

NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

ORAL HISTORY TRANSCRIPT

BRIAN DUFFY
INTERVIEWED BY SANDRA JOHNSON
HOUSTON, TEXAS – 21 JUNE 2004

JOHNSON: Today is June 21st, 2004. This oral history interview is being conducted with Brian Duffy in Houston, Texas, for the NASA Johnson Space Center Oral History Project. Interviewer is Sandra Johnson, assisted by Rebecca Wright and Jennifer Ross-Nazzal.

I want to thank you for joining us today and agreeing to participate.

DUFFY: Glad to be here.

JOHNSON: If you would, please share with us briefly about your experiences in your career before NASA and how they influenced your decision to apply to the astronaut corps.

DUFFY: I first became interested in aviation when I was—I can remember being probably four or five and watching some of the first jet aircraft make contrails in the sky, and I remember lying down in the grass and watching them go over, and that was actually the first bit of interest that I had in aviation, wondering, “Wow. How can they do that?” That was about the extent of it until we moved to another town when I was in elementary school. Well, before I started first grade, actually, and the adjacent town had a naval air station, the South Weymouth Naval Air Station in Massachusetts. So from that point on, I grew up watching airplanes coming and going, taking off, landing, flying around the neighborhood. I saw the Blue Angels [U.S. Navy Flight

Demonstration Squadron] every year when they came to town, and thought they were just the best.

So I was interested in aviation and kind of amazed by it and along the way, of course, the space program started, when I was in third grade or so, [19]’61, when Alan [B.] Shepard [Jr.] launched, and I remember watching that on television and it took my interest in aviation and my amazement to a whole new level, like, wow, they’re actually leaving the planet, which was something that I thought was just the coolest. And many children my age at the time wanted to be astronauts, because it was the coolest thing you could possibly do, me included.

But I thought I’m just a kid and I live in this little town and my dad’s a mailman, and I’m never going to have a chance to do any of that. But I did think that the aviation aspect was something I could do, so going through school, I applied to go to the Air Force Academy [Colorado Springs, Colorado], because I knew at the time, if you graduated and were physically qualified, that you were pretty much guaranteed a pilot training slot. And even though I had never been in an airplane in my life, on July 3rd, 1971, I got on an airplane in Boston [Massachusetts] to fly to Colorado Springs to go to the Air Force Academy, hopefully to become a pilot, because I thought that’s what I wanted to do.

While I was there at the Academy, I found out, yes, in fact, I loved it. As a matter of fact, one summer, one of my summer programs, I found myself—I think I was nineteen years old—I might have been twenty, but I was in the back seat of an [McDonnell-Douglas] F-4 [Phantom], 100 feet off the ground, going 600 miles an hour in a flight of four, going to the range to practice bombing things, and I realized this is really what I want to do. So that really focused me on my future and that was to become a fighter pilot. That is what I decided I wanted to do. And things worked out the way I wanted them. I got an F-15 assignment out of pilot training when I

graduated. I flew a couple of tours in the [McDonnell-Douglas] F-15 [Eagle], one at Langley in Virginia, Langley Air Force Base, and then we went over to Okinawa, Japan, to Kadena Air Base.

It was after that point, after having flown the airplane for five or six years, I was kind of about as good as I was going to get, I thought, and so I was looking for another challenge, something else to do, and I got the opportunity to go to test pilot school and that started me off on a whole new track now.

I went to Edwards [Air Force Base, California] for a year and did that, and then my assignment out of there was to go to Florida and fly as a test pilot at Eglin Air Force Base up in the panhandle. My wife and I were there, just loving life. I mean, things were good. We were raising babies and had a nice house. I was flying a couple of different kinds of airplanes. And one Friday afternoon, sitting in the back of the room, with my chair against the wall—we had a weekly meeting where we went over what we had done that week and what we were going to do the next week—and at the end of the meeting, the squadron commander said, “Oh, by the way, NASA’s looking for Shuttle pilots.” They were going to have another selection. This would have been in the spring of [19]’85 that the meeting was. And he said if you have these academic degrees and this kind of flying background, and kind of read off the minimum criteria that you needed, then he said, “If you’re interested, here’s how you apply.”

Well, mentally, I had put a check in every block and was amazed to find out that I was qualified to apply and I thought, “Jeez.” I thought back to that eight-year-old kid who sat there and watched Alan Shepard go, and I thought, how could you not apply something that you wanted to do so long ago? Even though I didn’t focus my career to do that, it just kind of worked out that way. But to find my self qualified to apply was amazing to me. So I said,

“Well, yeah, I’ll throw my hat in the ring with everyone else,” never expecting to get selected, of course, but you never know. And then I did get selected, so that’s how it all worked out. That’s how I got to NASA anyhow.

JOHNSON: If you will, just describe that astronaut selection process, from the time you applied and what happened until the time you were selected.

DUFFY: It’s kind of an interesting—this is more like my personal stuff as opposed to NASA. Is that what you’re looking for?

JOHNSON: Your experiences, yes.

DUFFY: There were a number of us who all had met those qualifications to apply. As a matter of fact, I knew my competition, because we were all cut out of the same mold. We’d been at the same schools; we’d flown the same airplanes; we’d worked together, maybe had desks next to each other. So I knew all the guys I was competing against and didn’t really think I was the one of the two, maybe, that they would select. They had some other guys that I thought were more qualified and would be better, more likely to be picked. So I almost didn’t apply, even though I wanted to, because my work got in the way. I had to go on a couple of trips on some projects I was working on; I wasn’t going to be around.

But one of the guys I was talking about there, one of my contemporaries, who had been my roommate at the Air Force Academy, called me up while I was on a trip and said, “You have to apply.”

And I said, “Oh, come on.”

He said, “You have to apply.”

And I said, “Okay, Steve,” just to get him off my back, I said, “I will. I will. I’ll be home for the weekend. I’ll do it.”

He said, “I want that thing, because Monday morning, I’m jumping in an airplane and flying to Randolph Air Force Base [Texas] to deliver all of our applications,” all of the ones from Eglin there, and he says, “And yours better be in it.” So I came home and I did it over the weekend, gave it to him that morning. Sure enough, he took off, jumped in an F-4, flew to Randolph, delivered the applications.

Then time passes from the time they’re turned in, because the Air Force has to screen the applications and make sure—well, they put criteria on top of the NASA criteria, because they want you to be at a certain career point and not too old, because they might need you somewhere else, but they have their own reasons for it.

So one day, a few weeks later, probably, I think I got a phone call—no, actually a message came out, a formal message came out of the Air Force saying these ten Air Force officers have been selected for interviews by NASA, and to make arrangements to be here on a certain week, arrive on a Sunday and leave the next Friday night or something like that, and I was one of the ten. Well, so now I really know the competition, because it’s just those ten names on there and all of them were my friends. I mean, we all knew each other.

So again, those stars were still amongst the group, so my chances of coming were pretty nil, I thought. But I thought, well, I’ll come and enjoy the interview, the whole process. I did; I arrived with everyone else and we went through that week. I met some of the other people that were here, Navy folks that were being interviewed, and had a real nice time. I got to meet many

of the astronauts and I actually sensed their enthusiasm for the program and just how special this was. Because it's even more special than you might think, and it's infectious. So I was here during the course of that week, which is really—it's a one-hour interview and a four-and-a-half-day medical, basically.

During the course of that week, I became infected with just how great a program the space program is and how topnotch the people are that work in it, how motivated and how this would really be a fun place to work. So my hope in being selected was ratcheting up here kind of slowly.

During the course of that week I made some new friends, met a lot of people, got inspired with the program, and had what I thought was a good interview. I was towards the end of the group, and that can be either good or bad, at least in my mind, because if you're here—I don't know how many people were here, maybe forty were here that week. It might not have been that much; it might have been thirty or some smaller number, but the board has to sit through each one of these, an hour at a time, one right after another throughout the week, so you just can't help but think that by the time they get to me, if I'm number twenty-seven or twenty-eight or whatever, they've got to be bored out of their minds; I mean, they've heard it all ad nauseam.

But while I was in there, I said, "Well, this is my one shot. I'm going to have a good time. I'm just going to enjoy it. I don't expect to get selected." I had a little bit of fun with the board. Mr. [George W.S.] Abbey, George, was running the show there at the time and I had done my homework so I knew some things about him personally, his personal life, where he'd gone to school, where he grew up, what he'd done in his Air Force career, those kinds of things. So I was prepared to interact with them on nearly an equal level, because I would know almost as much about him as he knew about me. So I actually had fun. I was relaxed and joked around

a little bit with them, and one time I threw a zinger across the table at him, just to see what he would do, and he didn't move his head; he just kind of lifted his eyes up at me and kind of cracked a little smile and looked back down. So I had a good interview.

So as I left, I thought, "Jeez, maybe I have a chance here, because that went really well." At least I felt it did. And then what's funny is that there's like, say, five weeks from the time you finish your interview until the phone calls go out, and over the course of that time, my confidence just—it was pretty linear; it just degraded in a straight line. So by the time the phone calls were about to be made, I thought, "Oh, I didn't have a prayer."

The morning the calls went out, I shared an office with like five other pilots and they were all out flying. I was the only one that wasn't on the schedule that day, and the intercom, actually, says, "Captain Duffy, telephone call from NASA. Pick up on line," whatever, line two or whatever. So I looked at my phone and I knew that when you picked it up, if George Abbey's on the other end, then he calls with the good news, and if it's anybody else, that's bad news. So I picked up the phone and recognized his voice, and of course, my expectations went sky high. And he was funny in the way he said it. He said, "Well, we were just wondering if you're still interested in coming."

And I was kind of like, "Are you kidding?" [Laughs]

He said, "Well, okay, we'll see you at the end of July." This was the first week in June.

And I said, "Yes, sir. I'll be there," and hung up the phone. Then I sat there and thought, "Now what do you do?" When you get this call, it's the biggest phone call of your life, at least up to that point. What's your first action? What do you do? So I called my wife. I figured that was safe. [Laughs] And she was all excited. She had the kids there on the counter and they

were all screaming, and she's dancing around the kitchen or whatever. She had them excited; I could hear them in the background.

So then we packed up and headed this way. So that's kind of the sequence, going from not expecting to be here, to thinking it was a real good interview, and then having it come all the way back down again over that time period. It's kind of an emotional ride.

JOHNSON: You said your wife was excited. Was she also excited about moving to the Houston area?

DUFFY: Yes. She was a little bit afraid that the city was too big. She didn't like the idea of living in a big city, but I explained to her, I said, "No, it's really like twenty, twenty-five miles outside the city. You can go to the city if you want, or stay in your little area if you want." So when we came here on a house-hunting trip, she was very happy with the area.

JOHNSON: You got here in July of [19]'85, and you began your training. I'd like you to go through a little bit and tell us some about your training and the different things that you did during training. But during your training, something significant happened, and that was the *Challenger* accident.

DUFFY: During that first year, yes.

JOHNSON: So maybe you can just walk us through some of your training in the different areas that you worked in and also how that accident affected your schedule.

DUFFY: Yes, that was a big deal, obviously, for everybody. Yes, we rolled into town here and spent that summer, August and September, doing some kind of team building with my group. There were thirteen of us that were selected, and a lot of it is getting to know each other in lots of different ways, whether it's professionally and socially. Some of us were runners, so we started running together and just doing things together. We were a pretty cohesive little group there. We were thirteen and the rest of the office was about a hundred, maybe, so we were this small little group.

I'll never forget the first Monday morning meeting that I went to. We got here and that very first Monday I think they had a formal press thing and all that for us, so that the following Monday, we went to the regular Astronaut Office meeting and I sat in that meeting for probably an hour and a half, and walked out at the end of an hour and a half and had not understood one thing they were talking about, not one thing. And I realized, wow, I've got a lot to learn about this, because people are speaking very passionately inside about certain subjects, using all these acronyms, which I had no clue what they were.

I came to realize that you can be the best fighter pilot in the world or test pilot—we had astrophysicists, we had all kinds of different specialties, engineers—and you can be the best of everything, but when you come here as an astronaut, you don't know anything about flying in space. So everybody starts at the same level, which is basically zero, and you have to build up from there, and to NASA's credit, that's where their training program started. They assumed you didn't really know anything, which, thank goodness, because I didn't.

Then we started building from there, and it starts out with just simple stuff, some simple astro classes to get you understanding orbital mechanics. Then even some other basic classes.

They brought in specialists and professors from different areas to talk to us about ceramics or rocket design or you name it, because I believe the idea was for us to be well versed, because when we go deal with the press or schools or whatever, you might get hit with questions in many, many different fields from different directions, and it's nice to be able to handle them and not have to give them the Navy salute [gestures] the whole time and say, "I don't know."

So we spent time doing that, sitting in academic classes, just learning fundamental, basic things. We started out with systems-level things for the Space Shuttle, and you take them one at a time. You take the normal system. They describe it. Here's how it operates. Then you go think about, well, how do you use it. Then they start saying, okay, well if this breaks, it acts like this, and if that breaks—you start learning some of the malfunction signatures, how you recognize if something's not working right and then what you do and what its impacts are.

You do those a system at a time and then you go to the next level, which is when you start combining systems and they start, well, the electrical power system actually provides power to the hydraulic system controllers, which—you know, and they start putting the puzzle together. So that year, starting from kind of basics, from zero where you don't know anything, at the end of the year you're in pretty good shape for being able to understand what's going on.

But I actually worked, by my standards, quite hard to be the best crewmember possible, to be an asset to a crew, not a liability, which was my goal. I found that it took me three years to get to the point where I was comfortable, and that was with a lot of simulator time that I got as a result of *Challenger* happening, and we can go back and talk about that.

Actually, when *Challenger* happened, we stopped flying for nearly three years, so some of the crews that were together were disbanded, some people left. There were a lot of simulators that they needed people to go fill, and so I got in every one I could, because I was working hard

at being the best that I possibly could be. So it took those three years, including all of that hard work time, I think, to get to the level that I felt I needed to be at.

Going backwards now, back in that training, you mix in things like your [Northrop] T-38 [Talon] checkouts and things, along with all those classes that I was talking about that we have, and then simulators start showing up and we start doing things in there.

I was actually out flying when *Challenger* happened. I was going to El Paso [Texas] for a training flight and I'd been waiting and waiting that morning. Because of the ice problem that they had, it was delayed for quite a while. It finally got to the point where I had to leave, because I had to be in El Paso by a certain time. So I was actually ten minutes out from landing out there, I guess, when the accident happened, and walked into the FBO and they had a television—FBO is a fixed base operator, where we used to get gas out in El Paso, and taxi in, shut down, get out, and walk in, and the television's on and everyone is looking at the television. I was trying to comprehend what had happened, because I hadn't heard anything and no one had said anything over the radio or anything.

I knew a little bit about the system. I knew that there wasn't any crew escape system, and I saw what happened and I knew that that was over. I jumped back in my airplane, flew back to Houston, just to be back here as soon as I could be for my family and for whatever else might need to be done.

It was hard. We had just built a house. When we arrived here in '85, there wasn't a lot of new construction that had gone on for almost twenty years. The areas around here, Clear Lake Forest, Nassau Bay, Camino West out there, those areas were established and were here. The prices on those homes, compared to where I was coming from, were pretty high, and I surmised that it was because over the years the owners would tack the real estate commission

fees on top of whatever they paid for it, so over the years, even though the house was getting older, the price was going up.

I found that it was about all that I could just to afford even a very old house, but I could build a brand-new house cheaper, which didn't make a whole lot of sense to me. So we found an area out in El Lago, out in Taylor Crest out there, where there were some lots and where there'd been some recent, a very little bit, but some recent building. We contacted a builder and we came to terms and so we ended up building a house out there, and that took from—we might have agreed in August sometime to do that until the end of December, or almost the end of January, actually.

We closed on our house, and I might be a day off in here, closed on our house like on Thursday, had our stuff delivered out of storage on Friday, and I think *Challenger* happened on Monday. It could have been closed on Friday, delivered on Monday, and *Challenger* happened Tuesday, but it was in that sequence like that.

So when I got home, we were wall-to-wall boxes in the house and she had stopped unpacking and she said, "What are we going to do?" I mean, we'd just bought this house like a day or two prior to this happening.

I never had a doubt that they would find out what happened, fix it, and that we would continue to fly. I didn't have a doubt, and that's what I told her. So we continued to do that, and it turned out, of course, we were right, I guess. But that's where *Challenger* happened, right in the middle of that year of training there, and it was traumatic, obviously, for everybody. A lot of questions about what are you going to do or what's going to happen. Where is the program going?

JOHNSON: You mentioned the crew escape and, of course, there was a difference in the suits after *Challenger* as before. So did those types of training issues come about pretty quickly or was that something that was later on down the road?

DUFFY: Right away the desire for a crew escape capability was addressed, and Aaron Cohen commissioned Bryan [D.] O'Connor to lead an effort to study different ways of getting crew escape incorporated into the Shuttle. They looked at everything. They looked at—and we've subsequently done it again, after *Columbia* [accident], but they looked at everything and decided that what we ended up with, was this like fireman's pole, escape pole, with these different suits, were probably the best that we could do, given the money that we had at the time and the design that we had. We probably could have, but we didn't, go redesign the vehicle and build a whole different vehicle. I'm sure it was because of costs.

JOHNSON: What were some of your first assignments?

DUFFY: I asked to go to SAIL [Shuttle Avionics Integration Laboratory] as my first, and that was after Christmas. The first six months, they didn't give us any technical assignments. It was just do your homework, study, learn. Then it was at about the six-month point where they assigned us jobs. Some people went down to the Cape [Canaveral, Florida] to become Cape Crusaders. Some folks did other things. I had recognized that the Shuttle was a software-intensive vehicle, and I thought the better I knew the software, the better off I would be. So I asked to go to SAIL, which is the Shuttle Avionics Integration Laboratory, where we did all the software testing for the vehicle. I guess I was doing that when *Challenger* happened.

Maybe about a month or so after *Challenger* happened, I got a new assignment from SAIL, even though I was just getting checked out on SAIL, where I was going to be of some use to them. I had had a flight safety background as a safety officer in the Air Force. One of my jobs in the Air Force was as a safety officer, and so Mr. Abbey basically said, "I'd like you to go to Huntsville [Alabama], to [NASA] Marshall [Space Flight Center] and be part of their process, their safety process and what they're doing. So that was what I did, and I did that for, I would say, quite a while, a year and a half or so, in slightly different capacities over time, but basically working at Marshall, up in Huntsville.

That was an interesting challenge, because I'm sure for the people at Marshall we were a little bit of a threat to them. On the other hand, we were their customer and the people they wanted to take care of so well, so it was a little difficult, I think, for them. So I went there and I believe some people would look at me—I'd roll into a meeting in my flight suit and I'd be a threat to them. However they really felt about it, I think some people felt that way. Not everyone felt that way, but some people did, and I don't blame them.

But I got there and I had a gentleman who was the head of their safety, reliability, and quality assurance outfit. He was an older gentleman. His name was Wiley [C.] Bunn, and he took me under his wing and made sure that I was involved in everything that he thought was important or he thought I might be interested in. He made sure that I was invited to the meetings and I had a place there. So he became a good friend and he was a great, almost a mentor for me while I'm in that role up at Marshall doing all this return-to-flight activity. He was a great man. We lost him a number of years ago, but he was a great guy. I don't know if anyone else has talked about Wiley Bunn at NASA. I wanted to get his name in there. He was dynamite, though.

So those were my jobs. Do you want me to continue, any other jobs?

JOHNSON: Sure.

DUFFY: Then, let's see. Different capacities for almost a year and a half, all the way up to return-to-flight, I was doing things associated with either the external tank or the Space Shuttle main engine or the solid rocket boosters. Those are all Marshall projects, so I was doing things at Huntsville, at Marshall.

I was one of two family escorts for the return-to-flight. [Richard N.] Dick Richards and I were the two family escorts for STS-26. That was a pretty intense time, but that was just a little temporary job thing, but it was very significant for me. It was a big deal, standing there with the wives and the children of the first crew after *Challenger* as they were launching. That was pretty tense.

JOHNSON: If you don't mind, just tell us a little bit about what your duties were.

DUFFY: It's not just for that flight, but for all missions we have what we call family escorts. The crew selects two astronauts who they and their families know. Not everyone knows everyone, but you have an idea who would be a good surrogate husband, who's a good stand-in, so these two astronauts do whatever is required to take care of the families. That includes going to their house the day they're going to the Cape, picking up the suitcases, putting them in the car, riding out to the plane, riding down with them on the plane, making sure either the transportation's there, the rental cars are there, whatever, getting them settled, going to the grocery store and

buying the diapers and the baby food and whatever is needed to get them back, because oftentimes the wives don't have the ability to travel around freely. They're under a lot of pressure, because when they get their families starting to arrive, they get tugged in lots of different directions.

So the escort makes sure they have everything they need, acts as the bad guy, if they have to, to protect the spouses from whoever they need to be protected from. Then you're with them on the roof, you travel with them, you stay in touch with them during the mission, you go back with them for the landings to wherever they're going. So you're like a family member when you're one of those family escorts. I did that a number of times.

JOHNSON: Creates quite a bond, I would imagine, with the family.

DUFFY: You do. You do. You get very close, yes. You share a lot with them, so it's good. Not as close as you get on a crew, because you've trained together for a year.

JOHNSON: If you don't mind, for a minute talk about some of the training you did as far as the STA, the Shuttle Training Aircraft.

DUFFY: Yes, that's great; because that's the best simulator we have for me, for who's eventually going to be landing the Shuttle. They start you out, introducing you to the whole system, how it works, what its strengths are and what its weaknesses are, because there are some weaknesses to it, things that you have to be careful of or you can get fooled, because the Orbiter will fly slightly

different than the STA, and if you expect it to fly like the STA, there are some areas where it doesn't.

We go out and they have a syllabus, a twenty-ride syllabus or some number of rides, and they step you through. They start out with real basic things and then gradually you work your way up to more and more difficult scenarios. It's very good. It's so good that even though I'd never flown the Space Shuttle, on my third mission, when I was the commander for the first time, and it's the middle of the night, three in the morning or something in Florida, we go through the whole entry, we roll out on final, and I looked out in front of me and I had the exact same scene in front of me that I'd had two thousand times before, because the training was that good. It was like I felt completely at home, like, "Oh, I've been here before."

So even though I was going to do something that—you know, landing Space Shuttle is a pretty big deal and I'd never done it before, I wasn't nervous, I wasn't excited or anything. It was just like, "Oh, yeah, you do it just like you trained." That's the way we do things, actually. Train hard and train right, and then when you go do it for real, whether it's launch or do a rendezvous or land or whatever, or do an EVA [Extravehicular Activity], even, if you trained right and then you just do it the way you trained, there's not a lot of pressure. As a matter of fact, there's hardly any pressure on you. You just do your job, do it the way you trained.

So that STA is a marvelous tool for getting us ready, because I never had a doubt. Sure enough, I found the vehicle was a little bit different. The Orbiter was just slightly different than the STA. Part of it is even your physical reaction, because when you go to train, let's say, a flight over to the Cape to go fly an STA mission, the night before, you got a good night's sleep. You get up that morning, had a nice breakfast and whatever it was. You feel 100 percent. You

feel perfectly great physiologically. You go fly, you fly to the place, fly your mission, ten approaches, fly home, and you're done.

Well, when you're coming back from space, you are not 100 percent. You might not have slept all that well the night before. You don't feel the same. You've got a G-suit [pressurized anti-gravity suit] that's squeezing the daylights out of you. Your fluid level is low. You're in a pressure suit; even though you've trained in them a few times, it's heavy. It wasn't heavy before. It's a lot heavier when you've been in space for a couple of weeks, when you're coming back.

So there's a lot of things that are different that make it more of a challenge to do it for real. So anything you can do to eliminate the other things that could distract you, which is what the STA does—all the visual cues are the same, even though your physiological cues are different—anything you can do helps make it safer for you. So the training is great. The STA is dynamite. It's the best tool we have, I think, for the pilots.

JOHNSON: Were there any other assignments during that time period?

DUFFY: I was at Huntsville. I was a family escort. Then I came off of that and they had me working with taking over from or with John [E.] Blaha and [Michael L.] Mike Coats, who had been working things called contingency aborts, and that is what do you do during an ascent if an awful lot of things go wrong. We didn't really have any great procedures for what to do. Like, in the case of *Challenger*, if all three main engines had shut down and the vehicle had at that point—say, it was a different kind of an accident; say the engines shut down or something, what would you do? We didn't have procedures for all these—we call them contingencies.

So we had these things called contingency aborts and we started working on developing the procedures for those contingency aborts, and that was actually tremendous fun for me. The answers weren't always good, like there were some regions where you say, "Well, you're going to die. If this happens, they're going to die. We can't help you. There's nothing we can do, and you just have to recognize that." Well, okay, what can we do so that doesn't happen?

What I did was I learned an awful lot about how the vehicle flies and reacts in all these different flight regimes, because we go from flying zero miles an hour, sitting on the launch pad, to flying 17,500 miles per hour in just a few minutes, eight and a half minutes, and along the way, you fly through a lot of different regimes of aerodynamics. So you have to learn what you can do and what you can't do with the vehicle and with the Orbiter in those different flight regimes.

How can you get to a point where you could bail out? Because now we had this bail-out system, but in order to be able to use it, you have to be essentially below 40,000 feet, subsonic, in controlled gliding flight. So you have to get from wherever you were during an ascent, where something bad happened, to subsonic, below 40,000 feet, in controlled gliding flight.

So there are a lot of things that you need to worry about, and this procedure development was just great, because I learned so much about how you do things. That meant so much later on, because I was so comfortable, even as the commander, where my crew is looking to me to be right all the time—all the time. I had the confidence and knew that I knew what I needed to know to do all of that stuff. So that job of developing these procedures, well, I probably did that for a year, year and a half. That was a great job. I learned a lot.

From there I went to Mission Control and I was a CapCom [Capsule Communicator], and, again, you learn a lot. You learn not the stuff that's going on inside the cockpit, but you

learn what's going on on the ground by being there. Then I worked a number of missions, trained with the crews and worked a number of missions. Then I got to go fly for my first time, finally, seven years later.

JOHNSON: During that time also you were a Technical Assistant for Flight Crew Operations?

DUFFY: Oh, yes. Where'd that fit in?

JOHNSON: 1987.

DUFFY: Yes, [19]'86, '87. It was after *Challenger*. Actually, I did that for quite a while. It was after *Challenger* happened, because [James D.] Jim Wetherbee was in that job before me and he was there during all of the *Challenger* activities, and then I took over from Jim, so it would have been toward the end of '86, I think.

For the next maybe year and a half or so, year, year and a half, I was George Abbey's technical assistant. We called it "the Bubba." I was George's Bubba for a while, and as far as my professional development was concerned, that was probably the job where I learned the most. He was a terrific mentor in that he introduced me to the people I needed to know and he taught me what I needed to know to interact at the higher levels of management, including dealing with the [United States] Congress and members of Congress and NASA Headquarters [Washington, D.C.] and senior industry executives. So I learned a lot.

There were times when I was just watching him in doing that and there were other times when he delegated stuff to me to go handle. He said, "I want you to go handle that. Just let me

know what happened.” So he trusted me to go make some decisions on his behalf in some of these meetings. So that was a real learning experience for me. It was in that time period there that I got to meet and know many of the people who would continue to lead NASA into the future, so personally that was good for me, because it got me the visibility that he wanted me to get. I’m not sure I sought it out, but it’s what he wanted. He thought, “You need to do this,” and so as a mentor, that’s what good mentors do, is they develop you. So he was really good at that.

JOHNSON: Did you ever have a chance to go back to SAIL?

DUFFY: Never went back to SAIL. Just had a very little bit of time in there, just enough to get checked out, and that was it and then it was all these other things.

Let’s see. Other jobs. Let’s see. I was a CapCom. That was really good. I really learned a lot there. Went off to fly; trained to fly. Oh, when I came off my first flight, they made me the lead Cape Crusader down at the Cape, so I did that for maybe a year, not a terribly long time down there. Not even a year, because I flew a year later. I might have done it for five or six months, because I had been assigned to my second flight the day we went into quarantine for my first flight. So I already knew when my second flight was going to be, and it was just a year later, fifteen months later.

So I did the Cape Crusader thing down at the Cape and then trained and flew again and then came off. So, summer of [19]’93. At that time there was a team that was pulling together—Space Station Freedom was being phased in and the new International Space Station was phasing in, and I got drafted by Mr. Abbey to come to Washington, which is up where he was, and it was him and [Daniel S.] Dan Goldin and [William M.] Bill Shepherd and [Douglas R.] Doug Cooke

and all of the early International Space Station team were all up in D.C., and they called me up and they said, "Here, you're done flying now. Come on. Get back to work."

So I spent the remainder of that summer and the early fall up in Washington, D.C., doing International Space Station things, right as the Russians were coming onboard. I went up there to help in some areas. [G.] David Low was brought up and David helped bring the Russians onboard in the very early days, when we were trying to figure out are the Russians of value and why should we bring them onboard and who should do what. So we were making those real fundamental decisions during that summer.

Then towards the end of that, my task became to move the International Space Station office to JSC out of Washington. So I had to come down and negotiate with people to get floor space and whatever support they needed. We just had to figure out, well, how are we going to do this; who are they going to be badged to, where are they going to live, who are they going to report to. There were just some fundamental things that we had to nail down, and it was in that fall of [19]'93 that we did that.

Mr. [Eugene F.] Kranz was not very happy with me, because I had to take some of his floor space over in Building 4. We looked everywhere for space and there was just some certain places that made sense to try to put an office. Unfortunately, his guys were there, so we had to boot them out. So he was not happy with me, but I don't think he still holds a grudge or anything. He would have preferred I went somewhere else, but that's the way it goes.

That's '93. Then I guess I was doing Space Station-related work for a while, maybe even through the next year as we were in the early design parts of it. Then I was assigned again to fly. Around in November of [19]'94, I was assigned and so I started working my crews. We flew in January of [19]'96, so that means in February I was back on the street. What did I do then? It's

funny how you come off of a flight, you know. Everything's a big deal in buildup to it, build up, build up, build up, and then the flights over. "Okay. Go get a job. Find something to do."

In my case, they always had something waiting for me. Now, in this case, let's see. We're in early '96 now. Mr. Abbey was the Center Director by this point and he had me come up on the ninth floor and be—I don't remember what it was called. Associate Director—

JOHNSON: Is that when you were the Technical Assistant Director?

DUFFY: Yes, Assistant Director, Technical. That's what it was, yes. So I did that for quite a while, a number of years doing that, and then off to fly for my last time, my last flight.

I came back from that and ended up on the ninth floor again, ended up after some time as the Acting Deputy Director of the Center. So I started out in SAIL and I ended up as the Acting Deputy Director of the Center and I flew four times in between.

JOHNSON: Let's go back to that first flight, STS-45. How did you find out you were assigned to that mission?

DUFFY: I think [Daniel C.] Dan Brandenstein had given me a heads-up. Dan was the Chief of the [Astronaut] Office at the time and he had given me kind of a heads-up that it was going to happen. He and I had had a discussion earlier about crew assignments and timing of things. It was to my advantage, actually, not to fly too early, because of the way things were working.

There used to be a policy that when you flew the first time, you got what we called a flight promotion, where you would, say, if you launched as a lieutenant colonel, you would land

as a colonel, essentially, that kind of thing; you'd get a one-rank promotion. My class was grandfathered underneath that. After *Challenger*—I think President [Ronald W.] Reagan had started it. After *Challenger*, the DoD [U.S. Department of Defense] had cancelled the policy. My group, because we had been selected prior to *Challenger*, was grandfathered. So we were going to be the last of the group where a military member would get a one-rank promotion, one-grade promotion, when you flew. I happened to know the way my promotions were falling in time, and so I had talked to Dan just to tell him, "Much as I want to fly right away, if it fits in your plan, it's to my advantage to fly a little later."

Then he had thought about it for a little bit and he had said, "Well, what do you think about something like this?" So I kind of had an idea. He says, "Will this work for you?"

And I said yes. His plan was perfect. So I ended up, I guess, being the last person to get a flight promotion, because I was the last person in my group to fly. It was actually okay with me, because it was going to work out in the long run. So I kind of knew that it was coming.

I didn't know who the whole crew was. I knew [Charles F.] Charlie Bolden [Jr.] was going to be the commander, and I was ecstatic with that, because he's great. I learned more about leadership from him than I have from any other single person in my life. So I was real lucky to be there, assigned to that crew.

JOHNSON: During the training process with that crew, can you go through some of the things that you trained for and how you trained together and some of the dynamics of the crew?

DUFFY: Sure. We were going to be a science mission. It was called ATLAS 1 [Atmospheric Laboratory for Applications and Science]. We had a number of payloads, like in the mid teens,

payloads in the payload bay that we would control either with special panels that are hardwired to the experiments or using software on the computers to turn things on and off. It was going to be a twenty-four-hour operation, so we were split into two crews. We were a crew of seven, so we split into two groups of three, a red team and a blue team, and Charlie kind of split the difference so he could float in between the two.

So we trained for the ascent and entry part as a group, because you do those things together. Then a lot of the other training was done just with our smaller sub teams, the red team or the blue team, for all of the payload activities. So I had a role, and my role was primarily to point the Orbiter, have it pointing in the right place at the right time so that when, say, [Kathryn D.] Kathy Sullivan or Dirk [D. Frimout], who was our payload specialist on the flight, when it was time for them to operate the instruments, the instruments were pointed at what they were supposed to see.

So there was a coordination effort that we had to learn to do, and the other crew did the same; that was [David C.] Dave Leestma, Byron [K.] Lichtenberg, and [C. Michael] Mike Foale. So we kind of complemented each other, but we operated pretty much separately for on-orbit ops [operations] and then we worked together for the up and the down part.

JOHNSON: Was there any criteria that separated you into teams?

DUFFY: You did what the commander told you to do. Charlie decided.

JOHNSON: Charlie Bolden was the criteria.

DUFFY: Charlie Bolden decided. He said, “Brian, you’re flying the Orbiter on,” whatever shift I was on—I think I was on the blue shift—and he said, “Dave,” Leestma, “you’re flying the Orbiter on the red shift, and you other guys,” Kathy and Dirk and Mike and Byron would work the instruments. We just did what Charlie told us. But it was a logical breakdown. Dave was a good operator and that was what I had done, been an operator in the past.

JOHNSON: You had a couple of payload specialists and a payload commander on that flight. How was the payload specialist-astronaut relationship at that time?

DUFFY: It depended on the individual, on both sides. I thought it went okay. It wasn’t frictionless. It wasn’t friction-free by any means, and there were some times when Charlie had to make sure things were smooth and that feathers weren’t ruffled. But for the most part, I thought it was fine. I never had any particular problem with it and I thought things were okay, but there was the occasional incident or two where people get a little crosswise with each other.

JOHNSON: Let’s talk about the launch for the first time. You mentioned the simulator was really good on your first landing as commander.

DUFFY: Right.

JOHNSON: The simulations for the launch, did—

DUFFY: I thought the sims [simulations] for the launch were great. I was absolutely impressed with the power of the launch. As a matter of fact, I was really impressed with just how much raw power there is in that vehicle. But there weren't really any surprises. I guess I had talked to enough people about the launch process and what it's like and what it feels like, and I've seen enough of them from sitting there on the ground watching it and I could just picture myself in that, you know, what was going on inside, but you can't feel it until you do it. You can think about what it might be like, but you don't actually physically feel it until you go do it.

The simulator is great in that it can give you vibration and some little sense of motion, but it doesn't give you that acceleration—it can't—that you get for real. I had flown Mach 2 in an F-15 in my career many, many times and had thought that had been pretty fast, and we blew through Mach 2 in nothing flat and we still had a long way to go to accelerate. So I was most impressed with just the amount of power, the raw power, and as a result, the acceleration that you had, because you just kept going and going and going. You're going faster and faster, and even though you don't have a good visual reference to see anything and compare it, you just know you're going fast, because mentally you're integrating all this acceleration. You're looking at your acceleration tape that's just zinging, going by, and it's just amazing. Those last couple minutes, particularly the last minute, you're averaging three Gs, you're accelerating, which is nearly 100 feet per second per second, so every ten seconds that goes by, you're going 1,000 feet per second, faster than you were ten seconds ago. It's awesome. It absolutely blows you away.

Then the engines cut off and you go from what I've described as like the most violent place you've ever been in your life, to the most peaceful place you've ever been in your life, in a couple of seconds. It's a real interesting little transition, when the engines shut off and all the

thrust stops, and all of a sudden you're free-floating. Everything's quiet. It's interesting how it happens, and every time I was equally impressed. Even the fourth time, I just went, "Wow. I forgot how much power there is." It's awesome, it really is.

JOHNSON: What were some of your responsibilities as soon as you got to that point of weightlessness?

DUFFY: The first hour and a half or so you spend turning this rocketship that you rode into the vehicle that you're—in our case, it was going to be a laboratory that we were going to use to do all of these experiments. So you safely shut down all of the systems that were operating that you're not going to need until entry. Then you reconfigure the cockpit. You fold up some of the chairs, the mission specialist chairs, they detach from the floor, and you fold them up and you stow them out of the way. You start powering up things that you're going to need during the mission that weren't powered during ascent. So it takes a while to do all of that, reconfigure the computers to the on-orbit configuration. It takes a while to do that. I was primary for some of them and backing up on some other tasks.

JOHNSON: You mentioned your primary responsibility was making sure that the Orbiter was in the right position.

DUFFY: During the mission, yes.

JOHNSON: During the actual experiments. Did you have any other type of responsibilities with the experiments?

DUFFY: Oh, there are always little things that you do, but I wasn't a primary operator of the instrument; I was a helper in ways. I wasn't the prime, but it was my job to have the Orbiter in the proper attitude at the right time.

JOHNSON: This was a historic flight scientifically because of the first ATLAS, the first Mission to Planet Earth flight.

DUFFY: Right.

JOHNSON: Do you have any thoughts on that?

DUFFY: Yes, I actually became more of a—I came to appreciate environmental concerns more. I'm still not a tree-hugger or anything like that, but you can't help but realize just like how thin the atmosphere is, for example, when you look out and you see it edge-on, and it's just like that [gestures]. You can block it out with the width of your thumb. So you really do have a sense that, wow, this is a small planet. And it is small; you go around it in an hour and a half. It takes longer to drive across Houston in rush hour than it does for us to orbit the Earth. So it's not that big and it's what allows all of humanity to exist, so we collectively have to take care of this little ecosystem that we have, because it's pretty fragile. So while I'm not a tree-hugger, I recognize that it's important that we take care of it.

I think some—well, I'm not sure they're scientists. Some people take the fact that the Earth's climate changes, is changing in a certain way or another, and they attribute the changes to us, something that we did, as if the Earth would have been static had we not been here or whatever, and that's not at all true when you look back in history. So that's why I'm not a big tree-hugger kind of person, because I don't necessarily believe that we are influencing the changes that we're observing. Are the changes real? Sure they are, but are they caused by us? Not necessarily. So I temper my environmental awareness with, you know, there's some reality here. I think we're not as important as some people think we are. Like George Carlin says, the Earth's going shake us off like a bad case of fleas. [Laughs]

JOHNSON: That's interesting. I've never heard that one before.

DUFFY: You haven't heard George's talk about it? He says, well, we're just—you know, people are complaining about us destroying—I think that's the way he puts it, we're destroying the Earth. "We're not destroying the Earth. The Earth's going to shake us off like a bad case of fleas," and he might be right.

JOHNSON: He may be.

DUFFY: He might be right. So anyhow, it was a big mission and I was happy to be part of it. I think here now, twelve years later, I think they're still reducing data from that mission. We collected tons of data.

JOHNSON: It was the first of, I think, of eleven-year—was it the sunspot cycle?

DUFFY: The solar cycle, yes.

JOHNSON: The solar cycle.

DUFFY: Yes, right. The sun cycle.

JOHNSON: I imagine they are still collecting that.

DUFFY: Yes, they probably are.

JOHNSON: The Shuttle Amateur Radio Experiment.

DUFFY: SAREX.

JOHNSON: Did you have a chance to participate in that?

DUFFY: Yes, I did. I got my license before. We had to have two licensed operators onboard, one on each shift, in order to be legal, to be able to use the radio, so Dave Leestma got his and I got mine so we could do that. That was really a lot of fun.

That ended up being one of the neater things for me for a couple of reasons. One day was kind of neat. I got patched. We were flying over Australia, and this was all prearranged. We

talked to a station on the ground in Australia and they were tied to the amateur radio shack out here at JSC, who patched me to my wife sitting at our kitchen table, so I was flying over Australia in space, talking to Jan in Seabrook, sitting in El Lago there, at our house. She was sitting at our kitchen table talking to me. So that was a neat experience.

Then over that week sometime, they had a school contact scheduled and we talked to Ed White [Elementary School, El Lago, Texas], where both my children were going to school at that time, and I found out there that my son got on the radio and I learned that he, in secret, had gotten his amateur radio license, without me knowing about it, so that he was KB5SIY, that's his call sign, so he completely surprised me with that. And that's a very technical thing to get and he was in like fourth or fifth grade. Of course, he ended up going to MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts], so I guess that was probably a hint that he was inclined to do that kind of thing.

JOHNSON: That was an early sign.

DUFFY: Yes. So that was really neat, but SAREX was great. I really enjoyed using it. It helped me really feel connected to normal life down here on the planet, because you can't see people from up there. You can see cities and highways and things like that, but it looks uninhabited, other than the buildings and things.

JOHNSON: Just a reminder that there are people.

DUFFY: Yes. So it was nice to do that, and to be able to stay in personal contact with my family. That was really special.

JOHNSON: What kind of questions did people ask you?

DUFFY: Over the radio?

JOHNSON: Yes, over the radio.

DUFFY: A lot of times they just want to talk to you just to put you in their log book. Big amateur radio buffs, they keep books on who they've talked to and where, and so talking to a spaceship is a big deal to them. So a lot of it is just they say, "Hello," and then, "Thank you," and they sign off and they let somebody else get on. They're a very accommodating community. They're very professional in the way they deal with you. But sometimes if you have a contact with a school or something, you get the normal kid questions. "What's it like in space?" and "What does it feel like at liftoff?" and the usual kind of questions.

JOHNSON: You landed at [NASA] Kennedy [Space Center, Florida]. As a pilot, what were your duties during landing? And describe that landing for us, if you will.

DUFFY: I'll talk about the entry a little bit, because the entry surprised me. I talked about the ascent did not surprise me; the entry surprised me. I don't know if I just wasn't listening or I just didn't understand. I clearly didn't understand; whether I'd heard it before or not, I didn't know.

But we were coming back in, we'd been up for nine days, and coming back in, pretty much all at night, because we were going to land just after dawn in Florida, so the whole thing was in the dark, pretty much.

We came in and, similar to the simulator, the outside you get this glow, which is all this hot gas surrounding the Orbiter as you're coming in during entry. Unlike the simulator, however, I looked out and I had little embers of things going by my window, and I remember looking over at Charlie and saying, "I hope that's not important."

He chuckled a little bit and said, "No."

A little bit later, I looked down at the nose cap on the Orbiter and it was like carnation pink. You know, it's normally a black carbon-carbon material. It was carnation pink and we're surrounded by orange and yellow fire that's alive and moving, and Charlie's over there, he's got his arms crossed, just watching the Orbiter fly and the needles coming in, and I said, "Bolden, you didn't tell me about this," because all of this other stuff going on, or that you don't see in the simulator. In the simulator, the window changes color, gets brighter, and then it goes back to black. It's not like that in the real world. So there were some surprises there.

The biggest surprise, however, was physically, and I think part of it was because, in my case, it was the first time in which I'd gone to extended weightlessness to now back into the G field, into gravity, and it's not just to 1-G; it's to 1.4 or 5-Gs and it's sustained for a long period of time, and you're coming in at a forty-degree angle, so the drag is this way, [gestures] so what happens is you're going down and forward. So I actually had to put my hand on the glare shield and hold my torso up to keep it from slumping down and forward during the entry, and I don't think anyone ever told me about that. I had to learn this myself. Not that it's that big a deal, but it was a surprise.

And also, physically you're working a lot harder. That G-suit's squeezing you, as I mentioned earlier. Your blood level is a little low so your heart's having to beat faster, so you're sweating. You feel like you're working out, actually. There are a lot of physiological changes that you're going through. So I was surprised by that on my first flight.

But my job then was to help Charlie watch the Orbiter fly the approach around to line up with the runway, and once Charlie was down on final, I'm kind of supposed to be his backup for this whole thing. Then once he's coming down, I just kind of verify that, yes, we're aiming at the right point, and that we're doing the things that we're supposed to be doing. Earlier on, I had started the hydraulic power units to get the hydraulic power we were going to need, both for the flight controls and to be able to put the landing gear down and the breaks to stop.

Then other than that, I just help Charlie fly the approach verbally; I don't touch anything until it's time to put the gear down and then I lower the landing gear. Then I'm calling altitudes and air speeds to him as we're coming in for the final approach, because a lot of things are happening very quickly and we have a certain cadence that we like to get in, 20-220, 10-210, 5-205. You're talking about air speed, feet. Twenty feet—we have a radar altimeter that tells us where we are that does a pretty good job, and so I'm calling off altitudes and air speeds to him and he's flying based on what I'm telling and what he's seeing, to land.

Then once we're down—at the time we didn't have a drag chute. We did on my second flight, but we did not, so he flew the nose down. Then I just called the decel rate that we were braking at to come to a stop. I didn't play a big part in it, other than I was helping him, and I was there to be the redundant system in case something happened to him, prepared to take over should it be required.

JOHNSON: After the flight, the crew was actually removed on gurneys instead of coming out on your own. Was this for the medical?

DUFFY: Maybe one or two of them might have been. Those are things they call DSOs, detailed supplementary objectives, or something like that. Those are things we sign up for ahead of time. They're voluntary and sometimes they only want one or two subjects; they don't want everybody. Yes, now that you mention it. I'd kind of forgotten that. I think one or two of the crewmembers did do that. It was because they wanted to try to preserve as much as they could, they wanted to be able to observe the recovery to 1-G from zero-G and, of course, even that way is not completely accurate, because even though you might be lying down, you're still lying down in 1-G, so there's some gravity things involved. I had forgotten that. There's probably a lot I've forgotten over the years, a lot of the details.

JOHNSON: Also, before the flight, Charlie Bolden brought in a psychiatrist to conduct psychological profiling of the crewmembers.

DUFFY: Yes, and the families.

JOHNSON: And the families, so that you would understand how each other operates.

DUFFY: Right.

JOHNSON: Since you flew other times without that, do you feel like that really helped?

DUFFY: I thought it was a good thing to do, particularly for a first-time flyer, and it was a little bit of support for my wife as well, so I thought that was good. It's not a lot different than the way things are done nowadays in different ways. Like this whole Myers-Briggs personality assessment. You know, the whole reason for doing that is to understand your tendencies, the things you're most likely to do and the way you're most likely to act, and then understand that other people are wired differently and have other different tendencies.

I've thought about that, actually, that this Myers-Briggs stuff that we're doing nowadays in management is not that different than what Charlie had us do back then. It just was called something different, and instead of taking a standardized test, it was done almost individually, one-on-one kind of thing, but the same idea. I thought it was a good idea. If nothing else, it makes people more aware that, hey, people have different needs than you do, they think differently than you do, they have different priorities than you do, they're going to react differently. So, yes, it was good.

JOHNSON: What do you think was your biggest challenge as a crew on that flight?

DUFFY: My first flight? Let's see. We weren't that experienced as a group. I had never flown. Foale had never flown. Dirk had never flown. Byron had flown once as a PS [payload specialist], in a different role. So that left Charlie and Kathy had flown. I don't know if she had flown once or twice at that point, but Charlie had flown twice. But we didn't have a lot of experience, so we just needed to be careful about not making rookie mistakes, not making

mistakes from inexperience, and that was a challenge, was to pay attention to the detail, trust the procedures, trust the training, to do what you were trained to do.

On orbit I don't recall that we had any particular big challenges. We had a good time. I loved it. I was just blown away by what I saw up there, flying through the aurora. On that mission, our launch time was timed so that every time we got to the southernmost point of our orbit, and we were in a 57-degree orbit, it would be local midnight. It would be midnight at that particular point, and then the next orbit, the Earth would have rotated some and we'd come back around and it would be midnight again at that place. So we were seeing the dark—when we were in the southern hemisphere, it was dark, dark down there and it was just unbelievable. I never got tired of looking at it. In the daylight it's beautiful in a different way, the colors and the different land masses that we got to see.

I fell in love with geography. I love it, and geology, because you get to see things from a regional perspective when you're up there, when you can see a thousand miles in either direction, you see large-scale things and it's really neat. It changes your perspective.

JOHNSON: I imagine so. After the flight, did you go on any of the post-flight trips?

DUFFY: I'm trying to remember. I know one extremely memorable one. We were invited to Belgium at the invitation of the King and Queen of Belgium, and we went on the most royal, wonderful trip to Belgium that I could imagine, where we were just treated like royalty. It was so nice. Well, it was nice for the spouses, too, because they don't get the rewards that we get when we fly. We get the personal reward of having been there and done it, seen it, and experienced it, and they don't get that; they get the pain of the launch and the relatives and all of

that stuff. My wife doesn't sleep very well when I'm off the planet, she says. So she needs to be rewarded, too, in some way, and this was a great way to do it. I think it was about eight or nine days over in Belgium that was out of this world.

JOHNSON: I read that you went along with Charlie Bolden and David Leestma to Hollywood to return an Oscar [Academy Award].

DUFFY: Yes, we did. We flew an Oscar on the flight. We went out—I don't remember if we carried it with us or if we just went out to present it, but it was really Charlie's show. It was his deal, and the rest of us just went along for the ride and to enjoy it. But that was fun. We had done a presentation where we actually presented the Oscar on the Academy Awards show from space. We did a crew event with the Oscar there, and that was fun. I'd forgotten about that one, too. I guess I should write all this down. That's why we're doing all this.

JOHNSON: [Laughs] You'll have it.

DUFFY: That's why we're doing all this. It's amazing what you forget over time.

JOHNSON: That's right. It will be written down for you.

Did you also take a trip back to your hometown?

DUFFY: I did. You can only imagine, my town's pretty much a blue-collar town, where I grew up, outside of Boston, and, first, my being selected in the program was huge and it was a great

boost for the school system, because I had gone through the public school system there. So all of a sudden they can say, “Here’s a product of our schools. This is what you can become,” as a motivator for the kids, which I thought was great to be able to do that.

But they made a welcome home, a big celebration. They had a parade for me. I rode in this big parade. It was fun. It was a big deal. Then I went down to the football stadium and I addressed the crowd down there, so it was neat. I was happy for the town, because they were so happy, because no other town around there had anything like this ever. So they were feeling pretty good, they were feeling pretty proud. So when you can do that for people, that makes you feel good.

JOHNSON: When did you learn about your next assignment?

DUFFY: Let’s see. My next flight?

JOHNSON: Yes.

DUFFY: The day I went into quarantine for my first flight, actually, and all I could think of at the time was, “Jeez, I sure hope I like this, because I just signed up for two of them.” [Laughs] It turned out I really do, I love it. Particularly the flying part was great.

So, going into quarantine, I knew, that day, whatever day it was, back in March of [19]’92, I knew I was going to fly on [STS-] 57, which was great, because I was all pumped up, ready to go. I knew I’d be freshly trained, I’d know everything I needed to know, I’d have the experience from the first flight I could use on my second, which turned out to be real beneficial.

JOHNSON: So you just went right into the training for 57?

DUFFY: Well, I went down to the Cape as a Cape Crusader for a few months down there.

JOHNSON: Describe that for us, if you will.

DUFFY: Going down to the Cape?

JOHNSON: Yes.

DUFFY: Well, it's great. Every time I go to Florida, good things happen, so I always loved going down there. It's a very special place. There's no other place like it in the world, where you get all this huge, high-tech rocketships and things, and then you've got alligators crossing the street, and snakes and eagles and everything co-existing right there, a beautiful beach. I always enjoyed Florida, so going down and being part of the support team, which is what you are down there, that help other missions, when you're not flying, you're always helping in some way, even if you're in a management job. You're helping support the following crews, and being down there as a Cape Crusader, you're helping also. So I liked doing that; it was fun. All we did was help get the Orbiter ready for launch, followed it through its checkout while they were getting it ready, keep the crew apprised of any problems that they were having getting the vehicle ready so they're aware of them.

Because when you launch, generally you don't launch with a perfect vehicle; you launch with, "Well, this is wrong with it. Expect to see this, and that's wrong." Nothing critical, but there's this little short list of things that aren't working. It's not any different than every time I flew an F-15, before you take off—or even a T-38, for that matter—you'd look at the aircraft forms ahead of time and in there are the gripes that are written up, the discrepancies that have been written up, documented by other people. If maintenance action was taken, they write in what they did to fix it and who checked it to make sure that it was done right. So there are things that are always wrong, and so as C², we followed those things, made sure the crew was aware of them so there weren't any surprises.

Then we got the vehicle ready when they rolled out to the pad, we'd help go through the countdown, turn on all the radios, check them all out, do everything, so that when the crew comes out to the vehicle, all they do is get in, get strapped in, and go, because everything else has been done. So that was fun. I liked that, being in Florida, going to Florida. It was a great experience.

JOHNSON: Did your family get to go back down with you for any of that time period?

DUFFY: I don't think so. Not during that time frame. They'd been down on one launch and they were coming down for the next one, so I don't think they did that.

JOHNSON: I think before we start STS-57, if we go ahead and take a break and let Rebecca change the tape.

DUFFY: Sure.

JOHNSON: You mentioned that you found out about your assignment for STS-57 and you went down and you worked at the Cape for a while and then you came back to begin training.

DUFFY: Right.

JOHNSON: Tell us a little bit about that flight and what the mission was about and what your training entailed.

DUFFY: Slightly different than my previous flight in a couple of ways. One was we had a lab module. It was the first flight of the SPACEHAB module, so we had to do the things that you have to do when you're following the first flight of anything. It was being manufactured down in Florida, right outside the Kennedy gates there, and so we'd go down there and follow the progress of it. As they were doing tests, we sometimes participated in the actual tests of the lab module itself. While that was going on, we had to learn about fifty different experiments that were going to be inside the lab, and those were divided up amongst the crewmembers and who was going to do what.

On top of all that part of it, we were going to rendezvous with the EURECA [European Retrieval Carrier] satellite, the European science satellite. It had been in orbit for a year, been dropped off by STS-46 the year prior, and it was done doing its science and we were going to rendezvous with it and grab it with the arm and stick it in the bay and bring it home. Essentially that was the mission, so it was slightly different than my first one. The up and the down part's

the same. Ascent and entry doesn't change very much, except our orbit was different. We were in a low-inclination orbit instead on 57.

We had [Ronald J.] Ron Grabe as the commander, and Ron had flown a number of times. I think this was his fourth flight, second or third as the commander. I'd have to go look at the record. I used to know all that. David Low was flying. He was our payload commander, so he was kind of in charge of that stuff, and our lead space walker, because we also had an EVA planned for the flight. [Peter J. K.] Jeff Wisoff was a first-time flyer, and Jeff was going to be EV-2. Nancy—she was Nancy Sherlock at the time—Nancy [J.] Currie was our MS-2, mission specialist-2, our flight engineer, and it was her first flight. Janice [E.] Voss was going to be one of our payload operators as well, and it was her first flight.

So again, we had another flight with some inexperience on it. We had Ron kind of carrying the ball. Particularly in the training, he was just really good about knowing what was important for us, what we needed to know, what we should focus on. Because I'd never been involved in EVA, I'd never done a rendezvous, so there were some things I didn't know, so I was watching and learning as we went. Fortunately, it helped me a whole lot later on, because on all my other missions I did rendezvous and did EVAs, so this was a good start.

So the mission was mostly the science stuff. One day was an EVA, one day was the rendezvous, and the majority of time was working science things, experiments. I became the first person to solder in space. We had a soldering experiment, which was kind of fun doing that, seeing how solder works in zero-G as opposed to in 1-G, and can you repair electronics up there. There were some fundamental reasons for doing it, not just for yucks, you know.

JOHNSON: You mentioned the EURECA satellite and your first experience to rendezvous with a satellite. If you can describe that experience and what responsibilities you had during that.

DUFFY: Yes, I almost blew it on Ron. He had to save it. We were in the final part of the rendezvous. We'd done all of the things that you have to do to get to the rendezvous, and this is a zero-G kind of a problem, because in zero-G, if you push on something, it pushes back, and during this rendezvous at this one fairly critical point, I don't know how far away we were, maybe one to two thousand feet away from the EURECA, I was supposed to change the digital autopilot, the DAP, manually by typing in a value into the computer. I think I was supposed to change some value from whatever it was to 0.5, and the keyboard that you punch into, the numbers are spring-loaded, they kind of push back, and apparently I didn't bottom out the decimal point, so I put in like .5 [point five] and it went in as 5 [five]. So when he put an input into the controller, he got ten times the response that he expected.

We instantly recognized what the problem was and what had happened, and Ron made just a fabulous recovery from that; never said a word about it. It was obvious to everybody what had happened. I felt badly about it and I apologized. He basically said, "Hey, we got it. Don't worry about it." But still, it was an event that happened that wasn't planned, and he made a real dynamite recovery from it. So that's what I was doing in there. I was messing up the DAP while he was flying a rendezvous. [Laughs]

During the [rendezvous], I didn't have much more to do. Ron was flying the rendezvous. All I was doing was backing him up, after that, watching. And the EVA, I was running the EVA from inside. I was the IV crewmember, the intravehicular crewmember, while David and Jeff

were outside. So I ran their time line and talked to them, told them what tools they were going to need and what settings to put them on and walked our way through all of that.

Then we had to do a little improvising on the EURECA. The solar arrays, they were supposed to have a latched indication and they didn't have it, so we took the opportunity and went EVA. It was already in the bay and then the EVA was the next day and David was going to go out and get on the end of the arm and have Nancy fly him out where he could then physically push on the solar array to get them to compact so that the latching mechanism would work. So we had to kind of make that one up on the fly. Not that it's a big deal, but it was something that we hadn't trained for or thought about.

JOHNSON: How do you think the training prepared you for those types of incidences when, as you mentioned before—

DUFFY: I think we felt quite well prepared for not only the normal things that would happen, but if something went wrong. We felt we were pretty well prepared.

JOHNSON: Did you train for the IVA crewmember in the tank before the mission?

DUFFY: Lots, yes. Yes, we did. We were in there quite a bit trying to get things ready. The NBL [Neutral Buoyancy Lab, Sonny Carter Training Facility] was just opened. We were doing some of the early training in there, if I remember right. No, I take that—were we in the NBL or were we still in the WETF [Weightless Environmental Training Facility]? We might have been in the WETF still. I'm trying to picture the control room, because those guys would be in the

water and I'm in this control room looking at checklists and a camera view. We were over in the WETF at the time. The NBL wasn't built yet, I guess, for this flight.

So we spent a lot of time over there, and a lot of time just table-topping things; not even in the pool, but just sitting around the table talking through time lines, coming up with decision points. "Okay, if we're at this point at this many minutes into the EVA, we should have been here. If we're this far behind, then what are we going to do? Are we going to take these other tasks that were scheduled for downstream? We're not going to do those; we're going to move this other thing in." So we kind of talked through the alternative things that we would do, the alternative time lines if things didn't go the way we wanted them to.

That's kind of the way we trained for a flight. You get to the point where you can pound the normal stuff flat, that it's just easy to do, and then you concentrate on the "what if" scenarios. What if this goes wrong? What if that goes wrong? What are we going to do? Because you want to be as prepared as you possibly can. And we did that a lot, because the EVA was a big deal for us, the biggest thing that Jeff and David had ever done or were going to do up to that point in their careers.

JOHNSON: It was a first for both of them?

DUFFY: Yes. Yes, neither one of them had done one, so it was a big deal.

An interesting thing happened while we were up there. I remember we were in this attitude, kind of belly forward, flying like that, and the four of us were on the flight deck. Jeff and David were outside. And all of a sudden it was as if somebody took the Orbiter and hit it with a bulldozer or something. The whole vehicle just went "thungg." It just shook.

It got quiet on the flight deck and we just looked at each other and looked at Ron, and Ron looked at me, and Nancy was there on the flying arm. We thought, well, what was that? We looked around and we thought, well, maybe we were hit by something. We looked outside and didn't see any damage. Nothing came flying through the wings or through the payload bay or anything.

After a while we said, "Well, maybe we ought to tell the ground about this." [Laughs] And we tried to figure out the diplomatic way to tell the ground that, "Hey, we felt like we got hit by something," because the whole vehicle just shook like somebody picked it up and went "wham!"

We told them about it and they came back a little while later and they said, "Well, we looked at all the data. We don't see anything. We think what might have happened is there's a tunnel—" the tunnel that goes from the mid deck back to the lab module. They were thinking maybe—it has supports to hold it in place during 1-G and during launch, for launch and entry, and they said, "We think maybe some residual forces that were built up on the ground just released, something released and it rang the whole vehicle." But that really got our attention. [Laughs]

JOHNSON: Did the two outside know what had happened?

DUFFY: They never knew anything. We asked them afterwards, we said, "Hey, did you happen to notice anything?"

And they said, "What?" No, they didn't have a clue. If they'd looked inside at that time, though, they would have seen eight big eyes like, "Whoa! What was that?"

JOHNSON: Get the hearts racing. [Laughs]

DUFFY: Yes, I mean, everyone just stopped, like, “What was that?”

JOHNSON: Not one of the noises you expect to hear.

DUFFY: It’s not a normal event. We had some other abnormal things during entry, too, that we can get to eventually.

JOHNSON: Were there any other experiments or anything that you can remember on that flight that you took part in that were memorable?

DUFFY: Some that I liked or some that I—there were some that I really despised. They were like Science Fair projects. We were not happy to be doing them. We thought this is the dumbest thing we’ve ever seen, but we were more or less ordered to do them, so we had to do them. But there were some good ones. We were growing some cancer cells just for research purposes, try to see how cancer cells and tumors would grow in zero-G, and ultimately there could possibly be a market for something like that, where in weightlessness you can grow things in three dimensions. Like take the cancer cells and grow tumors so that you can bring them back and do research on them, try medicines and try techniques and whatever. That’s a pretty painless way to get a tumor as opposed to having to grow one in a human and try things. So there were some neat things that we were doing as well; protein crystal growth kind of experiments for research,

again, medical research. The soldering thing I told you about that I was monkeying around with. That was kind of fun. But they were good. But I think their total was over fifty different experiments that we had onboard, so it was interesting.

JOHNSON: It was successful mission.

DUFFY: Across the broad range. Yes, it was successful, very successful. We came close to losing some of them, because the Orbiter *Endeavor* had a cooling problem on the runway and we came within minutes of having to do some sort of emergency powerdown on the runway, but again, Ron Grabe kind of worked through the problem and worked with the ground very closely and got that all squared away, so we kind of saved the day right at the very end.

JOHNSON: You mentioned that at the entry, there were some unusual things on that.

DUFFY: Yes, yes. My entry on the first flight had been, as I mentioned, all at night. It had been ascending coming over—I guess across Mexico, up across the Gulf by Fort Myers [Florida], and we kind of hung a right and took it out over Orlando [Florida] and then around over to KSC. This one was a flatter, lower trajectory. We were coming across Mexico, kind of northern Mexico, basically, and it was across Baja, across northern Mexico and then across the Gulf, coming in almost due east, more or less, and it was sometime in the morning, after sunrise in the morning, not sure the exact time; maybe mid-morning time frame; summer, so hot.

There'd been a lot of heating going on during the course of the day, down low, from the sun beating on it. We were coming in during entry. Everything's going smoothly, hunky-dory,

and we're about Mach—I don't remember, Mach 22 or Mach 21, something like that, slowing down, and we got one of these events where it was like somebody took the rear end of the Orbiter and just rang it. Just went "wham!" It was like we hit a speed bump or something in a parking lot. Like "boom!" We didn't think anything about it. About thirty seconds later, sometime later, another one. "Boom!"

Well, Nancy told us later, she said she was sitting there and—the simulator doesn't do this. She said we hit the first one and she looked up front and Ron and I just continued looking straight ahead, so she just kind of went, "Well, I guess that's what it's supposed to be like." She's thinking, "I'm just a rookie. I've never done this before." After the second one, Ron looks over at me and he says, "Have you ever felt that before?"

And I said, "N-no."

And Nancy said her eyes got about that big at that point like, "Whoa! What's going on here?"

They call them density sheers. Even up at a very high altitude, above 200,000 feet, there are these different air masses, just like you have warm fronts and cold fronts and things you see on the weather map down here. Well, those things extend up at a high altitude and when you're going very fast and you change from one to the other, you get an instantaneous notification that you're somewhere else. [Laughs] And it really gets your attention, because it's "brrroom!" It's like somebody really picks it up and shakes the whole Orbiter. The whole vehicle rings, because the vehicle's not very sturdy. It looks like this big massive, sturdy thing. It's about as stiff as a Twinkie, and truth be known, during ascent you can actually feel it flexing. It's not just made of I-beams of steel or whatever.

Anyhow, we had these funny events during entry and Nancy said the first one didn't bother her, but when Ron asked me if I'd ever felt—and here he is on his fourth flight, “Have you ever felt this before?”

“No.” She said that got her attention. She'll tell you that story from her perspective.

JOHNSON: As far as this mission, were there any specific challenges or any other memories that you'd like to share about the mission itself?

DUFFY: I made just some tremendous friendships. Of course, you do that on all these flights, but just made some tremendous friendships. I just had Jeff Wisoff and Tammy [Wisoff] at my house weekend before last. They were visiting from Colorado; they came down with their little two-year-old. So you form these bonds that are tight, like forever.

In the business world now, I occasionally run into David Low over there. It's like we're brothers or something. We see each other from time to time, but you kind of pick right up where you left off and it's fun.

So I made some really good friendships there. I haven't crossed paths so much like with Ron lately. I used to see Janice pretty regularly, Janice Voss, and Nancy once in a while. But there's some great memories. Nancy and I were on the flight deck one night, I remember. We were only the second flight to actually waive off for two consecutive days and not land until the third day, and that was a whole interesting experience doing all of that. But there was one of these waive-off nights, where we're waiting to go to bed, basically hanging out, and she and I were upstairs, turned all the lights out on the flight deck and the two of us just sat there and

floated in the window and watched the Earth going by, in the dark, you know, watched the dark side. It was pretty neat. Lots of memories like that.

JOHNSON: Having that extra time, did you have more time to observe—

DUFFY: We did, yes. Yes, and I just ate it up. I loved it. Yes. Looking at the Earth, I never got tired of it.

JOHNSON: Did you do any of the photography?

DUFFY: Oh, of course. Yes, but by that point, you kind of budget your film so that on landing day, you're done; you use all your film up. Well, we had two more days. We had passed the landing day so we had shot all the film early. So we didn't even have film to shoot, so we just got to look and just enjoy it. It was really cool.

JOHNSON: Is there anything else about those first two flights or anything we've talked about so far that you'd like to add?

DUFFY: No, I think what I saw, if I could summarize them, what I saw was two different but very effective styles of leadership, with Charlie in the way that he led people and Ron in the way he led his crew. I learned a lot from both of them in different aspects, places where Charlie has his strengths and places where Ron has his strengths, so I felt really lucky to have had those two

commanders on my first two flights, because I really learned a lot from them. They're both very talented in different ways and I extracted from those experiences things that I would use later.

JOHNSON: You learned as far as—when you became a commander, you took from both of them.

DUFFY: What to do, what not to do, things like that.

JOHNSON: Well, if you don't mind, we'll stop for today and get you out of here in time to go do what you need to do.

DUFFY: That's great, yes. Thanks.

[End of interview]