes longer to do stuff till you get accustomed to it. Everybody, once you get

to zero-G and you're still strapped in, you always take your pencil out and let it float to prove to yourself that you're really in zero-G.

JOHNSON: You deployed those satellites. As you mentioned before, you deployed three in three days' time. Is there anything about any of those satellite deploys?

HAWLEY: Well, I told you the story already. That's the thing I remember as being most noteworthy, was thinking we were in the wrong attitude and having the ground think I was a genius. No, we were pleased they went well.

JOHNSON: One was the Leasat. It was the first time that one had actually been designed to be released from the Shuttle.

HAWLEY: Yes. Right. And in those days, as I remember, they took advantage of what was then kind of the pricing policy, which was sort of based on the volume of the cargo bay that the thing, whatever it was, took up. So they built this thing that was a disk that basically minimized the amount of volume that it took up. So it was pretty clever. It was kind of interesting to see that actually come out and do its thing, but pretty much it worked just like we had trained to have it work, which was nice.

JOHNSON: What about the OAST, the solar array? Did you have anything to do with that?

HAWLEY: That was primarily Judy and Hank that were that. It was my one chance to get to fly the Orbiter, I remember, because part of what we did was to erect this solar array, which really was—it wasn't a functioning solar array, but it was the structure of a solar array, which is actually similar to the solar arrays we now have on the Station, and that was kind of the point of the experiment back then.

But one of the things we were supposed to do was to have this thing extended and then input pulses into the Orbiter's reaction control system and watch how the dynamics were generated in the solar array, how it damped over time and see if the predictions matched what we really saw. They had cameras set up to measure actually how much the tip of the mast deflected so that they could be compared with what they had predicted.

All that worked well, but some of it required inputting jet firings simultaneously in different directions. So that was where I got to play. Mike Coats was primarily responsible for making the input, but some of the times when we had to make a yaw and a pitch or roll simultaneously, it's easier for two guys to do that. It's better because you can put in a—if one person tries to do it with the Orbiter stick, if you're very good, you can do it, but you will tend to get a little bit of yaw in there when you're doing it, or not get it quite simultaneous.

So the way we did it was, he would do one axis, I'd do the other, and so I actually got to fly the Orbiter a little bit, which was kind of fun. But that was really a remarkable sight, to see this thing 100 feet up above the Shuttle's bay.

The thing I remember most about it is at sunrise or sunset, the first thing that either the last bit of sunlight or the first bit of sunlight would hit was the solar array, and it would make it almost look like it was lighting up with its own source of internal illumination. Everything else would be dark and the solar array would be glowing gold. It was really pretty, and the whole

thing fit in a box that was about six inches thick. It was really neat technology. So it was kind of fun, although I didn't really have too much to do with it myself.

JOHNSON: I bet it was a pretty amazing sight when it was totally unfurled.

HAWLEY: Yes, I was surprised it worked as well as it did, frankly.

JOHNSON: During this mission, too, there was an icicle that formed on the two water dump nozzles.

HAWLEY: Yes, I forgot about that.

JOHNSON: Can you share some of the details about that that you remember?

HAWLEY: I'm trying to remember. I think we didn't know anything was unusual initially. I think maybe the ground called us and told us to terminate the supply water dump because they had seen some temperature funnies. So we did, and then some time later, I guess they got curious enough to use the cameras on the robot arm to see what was there. So we set the arm up, and, yes, you could see this icicle there.

For whatever reason subsequent to that, they decided that we ought to try a waste dump and watch it with the camera on the arm, and the icicle was still there. I remember as we were doing it, watching the second icicle form. So we ended up stopping that dump, and now here we are with this icicle. I don't know. Initially we may not have been as concerned about it as the

ground subsequently became. What they became concerned about was the possibility that it would come off during entry and go back and hit the OMS [Orbital Maneuvering System] pod. I may have initially thought that, well, it'll come off during entry and no big deal, but you obviously wouldn't want it to hit something back there. So they were concerned about it and wanted to get rid of it. So that was one problem.

The second problem was, because we could no longer dump waste water, they had done a calculation to figure out how much volume we had left in the waste water tank and how much of the volume would be used up by the normal condensation from the air that the humidity separator puts into the waste tank and all that, and they had concluded that that was about all the room they had left.

What that meant practically to us was that we couldn't use the toilet anymore, because there was no room in the waste tank for the liquid waste. So that ended up being a problem. They had us orient the vehicle toward the Sun, hoping that the solar radiation would sublime the icicle. That may have worked a little bit, but it wasn't particularly effective.

So then I remember they told us they wanted Mullane and me and to go EVA and knock it off. I remember Mike was thrilled, because he was going to get to do a spacewalk, and I'm sitting there going, "This is not a good idea. I don't know how in the world we're going to get to it." I mean, it's down on the side of the Orbiter aft of the hatch, and there's no translation path down there. I guess they were talking about taking the CFES unit apart, using some of the poles that the CFES was constructed with to maybe grab one of us by the boots and hang him over the side and have him knock it off. That all sounded like a bad plan to me. [Laughs] Mike was real excited about getting to do the spacewalk.

Anyway, so we did the suit checkout and they sent us to bed, and we were going to do an EVA the next day, which I'm sitting here today, it's still hard for me to believe that I came that close to doing an EVA. Then they called us after they sent us to bed. Jerry [L.] Ross was the CapCom, and I was talking to him about this the other day, because he remembers it, too. He called, and they woke—we weren't actually asleep yet, but they called us to tell us that they changed the plan and we were not going to do an EVA the next day, and they were going to use the robotic arm to try to knock the ice off. I remember thinking, "Yeah, it's a good plan." [Laughs] And Mike was thinking, "Oh no, I'm not going to get to do an EVA."

So that became the plan, was to try to use the robot arm to knock the ice off. One of the challenges with that plan was that it was in a location where you actually could not see the end of the robot arm. Obviously the ice is right there at the edge of the Orbiter. I don't remember how big it was. It was probably a couple of feet, anyway. So you're translating the arm along the side of the Orbiter without actually being able to see what's going on.

One of the rules in those days, anyway, was you're not allowed to operate the arm in a place where you can't see what it's doing. But here was a case we were going to do that anyway. So I remember they still had us pointed to the Sun in hopes that the sunlight would continue to work on the ice. I was supposed to go down to the side hatch window and watch as best I could while Henry drove the arm to knock the ice off. He would move it through a predetermined trajectory, and if he did it properly, they knew from the ground simulations that it would hit the ice.

I'm sitting here looking out the side hatch window, and there's the arm. I can't see the ice, as I remember, but there's the Sun. That became important because this was *Discovery*. This was the first flight of *Discovery*, and *Discovery* was unique in many ways, but one way it

was unique is that the window in the side hatch was an optically high-quality quartz window, which means it transmits ultraviolet light. We actually had a little plexiglass filter we were supposed to put on the inside to protect the crew from the ultraviolet light. Most of the windows on the Orbiter were just glass, and glass normally blocks UV light, which is good. The atmosphere protects us on the ground, but in space, unprotected, you would suffer damage by that much UV light falling on you.

So here I am at the side window. There's the Sun. All of a sudden I'm thinking, "Oh, yeah, this is this neat window that transmits all this UV light. That's swell." [Laughs]

But anyway, that all worked okay, and we actually saw the ice float away, so we knew. I don't recall hearing it or anything or seeing anything until we watched the icicle kind of floating away. Then we knew we had gotten it. And we took some pictures of it, and that was good. So that part of the problem was better. They still wouldn't let us use the WCS [Waste Collection System] because they weren't going to let us do any—we got rid of the icicle, but they weren't going to let us do any more dumps, anyway. So we still couldn't use the bathroom.

Today we fly contingency urine collection devices for men and women on the Orbiter. We've done that ever since that mission for that reason. But on that mission we didn't have anything, and it's not a very pretty story. [Laughs] We did have the old Apollo bags, which are basically just hard plastic, and they were really designed for defecation. There's nothing absorbent in it, and actually the WCS was still usable for that. It was the liquid waste that you didn't have any place to store it.

Eventually somebody on the crew, I don't who it was, whether it was Mike or Henry, I don't think it was me, had the idea that if you had a towel and you put a towel in the Apollo bag,

that at least you'd have something that would absorb the liquid and then you could seal up the Apollo bag and you could put it in the wet trash. That worked pretty well.

Somebody discovered that actually what works better than a towel or a washcloth is socks. So after a while, socks became the coin of the realm. If you had socks, you were king. I remember, I think Mullane was running on the treadmill or something, and Henry or Coats or somebody flew through the mid-deck, and all of a sudden Mullane noticed he was wearing socks. He dove over and grabbed him by the legs and started to rip the socks off him. [Laughs]

So we did that for several days, and stuffed all these Apollo bags full of liquid in the wet trash, not thinking about this is going to weigh 1,800 pounds once it gets on the ground. [Laughs] I don't know this to be true for a fact, but I was told that after the flight, after we landed, they came to remove the bags from the wet trash volume, and it broke. I mean, I don't think all of the liquid went everywhere, but if it broke, then the bags certainly did, and hopefully they didn't leak. But it was probably a worse mess that you can even imagine.

JOHNSON: Well, what was the reason that the icicle formed to begin with? Did they find out what caused it?

HAWLEY: Yes, they did. I don't know that I remember all the specifics, but it had to do with the kind of tile they had around the dump nozzle itself. They ended up replacing—they had a new kind of blanket insulation, as I remember, and they decided that wasn't good enough, and it just got too cold, and maybe the heaters that are in there weren't enough to compensate for that. So I think what they did was to go back and put the hard tile back around that area for subsequent flights of *Discovery*, and that seems to have—I think we've only had icicles one other time.

JOHNSON: Of course, and then they came up with the logo of the icebusters logo. [Laughter]

HAWLEY: Yes, I didn't remember that.

JOHNSON: Were there any other memorable moments on that flight that you'd like to share with us?

HAWLEY: Well, there was the time that—it was entry day, as I remember. In fact, Jerry and I were talking about that the other day, because he was also the CapCom on shift when this happened. We got a call. I was asleep, and the call comes up on the radio that they see a leak in our O_2 system, and they needed us to shut down the fuel cell, and I'm thinking, "What?" So I get up and go upstairs, and Henry and Mike are up there. It turned out there was a real leak, and I think we even saw—somebody did, I don't remember if I did, but in the payload bay you could almost see, like, snowflakes. It turned out there was a check valve. This was the first flight of this vehicle, and there was a check valve installed backwards.

So when we swapped to the secondary oxygen system, which is a normal thing you do halfway through a flight, just to exercise both systems, this one started leaking. We were able to troubleshoot it and find out where the leak was, and fortunately it was not in the fuel cell, which is a possibility, because you really wouldn't want to shut a fuel cell down if you didn't have to. So that was interesting, that on entry day we ended up getting up early to go troubleshoot an oxygen leak.

No, the rest of it was, as I recall, pretty straightforward. We landed at Edwards [Air Force Base, Edwards, California], which was the plan.

JOHNSON: What was that like, reentry and landing?

HAWLEY: I guess reentry was a little bit different than I expected in two ways. One, having never been through this before, I wasn't expecting the—there's a bright kind of plasma plume that seems to form above the Orbiter during reentry, and it comes in through the overhead windows. The light from it does. But you could see it reflected off of the pilot's helmet, and that was kind of interesting, because I hadn't really heard anybody talk about that, that I remembered. But I had heard Joe Allen talking about reentry, "It's like flying lengthwise down a neon sign". But you get this soft kind of pink, whitish, orangish glow that develops and encircles the Orbiter, and that's true, and that was really kind of interesting.

I remember thinking that I sure hope the guys that built the tiles and designed the reentry trajectory knew what the hell they were doing, because the Orbiter, of course, doesn't really have engines anymore, and it's all about energy management and trying to manage the energy you've got to get to this little landing site.

The other thing I remember is that, I mean, it's real obvious you're going from 17,000 miles an hour down to 250 miles an hour, so you're slowing down, but in the simulator you don't feel that, so maybe you don't think about it as much. But the whole time it's like you're going down the side of the mountain in your pickup truck. You feel like you're kind of falling forward in your seat, because you're decelerating, and that lasts an hour.

It's kind of fun when the onset of Gs happens, and you think, oh, jeez, it must be two or three Gs by now. But the one little mechanical gauge we've got in the whole Orbiter is this little G-meter that sits up by the commander, and it's showing about two-tenths or something. Your whole calibration for what Gs feel like is different. On subsequent flights, it's kind of fun, having had that experience, to tape over it or something and then have people guess, say "When do you think we've got half a G?" and everybody guesses way too early.

There's a lot of noise when you get around Mach 1, which surprised me a little bit. And the touchdown surprised me a little bit, because it's really nice and smooth, and that was great. I didn't know quite what I was expecting. I guess it surprised me a little bit, too, when the nose gear touches down. It [falls through]. The attitude after landing is you're a little bit nose-low, and that's on purpose. But when the nose [falls] through, it almost feels like you crashed. [Laughs] But, no, Henry did a great job, and it was a really neat landing.

I remember probably people asked me that, "What did you feel like after landing or after your first flight?" The thing I remember is sitting there on the runway thinking, "Wow, we really did this," that we did all the things we had set out to do. Maybe in those days I always felt like, "Why are we bothering to put a flight plan together? It's never going to work this way." And it did, and there was a tremendous sense of satisfaction that we probably all felt, but I remember feeling it very much, that we had actually done this thing, and it had worked.

JOHNSON: I think I'm going to ask Rebecca and Jennifer if they have any questions about this first flight, and wouldn't that be about it, about time? Do you have any today? Okay.

HAWLEY: Okay.

JOHNSON: It's about four o'clock. If you want to stop for today.

HAWLEY: Sure.

JOHNSON: Okay.

[End of interview]