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CHARLES D. WALKER
INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is March 17th, 2005. This oral history with Charlie Walker is being conducted for the Johnson Space Center Oral History Project in Washington, D.C. at NASA Headquarters. Jennifer Ross-Nazzal is the interviewer, assisted by Sandra Johnson. This is Mr. Walker's second oral history session.

Thanks again for joining us this afternoon.

WALKER: Thank you very much for having me back.

ROSS-NAZZAL: Yes. I always enjoy it. I think it would be prudent for us to actually start with your first mission, STS-41D—

WALKER: Okay.

ROSS-NAZZAL: —and we might start with crew training.

WALKER: Crew training, okay. Yes, I was identified by the—just subsequent to the decision out of NASA Headquarters [Washington, D.C.] to allow me to fly as the first industrial payload specialist in late May, I think it was, of 1983, and immediately then, I mean, I knew what mission we were manifest on. The next flight of the electrophoresis payload, middeck payload, I

knew what mission we were manifest on, so I already knew who the crew was, and, of course, I already knew all the crew members. Knew Henry [W. Hartsfield, Jr.] the best, as having trained him to operate the payload on STS-4. But I knew Mike [Michael L.] Coats as well, as Mike, for STS-4, was one of the principals of the support crew for Hank and T. K.'s [Thomas K. Mattingly II] STS-4 flight.

Within days of the identification of myself, I went down to the Center. I was living and working in St. Louis [Missouri] at the time. Went down to the Center to not only officially meet the crew, but also to meet with the trainers and to begin to work out a training schedule. Working out the training schedule was interesting, I'm sure, for the crew as well as for the trainers, because I was not going to be a resident at JSC or in the area. I literally was an itinerant. Coming and going was the arrangement, and it was decided that that should be sufficient.

The syllabus of training for me, again, as the first industry and noncareer payload specialist to fly from the private side—now, of course, NASA had selected previously and had in training several science payload specialists for Spacelab missions. But using that as a template, but not exactly duplicating that, was going to be the task of the trainers and the schedulers for me. In other words, it was to be a unique syllabus, a new syllabus. I was expected to be the first of many itinerant industry or explicitly nonscience payload specialists to fly.

So we were working it out in real time as we went through, and it was kind of an ongoing negotiation between myself, my employer, the McDonnell Douglas Astronautics Company, and NASA, JSC and the crew, the Flight Crew Office, MOD [Mission Operations Directorate], and the schedulers as to just what my syllabus and what my schedule would be.

As it worked out, I was spending something like maybe two weeks a month, on average over the subsequent—as it turns out—nine months or so, in training with the crew and independent of the crew. Hank wanted to integrate me. Obviously, he wanted to integrate me as closely as possible with the crew; as closely as possible, given the circumstance that I wasn't living full-time down there.

So there were occasional social events. I was invited to more than one dinner or activity at Hank's house and some of the other homes of the astronauts, the crew as well as others. But it was mostly a—it wasn't as close a relationship as was the case, I could clearly see and knew, between the career astronauts and families down there that were obviously living and working at each other's elbows day in and day out.

But let's talk about training syllabus again. The training syllabus was probably about—my guess—something about half as much as what the mission specialists had, or maybe even a little less, and it was not as in-depth. In almost all aspects, it was not as in-depth as the mission specialists' astronaut candidate year training, or up to and including flight-specific training. And the reason for that was, it was decided—not in the beginning, but a little bit into my training ten months or so—it was decided that I wasn't going to be operating any of the Orbiter systems.

In the beginning Hank held the position, I recollect, that he did want me to be able to work with the crew and be a part of the crew to the extent of literally, when my payload did not require my attention, that I could operate water dumps, for instance, Orbiter water dumps, or initialize or turn off other systems, power systems or the like, and even have some time—not that I would ever operate the remote manipulator system, but to have that capability. As it turns out, we didn't even have an RMS [Remote Manipulator System] on board that particular mission, but it was standard training, MS [Mission Specialist] training.

But it was decided after a month or two months, by levels above us, that no, for my training, for payload specialist training, that was not something that NASA needed to either spend the time or energy doing, and I didn't need during the mission. So I was still invited by the crew to look over their shoulders at some both individual training that they would go through on like the RMS onboard systems, so that I was at least familiar, not only in textbook, but with the hands-on operation of these systems. The whole point of the training in that regard was for me to be familiar.

I give tremendous credit to NASA in training crews up and down the line from the pilots and the commanders through mission specialists and to payload specialists. With this whole concept of being intimately familiar with the systems, how they operate, the failure modes as well as the successful operation of systems. I think that leads to a level of comfort, not only in the crew working together, but in terms of each individual's level of comfort with what's going on around them, that is a tremendous attribute to the mission successes as they have happened over the past many decades.

Henry wanted to see me as familiar as was possible with the time and the resources available. I think that I got a sufficient level of training that I was familiar with systems, not only the onboard systems, but with general space transportation systems, Orbiter systems, STS [Space Transportation System] stacks, systems components, as well as even ground support, and all that without having been as involved in all of those aspects of the launch and ground support as, of course, the other crew members are.

Now, I also had—they recognized at the time, and I certainly was very thankful that I had trained crews for three previous missions of our payload—four previous missions of our payload, as it turned out; at that time we were just about ready to fly the STS-8—and I had worked not in

the front room of the Mission Control Center, but in one or more of the back rooms in support of those payloads. So I had worked literally in that flight support mode and so knew, had the feel of, and literally had worked in the system supporting payloads, supporting the missions during flight, so I had an idea of what goes on on the ground, and I think that was all important, too. Of course, it's an integral part of what the pilots and the mission specialists spend a good deal of time training at before they have a flight designation.

So the training activity started in the June time frame of 1983, and we were proceeding then. It seems like we were expecting a launch. This was the first flight—it should be noted, of course, that our mission 41D was scheduled to be the maiden flight of *Discovery*. I always felt that was a great honor, and I felt like, "Actually, they're putting me, this rookie and this outsider, on board a maiden voyage of the third Orbiter to fly to space." So it was a special feeling just to be on that maiden flight. I think the whole crew felt that way.

It was at that point and as I started my training, and the crew had already been together for some months prior to my being designated, so they had already been training. We started training, expecting a launch in the late spring of 1994. Through the winter, the fall and the winter, of '83, my training, again, was intervals of visits, something, again, on the order of maybe two weeks per month.

I would do mostly classroom training or solo training with textbooks and in-print training materials that the training folks would send me or I would pick up while I was there, interspersed with one-on-one training with an instructor at a single-participant training station, a computer simulation or other low-fidelity simulator of various Orbiter systems, or even with my payload. I did have a simulator of my research payload down there, which I would work at, and, of course, back in the laboratories in St. Louis, I had a ground-based model of the equipment, as well as all

of the people that had done the design and development work of the payload. So I'd do most of my payload training back in St. Louis, and, of course, since that was going to be my focus, at which I was going to be spending all of my useful time, so to speak, on orbit with that payload, all of that training time, virtually all of that training time, was done in St. Louis.

At that point, and I think it's still the case, but certainly at that point in the Space Shuttle Program and with payloads, certainly, there was the designation of not only a primary crew member to conduct the research, do the payload work, but there was a backup as well. That backup crew member knew virtually as much as the primary did, and in case the primary operator had another situation or was off doing something else, then the backup would know enough to continue or to pick up the work on that payload.

Well, here I was primary, obviously, for the Continuous Flow Electrophoresis research, and Judy [Judith A.] Resnik was designated as the backup, my backup. So I was training Judy about the payload, and Judy would come to St. Louis—and often, at least in the beginning, it was Judy and Henry both, again, because Henry had some prior training on it, and would come to St. Louis and work with me in the laboratory in St. Louis at the McDonnell Douglas Astronautics plant, working with both the flight equipment, which we had back in St. Louis, between its location or between its presence at the Cape [Canaveral, Florida], for loading and manifesting on the particular Orbiter that was going to carry it on its mission.

So it was through the summer of '83—well, in August, in fact, it flew on STS-8, and there was that interruption, if you will, in my training for the STS-41D crew—to work on the ground, both at the Cape to prepare the STS so that our payload on STS-8, in which it was operated by the STS-8 crew, and then supporting it at Mission Control Center in Houston [Texas] during the two weeks that they were in flight in, I think, August of '83.

Then after that the payload was taken out of the Orbiter, the *Challenger*, at the Cape. In September it was sent back to St. Louis, and beginning then up until we needed to send it to the Cape in the spring of ’84 for loading on board *Discovery*, it was in St. Louis and I was working with it. It was being refurbished and reconditioned and, in fact, upgraded for its specific research role on my first mission on 41D. At that same time, Judy again occasionally came to us, to St. Louis, and we worked in the laboratories and with the payload so she could become familiar with the real flight hardware, as well as with all the processes and the biophysical processes behind the research.

The time that I would spend in Houston was also with her and some of the low-fidelity simulation work that we could do in Houston with that simulation equipment which we had stored in Houston, as well as, again, my training time with the trainers and with one-on-one lessons. Probably starting in the winter of ’83 and certainly into the spring as we got closer to the planned launch, as is normal in flight crew preparation, the simulations become more and more high-fidelity, with a Mission Control Center, a front room that’s working with the crew, with the simulation supervisor team, of course, between them, so to speak, in running simulations and working through Sim Sup’s [Simulation Supervisor’s] problems.

So those simulations began with, first of all, just the crew and standalone simulations with Sim Sup, and then combined simulations with the Mission Control Center. I was involved in probably most of those and had some role, again, in the mission simulation that was being worked, and there were separate simulations, of course, in which the flight deck crew; that is, in this case, Hank and Mike Coats and I think probably Steve [Steven A.] Hawley was, I think, the third seat, and [Richard M.] Mullane was on the flight deck, too.

So those simulations, for the most part, I was not involved in; that is, the motion-based simulator work. I got a seat, fourth seat, probably, now and then, just because they wanted me to be familiar with what it was like, what was going on on the flight deck. I very much appreciated that opportunity to sit up there. Didn't get a chance to, again, very often, but it was very educational, very instructive for me, again, to know what was expected of the crew, the guys that had the windows during launch and during entry simulations, of course, as well. So that was the way training went during those months up until our flight.

ROSS-NAZZAL: Did you get a chance to fly on the KC-135 before you actually flew?

WALKER: Ah, good point. I did get a chance to do some KC-135 "vomit comet" work. It was part of the familiarization training, and I cannot now recall just when it was. It was probably, would be my guess, was probably in the fall of '83. I think overall I did some KC-135 work probably before—I don't think I did any before my third flight, but I did some others, some more parabolas in either late '84 or early '85, before my second flight. And then I did additional research as a research subject for the Life Sciences folks after, in the late eighties. So probably overall I've probably flown 140, 160 parabolas in the KC, in the K-Bird, in the mid to late eighties. So, yes, I did. I probably flew some forty parabolas, thirty to forty parabolas would be my rough recollection in preparation for and training for the 41D flight.

ROSS-NAZZAL: Why don't you take us back to the day of launch. What are your memories of that day?

WALKER: Well, this will be even a little more extended, because, as you may remember, we had two and let me call them serious launch delays. As training went along and, of course, another flight or two were flown between STS-8 and 41D. I mean, in the fall STS-9 launched with Spacelab 1, and in the spring 41B and 41C flew. So in that time period, the schedule slid a little bit, as we say, to the right. So instead of actually, as we came into the spring of '84, looking for a flight in May of '84, we knew we were slipping into the June time frame.

Some of the training process, I need to mention, included at least one trip as a crew to the Cape. Of course, the pilots and the MSs were at the Cape often and, pro forma, spent a little bit of their training time actually resident at the Cape for weeks or months at a time, supporting other crews preparing for launch; as "Cape Crusaders," as we used to put it. I didn't have that experience. I was down there on the payload side, preparing payloads and working with the crews that were operating my particular payload through '82 and '83, so I saw that experience, but from that side, not from the astronauts' side.

Now, in early '84, we went down to the Cape to view the 41C launch, and I remember viewing that launch with Hank and the 41D crew. By the way—I'll mention it here; we'll probably talk about it again some more—but the crew had a nickname. The crew was called the "Zoo Crew." So the Zoo Crew, we got our opportunity as a crew of an upcoming mission, in fact, the next mission, to be in the crew quarters the morning of the 41C crew launch, and got to wish them well and see them off on their journey out to the pad and then watch their launch. We watched the launch from the top of the Launch Control Center. The experience was a really remarkable one.

It wasn't the first Shuttle launch I had seen. I think, in fact, it may have only been the second launch I had seen, although I had been at the Cape working with payloads—my

particular, the electrophoresis payload—in support of that on [four] previous flights. I always supported it in getting it on board, getting the fluids serviced, and the biological materials on board, and then I caught an overnight [commercial airline] flight to Houston to be in Mission Control Center for the launch. So I had never actually seen one of those launches.

So this was exciting to be this close, three and a half miles away, and to see a launch in daylight. There had only been one night launch before this, but to see this launch and standing there, both with the crew that I was going to fly into space with in just a few months, the excitement of that, the emotion of it, because a Shuttle launch is, I think, for everyone that sees it, it is some degree or another of an emotional experience. I will say that to be, to watch the launch of that vehicle, knowing that you are going to be the next crew that will do that, and standing there watching that and feeling that launch with your crew is an exciting experience.

To do it on top of the Launch Control Center, when, and this surprised me; I don't know if the others knew this was going to happen, either. I certainly didn't. But as soon as the shock waves of the solid rocket ignition and the liftoff struck us as the vehicle was rising into the sky, as those waves moved over us, the panels on the doors and the walls of the Vehicle Assembly Building started rattling. Now, here is several tens of acres of aluminum and steel rattling, and it is like this thunderstorm going on behind you at the same time the sky is burning with the thousands, millions of pounds of propellant that's pushing this rocket into space in front of you. So it was a mighty experience, and a mighty emotional experience, a very memorable one, obviously.

It was interesting, also, to—in recollection, that was probably also my first, if you will, public exposure with the crew. Now, there had been a press conference in which I had been introduced with the crew, probably before that event. There was going to be more, previous to

our launch in the months ahead, but I was certainly—we did events, informal events, walking around through the Orbiter Processing Facility and out on the pad and in some of the offices at the Cape for the payloads preparation. There were other payloads on board that flight, of course, some satellites and other middeck payloads. So we as the crew spent time both then and probably on another visit of visiting both the civil service as well as the contractors, some of their offices, again, around the vehicles and on the pad, there.

So that was exciting, very exciting for me, to be associated with the career crew as one of the flight crew members for this upcoming flight, and it was my first real taste of what being an astronaut was going to be like, maybe, in the public's eyes. So thrilling and exciting and humbling at the same time.

Launch for us was slipping into June. As we got closer to it, of course, the rigor of training, there were more integrated simulations between the Mission Control Room, the crew, and the Simulation Supervisors team in Houston. I was involved in all of those. I was spending more and more time in Houston. I didn't spend as much time at all at the Cape in preparation for this flight. There was another team of folks from my office and from the company that had taken over the preparation at the Cape of the payload, the installing of it into the Orbiter, servicing preflight.

So literally about one month before launch, so in early June, I took up residence in Houston and was there full-time, twenty-four hours a day, for completion of training and for final preparations, and just being around the crew and going through, shadowing them in many cases, with the preparatory activities. And, of course, the third week in June, the crew, we went into quarantine, medical quarantine, one week before scheduled launch, and I think the launch was scheduled for the 24th of June, I believe.

So quarantine, at that point in time, it was in a trailer, a fairly old trailer out on the back forty down at the Space Center.

ROSS-NAZZAL: Did it have air-conditioning?

WALKER: It did have air-conditioning. We were allowed that, probably only because we were in medical quarantine, so they didn't want to have the windows open very often, right?

Oh, I've got to remember, we had—the Zoo Crew was interesting to work with as a bunch of individuals, I've got to mention. Of course, the Zoo Crew came from, and I do not recall if I ever did know, had ever heard, how the designations sprang up in the Astronaut Office, but it must have been when the crew was identified that suddenly they just—because working together, they got this association of names, but Mullane was "Tarzan," and Hawley was "Cheetah," and, of course, Judy was "Jane," right?

Separately and not connected to the Zoo Crew thing at all, Mike Coats had the nickname "Superman." Dare I say, it was probably a little bit because of the square jaw and his resemblance to, if not the cartoon character, then the movie *Superman*. But it was always fun, because these guys were—always had something going on, either between them, a running joke or a practical joke with another crew or somebody else in another office, and Henry was the perfect straight man, very humorous himself, very dry wit. But it was just a fun group of folks, and I always felt very humbled at being a part of this crew, and they often let me know that I should be humble, but that is beside the point.

We had I think the usual set of experiences—oh, let me also mention, you asked me about the KC-135 flights, and I talked about that. But there was another part of the training,

requisite training, which I was very happy to be exposed to as well, was some backseat time in the T-38s. Now, that, as it turns out, I think Henry—if I recall right, Henry wanted for me to have the opportunity to fly fairly often backseat, but that, like some of the other aspects of training, it was finally decided at levels higher than us, didn't necessarily need to be the case for a payload specialist. So I got one backseat ride, one flight in a T-38 before that first [Shuttle] flight. Actually, now that I recall, I think it was more than one flight. Henry did fix it so that I got more than one backseat ride.

First flight, Hank took me up, and it was sometime probably in the early spring of '84. It was a nice Texas day, a nice spring Texas day, and as we both know, there aren't that many of those the rest of the year, but there are in the spring and there are in the fall. It was a great spring day, puffy clouds and nice weather. I was backseat, got all the familiarization. I went through the textbook training with the trainers out of Ellington [Field, Houston, Texas], got a once-around the aircraft and familiarization with the systems, got ejection seat familiarization, emergency procedures.

Come flight morning, Hank and I were out there on the ramp. He was a good instructor pilot, and so I felt really comfortable. I was nervous, yes, but I was comfortable with the backseat ride.

Now, background here; I was not a military aviator, didn't have much in the way of private pilot background, although I did do most of forty hours or so while working toward a private pilot's license in the early seventies, but the first gas [oil/gasoline] crisis came along in the early seventies, and aviation gas went sky-high, and I was a poor student, and I couldn't afford to fly. So I kind of gave up on the pursuit of that ticket. So I had some time in the air, I

mean, a few tens of hours, but not in a high-performance jet aircraft. So it was a great thrill to have a backseat ride.

Hank did allow me to take the stick now and then. Henry being a good pilot as he was and one who enjoyed to fly and especially enjoyed to do aerobatics, as they tend to say, tried to "wring me out" by doing some snap rolls and a number of loops. I managed to hold the contents of my stomach in until after we got on the ground and out of the airplane. But it was fun in flight, and I certainly enjoyed that experience, and I know why those gals and guys like to go fly as often as they can and as often as the small fleet of T-38s and their availability will allow.

I did get to fly one more time. Again, I said Henry arranged one more flight. He couldn't take me up, but I remember T. K. Mattingly did take me up, too, and that was another great ride. T. K. took me out over the Pelican Range, as the air traffic control calls it, out over the oil rigs out in the Gulf. We dove on some oil—no, I can't say that. There just happened to be some oil rigs down there in the Gulf when the aircraft was pointed down toward the Gulf, and we were doing loops and rolls. So a couple of great flight experiences. Probably I got a total of maybe six hours or so in the air in that time.

So, again, back in Houston just a week or so before flight, finishing up, spending our time textbook learning—well, refining our procedures and making sure that we know in our sleep what's in the flight procedures in front of us to be done for all aspects of the mission. And just beginning to wind down in the last three days, when we fly to the Cape three days before launch. We're still in medical quarantine, of course, but move into the crew quarters at the Cape.

I remember there both the diet—it's worth mentioning here that—I remember an individual by name. I remember her very fondly. Rita [M.] Rapp, who managed the foods for the crews, was a dear lady. I think she was probably tough as weathered leather, actually, but

she was a dear lady to the crew members. She did our—a dietitian, worked up our menus, I'm sure worked with the foods contractors to prepare the food for crews and to get the diets right and to help us go through the selection of what it was we wanted to fly into space, of course. Every crew did get to pick from the fairly wide menu of provisions for both meals as well as for snacks on orbit. Rita was both in quarantine with us and fed us in quarantine in Houston as well as in the three days preflight down at the Cape.

I remember she and the KSC [Kennedy Space Center, Florida] kitchen crew were—anything we wanted. I mean, it's the last two or three days; whatever you wanted. I loved cookie dough, so they always made a bowl of cookie dough, and they told me where it was in the refrigerator, and this is raw dough, you know, so I had my raw cookie dough, which I could had have a snack on it with the middle of the day, and then I'd have to go out, or felt like I did, and I would go out. We were allowed to leave the building and run in the environs of the crew quarters and up and down the roads at Kennedy Space Center for exercise.

I remember, it was an interesting experience. The room that I had in the crew quarters had on the wall the Apollo 15 mission patch. Now, the wall decorations, they were lithographed images of the mission logos, and they were like three feet in diameter. I mean, they were big wall décor. So I was so impressed, thinking, "My gosh, I'm probably sleeping in the same bed that the Apollo crew slept in before they went to the Moon. This is so neat."

That was just another one of those aspects of the whole experience, and there are so many that—in fact, at every turn, here I was immersed in the environment of historic spaceflights that this country had been engaged in since the early sixties. Of course, still with us at that time here in the early eighties, many of the folks both at JSC in training, ground support, management, were the individuals, in some cases, in the Astronaut Office, who had gone to the Moon. Ken

Mattingly, for instance, and others in management that had been on the Apollo team, managing that program.

So it was just an awesome experience to feel immersed in. There was this kind of—this buoyancy that as a very—it's a descriptive term, and, of course, what I'm talking about is just the atmospherics of being with the folks that were involved in training and preparation and planning as well as the flight crews, and in the same physical environment. There was a buoying about it. There was kind of like a—I can recall a glow of it, again, to add a term to the sensation.

That launch in June, we went out to the launch pad on launch morning. You go out to the pad—well, first of all, you wake up at something like three-thirty a.m. There's a knock on the door, and the support team is making sure you're up and out. I think I actually took a sleeping pill. I was offered a sleeping pill just to make sure, if I felt like I needed it, and I felt like I did need a sleeping pill to sleep somewhat the night before. I think we turned in fairly early, and I took a sleeping pill. I did sleep well and responded to the wakeup call at the door and was up and sharing a bathroom with Hank, I think it was.

So, get shaved and looking at myself in the mirror and thinking, "My gosh, what a special day this is." Get ready, go back in the room, suit up. Actually, I just think wear sweats to breakfast, but not this morning. Usually I did that, but not this morning, because the launch morning, the crew has the official prelaunch breakfast picture taken at the dining table, and there's a cake that the kitchen crew has prepared with the mission logo on the top of the cake.

The cake there at the front of the table, and the crew arranges themselves around the table, and we have our—in most cases, the crew picks what they want to wear to breakfast, and we wore our tennis shirts with the mission patch on the breast. We array ourselves around the table, and then the NASA photographers are invited in. There's two. There's a still

photographer and a video photographer and a sound person, and we're taking pictures. We're told to smile, you know, and so everybody's smiling.

I remember, I was asked, "Well, anything you want for breakfast, of course, just as much as you want." And I had gotten some advice, and I can't remember who it was from, that, "Remember, you're going to be going out to the launch pad. You're probably going to be a little nervous, to say the least. You're going to be going through a high acceleration launch, then weightlessness, and this all is going to happen starting three hours after you leave breakfast. So keep all that in mind."

Okay, I got all that in mind. "I'll have toast, one piece of toast, unbuttered, and half a cup of coffee. Thank you very much." And I think I did have orange juice as well. So I've always since that time looked back at those pictures, and you see people's plates and the plates are virtually empty. Most people don't eat much of anything, as was my experience, to begin with on that launch morning meal.

The cameras leave, and we finish having breakfast and are rushed off to get suited up. In my case, I was wearing some medical instrumentation. I agreed with the Life Sciences folks to be a willing subject for some heart and blood pressure measurements on the way up. I don't think there was anybody else in the crew that volunteered for that. It occurs to me now that I probably felt like it was an obligation that I needed to do that, anyway, to be a test subject, but I heard readily from other crew members is like, "You really don't want to volunteer for that. I mean, they've got the goods on you if you—."

But I thought, "Hey, this is probably my only ride into space." I think I need to make that point again, too, because I've referred to already future history from this point in time. But at this point, I expected this to be my one and only flight. There was no obligation on NASA's part

to McDonnell Douglas, to the commercialization project that I was a part of, to fly me, or even a payload, necessarily, any more than this [fifth] time that we would have flown it, and my one and only time into space. So I thought this was going to be my chance, and I was like, "Well, what have I got to lose if I volunteer to have my blood pressure taken and my heart rate monitored on the way up."

So I had some instrumentation installed and then finished putting on the blue coveralls. Of course, it needs to be mentioned that now, from historical perspective, here in 2005 looking back at 1984, I tell people today, "Well, that was the equivalent of the white scarf days of aviation." We were flying in blue coveralls, sure flight boots with steel heels and toes, and a partial pressure helmet, and on the back of the seat was an oxygen-generating contraption that, if you could reach and around and throw the switch, you'd have oxygen for four minutes to your helmet. But you wore fire-retardant gloves. There was no pressure suit, not even a partial pressure suit, just a helmet to give you some oxygen for a short period of time if you needed it.

It was all intended for use with on-pad escape if there was an emergency before liftoff, or on the ground after the vehicle had landed and rolled to a stop, and you could get out and away from the vehicle, and the oxygen would protect you, theoretically, from fire fumes or ammonia from the ammonia boiler on board or if it should leak or the hypergolic propellants or whatever. But that was the way that we were ready to fly, and we did fly.

So we suit up in that regard, and then we go wait in the crew quarters, the assembly area; I call it the family room area of the crew quarter. They saw to it that there was enough time, that we were prepared well in advance, assembled, and so we were telling jokes about "What a great day it is outside; wish we could see the weather." You can't see—the windows are all closed in

the crew quarters, at least covered with draperies, so you really don't know whether it's day or night outside.

That was required, because the crews would go through, depending on launch preparations and as they were supporting launch preparations, crews that are staying there in the crew quarters would rotate their time cycles, their day-night cycles, to various parts of the twenty-four-hour day, day-night clock that we live to with the sun out here. So you really were isolated in terms of knowing what it was like outside. Plenty of jokes about wishing we knew what it was like outside before we went out; take our umbrellas or not?

For me, the tension was fairly great. I mean, I remember again thinking, "Man, this is a great opportunity," but I knew why I was there. That was always at the front of my mind. I was there to conduct some serious biotechnical research with a pretty expensive investment on the part of private industry, my company. NASA had some research that I was going to conduct for NASA on the same payload for a part of its operating time on orbit. It was important to see that work done and to see it done successfully.

So I can remember, in my mind, there was the questions—any questions that may have been running through my head or in conversation among the crew about the technical risks, the issues with regard to the launch itself, that was secondary to me. I was more worried about getting the job done right and was it going to work. Was I going to be able to figure out a problem, if a problem developed? Had I thought through all the problem modes, if you will, the kinds of problems that this experiment might see in space?

I felt like I had, because we had flown it [four] times before. Crew members had operated it. They had debriefed me after each one of their flights. I had torn through the equipment after each one of the previous three flights. So I felt I pretty well knew what was

going to be the case, and I felt pretty comfortable with it. But then when I resolved that kind of thinking process to that point, then would probably up pop the, "Yeah, but you've got to ride a rocket into space first." I tell you, with that thought, probably then came the solid, solid knowledge, certainly conviction, that these people that I was flying with, the other five crew members on this flight and all the hundreds and thousands of people that had prepared the vehicle and prepared the systems, were working on the ground, I had no doubts. I had no doubts that those people were doing everything that they possibly could.

Let me as an aside here say that I've worked up right up to the few hours before launch, but need to mention as let's call it a footnote here, that within a day or two days before this, while we were in—as memory serves—as we were in isolation at the Cape, there came up a problem, as identified by the launch support team and the contractors, with some electronics on the vehicle, and specifically electronics that commanded the separation of the solid rocket boosters from the external tank. I think it was the main events sequencer, or the main events controller, maybe; we called it the MEC, I think, so it was probably the main events controller.

There were like more than one of these boxes, maybe four of them that both backed up each other as well as controlled all of the pyrotechnics that—the explosive bolts that mechanically held the solid rocket boosters to the external tank and at the right—obviously, the right point in time and all together, needed to fire to break those bolts and those mechanical connections so the SRBs [Solid Rocket Boosters] fell away and fell away together.

There was discovered that, and I'm forgetting the details, but remembering that someone had determined that one of the circuits or a chip was probably either not programmed right or was prone to failure. In other words, within a couple of days of when we were supposed to launch, there was identified a prospective problem that literally could have prevented the SRBs

from falling off at the right time. We would have never gotten to orbit; would have had to try to do probably some kind of an Orbiter separation out over the Atlantic Ocean, and to do a never-before-performed and, thank God, not since, either, yet—and hopefully never—launch abort with a return to launch site landing.

So we worried, and I know Hank and—well, all the crew, but particularly Henry as the crew commander was worrying the details, wanting to know everything about not only the problem as it was identified, but the resolution of it. As it turned out, within twenty-four hours of identifying it, there was a changeout made on the pad, I believe, of the electronics in those boxes, and the verification that was made, again by the NASA launch team and the contractors, within a day before the scheduled launch, that, "Okay, now we have good electronics, and we're satisfied with it and comfortable with those electronics. So we should go."

So there was that little bit of tension with regard to the vehicle as we came up on launch day. The first launch day, that day, the time comes. Two hours, two and a half hours before scheduled launch, we're told by [Richard W.] Nygren, the support team leader, that we are ready to go out to the vehicle. Of course, George [W.S.] Abbey is there with us. A couple of the NASA launch support team were marched out. They're carrying the bags. We're just walking out to the elevator, out the front door of the crew quarters, around the corner to the right into the elevator, down the elevator, and then on the first floor of the crew quarters, here's contractors and NASA personnel with banners and applause.

You walk out into this, turn the corner to the right. You're going down the ramp out of the building to the van, which is on the left. There's the photographers out there. And it's an awesome, awesome experience to confront smiling faces and to be wished well on the way to the pad, and it's still dark outside, for the most part. But get into the van, and then we're off, and I

think here's another aspect of this tremendous experience, because the van starts out slowly. We wind our way through the parking lot and out onto the access road to the pad, which is some five miles away or so, driving.

But there's this police escort, of course, in front of you—well, the local KSC security—with lights flashing and everything, so you feel like you're on top of the world already. Here it is, you're getting a police escort with flashing lights, and people are standing along the fences and the roads as you go out, and so you're here with crew. You're inside there; we're as nervous as—butterflies are all over my stomach, I know. We're cracking jokes about, "Well, we didn't need the umbrella after all. What a nice day, or at least it will be when the sun comes up," and yada, yada, yada, and waving out the window to people at the same time. I suddenly feel a little bit like the queen, you know; do the royal wave as you go by.

Then we arrive out at the launch pad, and at the base of the pad—of course, security waves you on. You don't have to show all your badges and everything this time; they know who you are. At the bottom of the crawlerway up the pad, you can get the view, and I remember we all—as we came around the corner, following the crawlerway out toward the pad, we were all ogling for that view of the vehicle on the pad.

Henry had snuck us out, essentially, of crew quarters one night, the first night, I think, we were down at the Cape, to get a view of the bird out on the launch pad. So we took a bus up there, went to the fence, and we had a nighttime view of the vehicle. But now this is the first time we'd really seen it clearly without the rotating service structure around it, and so it's an awesome experience, knowing that you're going to ride this thing into space and there's your spaceship waiting for you out there.

Go up the ramp, the police car leading the way, and you just get to the top of the ramp, and the thing that I noticed first was really different, besides the police escort, was that there was like only one or two other people there. Now, every other time you've been out there, there's like dozens and dozens of people all around and conversation going on. But now it's like silent, except for the wind, maybe some seabirds now and then. As you get up closer to the vehicle, you begin to hear the vehicle. You begin to hear the Shuttle and the external tank.

We get to the elevator, and the elevator operator takes us up to the white room level. The walk out to the white room, we knew what order we were going to go out in. Again, footnote and backtrack a little. About one month before this, in the third week in May, we had all gone to the Cape the one previous time, before we had gone down for the launch itself, for what's called the terminal count demonstration test, TCDT. That literally is a launch simulation with the Mission Control Room and all the team at the Cape. The vehicle is on the pad at that point in time. It has just arrived at the pad a week or two before that.

You go down as the crew to work with the Cape team, the Houston team, and a simulation of those last four or five or six hours up to launch time. So we had done that toward the end of May, and that had included, again, all of these procedures, again, to getting on board. So we knew what it was going to feel like and was going to be like here on launch morning.

That day the TCDT ends with an emergency get-out, an on-pad launch abort simulation, in which something has gone wrong and you need to get out of the vehicle, across the access arm to the slide wire baskets and down [into] the slide wire baskets, although nobody, at that point, had ever gone down the slide wire [in the] baskets. I think it's only happened yet even once. After we lost *Challenger*, then everything needed to be recertified, and I think it was Charlie [Charles F.] Bolden [Jr.] that actually took the ride down; am I right? Took the ride down [in]

the basket. But at this point in time, nobody had ever done it and nobody really wanted to. I mean, certainly nobody ever wanted to for the reasons they were intended, but nobody wanted to practice doing it.

But we all climbed into the baskets. They were firmly anchored. We cut the wound cloth loop that held the basket on until you would cut it and slide down, but fortunately the chains were there also during the training exercise and kept the basket from sliding, so we didn't go anywhere. But it was a good exercise, and then we were later taken out and shown where we would get out of the baskets, the bunker, the armored vehicle that we would get out of there with, where the helicopter would land if that was the option, yada, yada, yada. So, lots of fun during the TCDT as well.

But now this was real launch morning, and unlike TCDT and unlike any other time except for the launch day, now the rocket is fully fueled with the external tank with a couple of million pounds of liquid hydrogen and liquid oxygen. And it's groaning. To me, this was one of the most magical and amazing parts of the thing, the experience. To start with, this experience of spaceflight, is to feel the presence of this spaceship that's going to take you there, because it came to me at that point in time that this is almost like a—the sense is that this is a living thing. And I say that not because I thought it was going to stand up and walk off the pad, of course, but it made noises.

There was some physical motion as well. The tank would contract and expand, a few millimeters, probably, but enough that the sea breeze and the moist sea air, even with the inches of insulation surrounding the tanks of cryogenic fuel and oxidizer, was cold enough that ice would form on lines, fuel lines going into the tank, and occasionally on places on the tank. And that as the vehicle would creak or the ice would build up to where it was too heavy to stay on, it

would fall off. So you would hear the ice break off, and you would hear it fall to the pad below, the concrete pad below the vehicle. So these noises were taking place.

At the same time you'd hear a little bit of the radio traffic that you could hear inside, the speaker inside the white room. Of course, there was a little conversation, but I've got to say, I think the conversation was all hushed. It was almost like we were in the presence of this enormous power, this vehicle, and there was a hushed tone, almost. At least that's the way I remember it and I think I conducted myself. But still was plenty of banter about how beautiful it was and what a great day this was and, "Gosh, too bad everybody couldn't be here with us. Oh, gosh, the cameras are on; they are here with us." You know, that kind of thing.

It took maybe an hour for us to all get on board the vehicle one at a time into the white room, putting on the helmet, getting cinched up in our seats, going in one at a time. I think I was next to the last in, and I think there were only two of us on the middeck, myself and Judy, and I was in the seat in the middle of the middeck, right in front of, or in this case, out on the pad, just above the airlock. Judy was in the seat right in back of my electrophoresis device, which was in place of the galley, and she was right next to the ingress-egress hatch.

So Judy was in last, and we were all cinched in place, and the countdown starts. Well, the countdown was ongoing. We enter the countdown as the crew. We do a voice check. Each one of us does a voice check with both LCC [Launch Control Center] as well as with mission control, and we sit there and we basically wait for it.

Now, the guys on the flight deck, of course, they're checking procedures and they're fairly busy up there, but downstairs, here I am. Judy is sitting in the seat next to me, about four or five feet away, and she's looking up at an emergency procedure that's on a cue card on the

side of my electrophoresis apparatus. She's near the window, as well, so she can look out and see them close out the vehicle out there through the white room, doing the final pressure checks.

There was one last thing—I think it was 41D—in which I had to help with one last procedure. They couldn't verify the pressure seal on the vehicle and on the crew compartment. In other words, they pressurize it through a valve in the doorway, but there was a leak somewhere, and it wasn't pressurizing. Oops, not a good thing. So there was a few minutes of trying to figure it out. You could hear launch control over the intercom. You could hear launch control and mission control [working] to figure out, "Well, what could be causing this? Oh, boy, this is going to be a—we're not going to get off today if we can't fix this."

Somebody came forward, probably from the back room; said, "Well, check all the vents." Well, as it turns out, there were a couple of vents in the compartment, one on the door. Just little vent valves, and there was another one on the airlock down here, which was—I say down here; it was behind me as I'm sitting on the seat that's attached to what's now the wall of the Orbiter as it sits on the pad, and the airlock is to my back, below me, in terms of gravity reference.

So they finally figured out, the closest one to it, unless Judy gets up out of her seat, unbuckles, gets out of her seat—don't want to do that—is Walker. "Walker, okay, can you feel that valve? Can you see it back there?" So I'm turning like this and stretching. [Demonstrates] So I see this valve back there, and sure enough, there is an indicator on it, a visual indicator, of either "on" or "off" in the window, and I can see it says—well, "open" or "closed"—and it says "open." Ah, that's got to be it.

"Can you turn that valve until it closes?"

"I think I can do that." I can reach it; I turn it; it's closed. "Try the pressure check again."

"Okay. Hey, we've got a good pressure seal on the vehicle." All right, man, we get to go today. Don't throw Walker off the island.

Okay, so we got down to, I think it was probably something like twenty minutes in the count, and a computer fails. One of the GPCs, one of the five general-purpose computers, just wouldn't sync up with the other ones, and so it was determined after a few minutes that this computer's not going to work today. Crud. The launch rules say you've got to launch with everything good to go, everything, and computers are important. So it was determined that we weren't going to be able to fix that problem at that minute on the pad.

Sorry, going to have to waive off for a day, at least one day. So we're disappointed. Yes, crud. Okay, we don't know if we're going to go tomorrow or when. Gees, so another nice exercise to practice going to launch. So we got out of the vehicle; went back to the crew's quarters.

As I remember it, we got the afternoon off and went off to the beach house. Beach house, I'm not going to tell you stories about the beach house, other than to say that of course there was a beach house. Different from the one today; same place, basically. But it was fascinating for me to get to see the historic beach house that the astronaut crews have available to them. So we spent the afternoon at the beach house with toes in the surf and time to reflect again on the experience. A little bit more tension here, both tension and relief, you know. Gosh, we got another problem fixed today, but gosh, we're not in space yet.

So we got a nice sunny afternoon off, and we got back to the crew's quarters, and that night found that they had managed to really get into the work of replacing that general-purpose computer. We were going to go to bed that night thinking, hoping, that we would be awakened at three-thirty the next morning, and we'd go through the whole process again with the computer

having been fixed overnight or replaced overnight, but not knowing for sure when we went to bed.

Well, as it turns out, went to bed expecting—did get the knock on the door at three-thirty. I remember thinking, first of all—knock, knock. "Who is that trying to wake me up? I'm still sleepy." And then realizing where I was and what was about to happen once again, and like, "Oh." I look at my watch. "It's three-thirty. Well, they must have fixed the computer."

Sure enough, the ground crews worked diligently during the night and turned around, as something that had not been done at that point in the program, but rarely before, that kind of a major equipment turnaround and reverification of the computer within the flight control system, all within twenty-four hours, less than twenty-four hours' time. So it looks like we were going to get to go again.

So we go through the whole process once again, and it's a little bit like—and I'm sure that we said the words out loud—"Déjà vu all over again, folks," in a jocular way, of course. Went through the whole preparation process, back out to the pad. I think we practiced at our royal waves on the way out. Although if memory serves, it might have been a little fewer people the second time around than there were the first attempt. Out to the pad, and countdown then proceeds right down to the final few seconds.

Here you are, strapped into your seat, and these seats are, of course, they're aluminum benches with a little bit of woven Nomex fabric cover. I say very little, because after like ten or fifteen minutes, it doesn't matter if there's a little bit of cover there, you've lost the sense of that. All you feel is the hard aluminum seat, and you've still got a couple of hours to go before you go into launch itself. So the seat, after a while I think I just got numb to the hardness of the seat and the fact that I'm constrained and strapped into the seat.

Helmet's on, but the visors aren't down yet. The visors go down at like T minus two minutes. Now, we've done the visors down to do a voice com [communications] check, most likely, but you can open the visors back up again until T minus two minutes. It's at that point, I remember, T minus two minutes, visors down. I thought, "Oh, this is serious. This—is this—?" It came to me again really starkly, "This is really serious."

Of course, the next then step, the next serious perception or perception of the serious nature of all this came at like T minus thirty-one seconds when you go from, per the launch control, Launch Director, from ground support computers to onboard computers, and you're under computer control now. So the ground computer is talking to spacecraft computers, checking out all the systems. The final checks are now going so fast that the control is left to them and to the programmed procedures. The ground controllers don't have enough time to do all of the checking, but they're still watching critical parameters.

But you hear those words, "We're now under computer control. Thirty-one seconds. Thirty seconds, and counting." Here, this is serious. I'm sitting there, and I remember thinking—I reached over to my left, and I think Judy reached over at the very same time, and we locked hands, and we glanced at each other out of the helmets and winked and smiled at each other and wished each other well silently. The intercom was on, and I think Hank said to everybody like, "Okay, now, this is it." And the countdown goes to T minus five seconds, and engines start.

That's when I knew things were really getting serious, because you hear this roar. The liquid-fuel engines, the Space Shuttle main engines are starting down there ninety feet below you, but you feel the rattle, and there's some motion that starts. And "T minus four, three," and I thought, "Here we go."

Then there's this grinding. I cannot describe it. It sounded—I told people afterwards, it was like, okay, imagine in your mind the hand of God comes out of the sky, reaches down, and twists that launch tower and structure outside the vehicle. Just twists it. It sounds like the place is being ripped apart. This is just the audible, the acoustic.

What was happening was that the sensors monitoring the engines had sensed that one of the valves controlling the thousands of pounds per second of liquid oxygen, as it turns out, oxidizer, wasn't flowing. The valve was not turning at the rate at which the computers were programmed to expect it to close. It wasn't working per the program. The computers say, "Something's wrong. Not right. Shut down." So T minus five, the first engine starts. The second engine had started, and the third engine was just into the fuel flow process and hadn't ignited yet, and the second engine was shut down. All of them were shut down because of this valve on the second engine.

So there's this grinding, and it's probably both the mass of fuel, and there's like a ton of fuel that's flowing through these engines now, dumping on the pad. The tank is rocking and rolling like this. [Demonstrates] The valves are turning, and you're getting all of these hydraulic reflections, if you will, up through the vehicle structure. And there's this noise, and then there's silence, except for over the speakers in your ears, in your headset. "We have an RSLS. We have a redundant set launch sequencer on-pad abort." There's silence, and the Launch Controller immediately starts running around the consoles in the Launch Control Room, verbally running around asking, "Give me status on this. Tank pressures," yada, yada, yada. "Engine shutdown."

We're all there like—I was looking at this emergency procedure that was in front of me, too, on the middeck. It was for what's called "mode one egress." There's five lines on there,

and those five lines basically are, "Get your butt and every other part of you out of the Orbiter as fast as possible."

We had practiced this once, but right now I was focused like a laser beam on these procedures, because the rule—what happened was that the commander would call mode one egress, and so I was like all ears, except for my eyes, which were all on that procedure. I was looking over at Judy, and she was looking at me, and then she'd look back at the procedure, and she was waiting for that call, because she was the one who was going to have to open that door and get out of there in as few a seconds as possible, because that would only be only called presuming that there was a worst case circumstance predictably going to happen to the vehicle on the pad. Something was going on.

We must have sat there for thirty seconds, which seemed like hours at the time, before the Launch Director said that we were safe, that he had gotten all indications the solid rocket boosters were not going to ignite, that they were safed; that the liquid-fuel engines were all off, and the valves were all off. So the vehicle was safe and in a shutdown mode.

Now, what was going on—I could look out the porthole. There's a nine-inch porthole in the center of the hatch leading into the Orbiter, and so I could just turn my head, look past Judy, and look through that porthole, and what you saw out there was this gray steel structure in the morning sun. You saw a small part of it at the ninety-foot level, hundred-and-twenty-six-foot level, I guess it is, in the launch complex.

There was water all over the place, because the water spray system, which goes on some five seconds before the liftoff is to occur in order to both drench any fires on the pad, but it's to suppress the very high volume of sound which accompanies the rocket engines at their ignition and their firing. So all of that is still going off. It's gravity-fed, so all the water is still spraying,

even up to our level, and there's probably some steam out there, too. Every once in a while, a cloud of steam would go by the window.

We were told, "Okay, okay, vehicle's safe."

So Hank says, "Just everybody sit tight. We're okay. They'll come get us, it'll be twenty minutes or something, twenty, thirty minutes." So we did. We unbuckled, for the most part, knowing we're not going anywhere today. And it was an interesting set of sensations that I remember thinking as well as feeling, in that I'm really gratified that something has happened here and that I'm still in one piece; okay, I thank God for that. The vehicle's still in one piece, apparently; that's good.

Ah, is it? I hope it is, because if it isn't, I'm not going to get to fly anytime soon. Let's really hope that this wasn't anything. And nobody knew exactly what it was yet, except the ground had—the engine folks had some indication of a valve or something in the engine, anyway, which had caused the redundant set launch sequencer to shut things down. So it was literally probably within the next twelve hours or so that we determined what it was, but at that moment, we didn't know exactly what it was, but we just knew we were not going anywhere.

So we unbuckled. We're telling probably pretty grim humor. Well, the one notable thing that I will remember from that day, before we unbuckled, it was that thirty seconds going on an hour or two of silence after the engines shut down. We're waiting to hear that hopefully everything's okay, or waiting to hear another call, and after that thirty seconds, as soon as we got from the Launch Controller, Launch Director, that we were safe and Henry said, "Okay, we're not going anywhere," I think it was Hawley.

Steve Hawley says over the intercom, he says, "Henry, at thirty seconds, I sure thought we were going to be higher than this." [Laughter] And he says it deadpan, and everybody busts up. It was a good icebreaker, because we needed it at that point in time.

But I've got to say the really harrowing part happened an hour or more later. In the meantime, we sat up on the edges of our couches. We unbuckled, sat up on the edges of our couches, and just bantered back and forth, waiting for the launch control, or the launch support team, who had gone three miles away, to come back to open up the elevator to get the elevator up to our floor to swing over the swing arm and open the white room up to get us out.

Now, the swing arm was there; I've got to note that part of the emergency procedure is that any such thing happens, and immediately the swing arm comes back so that we can get out the door, jump into the white room, which is not really sealed, but it's there, anyway, and we can run across the arm to those baskets and down those baskets. The room was there, but they hadn't sealed it, and they wanted to seal it, again, to keep the cleanliness of the vehicle, the crew compartment, as they got us out. So it was like forty minutes, thirty or forty minutes, before they were getting us out, and it was an hour.

Then we were all out of the vehicle, and what I remember is that it was like a rainstorm, a Florida rainstorm in bright sunlight, because there was water still pouring off of the steel structure of the tower like waterfalls coming down. The white room floor was water-covered. We went out to the elevator, and the elevator had an inch or two of water standing in the bottom of the elevator, and it was soaked. We go down to the first floor, and again, now here you are, a hundred and ninety feet below the top of the—on the surface of the pad, a hundred and ninety feet of structure above you, and it's all raining on you. So it is like a rainstorm, and we're soaked in our coveralls as we get into the crew van and go back to the crew's quarters.

It was sometime in that time, probably after we got back to the crew quarters, that we heard that the support team that had come out found scorched paint up to the hundred-and-ninety-foot level, so as it was determined, the hydrogen and oxygen propellant that had gone unignited through the engines and out into the flame trench, had been ignited by the one engine, and the fire of that engine-ignited propellant had ignited the rest of that, and there was literally a fire burning up and around the outside of the Shuttle, and flames including up to our level. The paint was scorched.

If we had tried to run across the service arm, if we had tried to egress and had tried to run out through that invisible fire—because it was a hydrogen fire, and hydrogen fire is invisible to the eye. It's very visible in the ultraviolet, but there weren't any ultraviolet fire sensors on the pad at that time. Needless to say, there have been on every launch since that time.

But they did not know. The ground did not know that there was a fire burning, raging on the pad for as long as there was, nor was it as large as it turns out as it was. So it would have been a bad day for us if we'd tried to get out of there. So we all bless Henry. I thank Hank—thank you very much, Hank—once again for not having called a mode one egress that day.

ROSS-NAZZAL: Let's take a break for a second and change out the tape. This would be a good time.

WALKER: Okay.

[Tape change]

ROSS-NAZZAL: So after you left the Space Shuttle, after the on-pad abort, what happened?

WALKER: After we left, there was probably a fairly short debrief back at the crew quarters. And again—I know I was—I think the rest of the crew was a little tense about just what we had gone through. From the standpoint of probably not so much how life-threatening it might have been, but it was like, well, how much damage is there to the vehicle? When are we going to be able to—are we going to be able to fly this mission? We didn't know that for sure, and we probably supposed the worst in that regard, that they might scrub this mission, and reprogram the Orbiter and the payloads and us.

So we were a little concerned about that, but we all kind of went our different ways after a couple of hours. I remember I went to the Cape, joined friends and family that was there to watch the launch, and joked about it and spent time recounting the events of the day. Because we were just basically told, "Well, you're dismissed until NASA tells you that you've got another flight date and what that is, and we'll get back with you with regard to picking up training in preparation for the next launch attempt for this mission."

So I presumed that mission would fly again. As it turns out it was within a few weeks' time. Certainly within hours, it was determined what happened. Within a few days the vehicle, the bird, had been rolled back to the VAB [Vehicle Assembly Building], and the engine was looked at, and it was determined where the problem was, and I think the engine was changed out. We were rescheduled for launch in August. So basically we reset the training cycle to like T minus two months, and within a couple, three weeks, I started visiting Houston again; back into the training cycle at like T minus two months. And we redid almost everything that we had

done, both as individual crew members and as a crew, in simulating, training, preparing for flight.

Now, my folks, my project, we had to unload the fluids, the liquids, the several tens of gallons of liquid in the electrophoresis apparatus. We did that out of the apparatus within a couple of days, I think while it was still out on the launch pad after the launch abort, on-pad launch abort, which, by the way, this was the first on-pad launch abort in the Shuttle Program, and only the second one in U.S. human spaceflight history. I think the first on-pad launch abort was Gemini VI, maybe, if memory serves me, Tom [Thomas P.] Stafford and Wally [Walter M.] Schirra [Jr.] back in like '66, when one of the engines did not start on the Titan booster.

So, anyway, the electrophoresis device had to be deserviced and sterilized, chemically sterilized, as it was installed on the pad, and we had procedures for that, but we didn't expect to have to do that again before the mission had been flown and landing. So the team—and I joined the team in some of those activities at the Cape, and then back in St. Louis in preparing new batches of the biological materials that we were going to test on that flight, etc., over the next couple of months, at the same time that I was back and forth to Houston in training.

So we prepared for an August, late August launch, and launch was scheduled for August 29th, which I felt a remarkable affinity for that date. It happens to be my birthday. So I thought, "This is going to be great if I get to launch on my birthday. What a memorable day."

As it turns out, we got down to the Cape, went through the preliminaries again, same kind of scheduling for a late August launch. Went through the preliminaries and found that there was again a problem with a computer—I think it was another onboard computing system—that delayed us by one day. They had to make a changeout on the pad, and so we didn't get to launch

on my birthday, but I did get a birthday cake and we had a birthday celebration in crew quarters. We actually did the launch preparation again on the 30th, and we got to launch this day.

So STS-41D finally did launch on launch day, the Zoo Crew. They felt like they needed to give me a nickname. Talk about the Zoo Crew. They felt like they did need to give me a nickname, but since—well, they didn't know me that well, and so they didn't know all of my ins and outs and peculiarities so they could pick on some aspect, you know, and really give me a memorable nickname. So I was known around, by the crew and by the office, as this Continuous Flow Electrophoresis guy, CFES, so I was just called "CFES Charlie."

But the Zoo Crew finally did launch on the 30th. That day I can remember that we were delayed by probably something like, oh, ten, fifteen minutes by a—and we're just hearing all this over the intercom, of course, up in the crew compartment as the Launch Director was talking to Range Safety.

Range Safety said, "We've got a private aircraft in the restricted airspace." So the FAA [Federal Aviation Administration] and the military were chastising and noting the number of the aircraft and waiting for the aircraft to get out of the airspace before we could go launch. So I can remember there were probably some pretty colorful, over the intercom in the crew compartments, some pretty colorful comments about the parentage of the pilot, whomever he or she was, of course, at keeping us from going into space and costing the nation, obviously, a lot more money because they were delaying us from doing that.

But it was that kind of humor, and a launch hold of just a few minutes before we actually did go launch. As you can well imagine, there were jokes, or at least quips, right down to the moment of launch, particularly from, I can remember, not only Hawley but from Mike Mullane,

like, "Well, Hank, I sure hope it goes a lot better. I hope we get a lot higher this morning than we did last time we did this."

The launch did occur, and it was very memorable. Every launch has to be very memorable. The engines started up again, and I know everybody was silently, in their own mind, was looking for that second, that fraction of a second beyond T minus two and a half seconds when we heard, "Second engine is up. First engine is up," and you knew you had all three liquid-fuel engines. Of course, you're hearing that just in fractions of a second time, because this is five seconds for the engines, four and a half seconds for the liquid-fuel engines to ignite, to build up in thrust, before the solid-fuel engines light.

In that four seconds, though, as everybody knows and as you see, there's what's called the "twang" on the pad. The way the Space Shuttle is secured to the launch pad by the solid rocket boosters, the center of gravity of the mass there is a little bit off-center of those pinions, and so the force of the liquid-fuel engines forces it over, and it swings back again. It's anchored on those solid rocket booster attach points.

Literally, you're up there on the nose of the Orbiter, and you look out that porthole—I look out that porthole; the guys upstairs have got a much better view of the outside—and I could see the structure, the steel tower structure. It looked like the tower was moving. As far as I'm concerned, I'm sitting still, but the tower out there starts moving. Whoa, boy, that is something to see again.

As soon as I turn and I'm looking at that, the twang—of course, again, it's like just two seconds in time between the twang starting and T-zero, essentially timed to when the Orbiter and the vehicle stack is straight up and down again, and the solid rockets light. I'm watching out that

window, and the vibration has started from those liquid-fuel engines firing. The twang is under way. The tower looks like it's moving outside.

Suddenly this roar is exaggerated by ten times. Now, thank goodness, we've got all this insulation in our helmets, because the acoustic level is something like 170 decibels in the crew compartment here. I mean, we would readily be deafened if we didn't have the insulation of the helmets around our ears.

So the sound goes up, and I see the tower out there suddenly turns from a white gray in sunlight to—it looks like it's on fire. There's a golden blaze around it as the illumination from the solid rocket boosters flares out there, and it's twice as bright as the sun, and it's yellowish, golden yellowish, and just as suddenly, instead of moving left and right, now the tower starts dropping away. And again, that's the way it feels, although you're pushed back into your seat immediately with one and a half times the force of gravity.

So you're pushed back in your seat. There's this vibration that's like you're driving a pickup truck with stiff shocks down a gravel country road at fifty miles an hour. I'm looking out the window, and I'm watching the tower. The tower disappears in just three, four seconds. It's accelerating faster and faster as I watch it disappear, and suddenly there's just a view out across the Florida countryside. It's bathed in golden light now. Again, twice the illumination of sunlight before, and then it starts rotating.

So there's this tremendous sensation of I'm not going up; the world is falling away from me out there, and now the world is spinning as the Shuttle goes into its roll to the correct azimuth on flight path. And the window—I'm watching the tower structure go away. I'm watching central Florida and the VAB go by, and now the roll stops after a few seconds, and my window is looking south and I can look down the Florida beaches to the south.

Now, knowing Cape Canaveral and Cocoa Beach and knowing where that is, I'm watching as I can see farther and farther down the coast. Every second the world is falling farther and farther beneath me, and within a few minutes I can see down the coast, and I can imagine I can even see the curve of the Florida coast around toward the Keys. And I'm arcing up, and now it's disappearing out of sight. There's nothing but blue sky out there.

Within that two-minute ride on the solid rocket boosters, all this vibration, the noise, the roar picks up but starts to soften and dim out the higher we go, because there's less air to carry that noise back into the structure and to be amplified in the cabin. But there's also an added noise now that builds up, which is air noise. As you start to go through Mach 1, and then Max Q, maximum dynamic pressure, you're still in the lower few miles of the atmosphere, and the air pressure outside and airflow was such that it's creating noise as it rushes by the outside of the Orbiter at the speed of sound and beyond. You can hear a roar that changes in amplitude until it goes up out of the range that you can hear.

So there's a roar from the rockets, a deep basal roar amplified through the vehicle. Then there's this rushing roar that sounds like—it's like a waterfall of air moving by the ship. Then all of that tends to dim out, even while you're still under acceleration up to two and a half Gs under the solid rocket boosters. At two minutes into flight, the roars just start to dampen down.

You know what's about to happen now, from training, but you're not ready for it, because the simulator in Houston gives you a pretty good audible and a bit of the physical, but in flight, it's like this tremendous bang all at once. You feel it rattle, and suddenly then the vibration is stopped, and the acceleration has gone back to like 1-G, so you feel normal. Here we are on the middeck, and I'm thinking to myself, "I know what's happening, but there's no instruments or anything to tell me what's happening."

You're hearing from the ground, though. The CapCom [Capsule Communicator] is giving us the record and the notation of what is transpiring in the flight profile. Hank's giving—or in this case, Coats occasionally—is giving a "Roger" to the ground; we're there in that part of the flight sequence. So we knew we had SRB separation. There was some comment from the flight deck that they saw this tremendous flash outside. This is always recorded when the solid rocket boosters are separated. The rockets on those that propel them away create a big flash, and there's always some propellant from those boosters that tends to deposit itself on the front windows, and so they make a note, a verbal note of, "Yeah, I've got a little bit of frosting on the windows," or something, from that.

But we're hearing all this downstairs, Judy and I, and making note, and I note that occasionally I think, to look over to my left, and Judy's like—she's just really intense, listening to everything, as well as looking out the window herself. She's really focused on the process and the procedures of going uphill, as we say. I'm just taking all this in, thinking, "Man, this is a great ride." But it seems like—now, it's eight minutes altogether, but it sure seemed like a long time at the time.

But most notably now, with the solid rockets gone, the ride on the liquid-fuel engines is just glass-smooth. You don't feel any vibration. You don't hear any noise to speak of, except for the fans, except for your own breathing, except for maybe the intercom, and people are fairly silent on the intercom. You're just paying attention to the instruments upstairs, the procedures, and the acceleration, which builds up to about three times the force of gravity something like six minutes into flight.

Now, the other thing that I can see is, as I look out the windows, even before the solid rockets separate, it's fascinating to see as the coastline disappears from view. I'm looking at

blue sky, but literally within a few tens of seconds, there's this blackness that appears at the top of that blue sky, at the top of the window, and the blackness starts eating the blue sky. You can see more and more of the horizon of the Earth, and you start to see a little bit of a bend, a curvature in the horizon, at the same time that the blackness is eating the blue sky. Within two, three minutes, there is only like as much blue sky out there as you can pinch between your fingers with your hand stretched out at arm's length, and even that is shrinking visibly. It's shrinking as you watch.

So you get this definite sensation that you're going somewhere. You're feeling pushed back into your seat. You're watching the sky turn black and the air disappear, the atmosphere disappear beneath you. So there's this tremendous sensation of being on your way to a distant place.

Eight minutes into flight, of course, you're under three times the force of gravity, and I found that it was an experience in which you could readily exhale, and it was a little bit harder to inhale. You had to—there was a force, again, three times your own weight now on your chest and your lungs and the rest of you. So it was hard to move your arm. In fact, I found that once I turned my head to the window and under acceleration, I started to turn my head back again, and I thought, "Ah." My inner ear goes like, "You don't want to do this very much." So the inner ear is under this acceleration, and you can get disoriented. I could determine that pretty readily, so I slowly remember moving my head back to look over Judy and out the window, and I didn't move it back again until maybe just before the engines shut down.

It's hard to move your arm. Your arm weighs three times as much as it normally does. I didn't have anything to hold up in front of me, in any case. But I was also thinking about these dozens of middeck lockers that were in front of me. Middeck lockers that had, oh, ten, twenty,

thirty pounds of stuff in each one of them that were only locked with two wing nut latches each, and they're now under three times their force of gravity, and I'm thinking, "I sure hope whoever sealed those sealed them real well, or I'm going to have somebody's underwear all over my face at three times the force of gravity." Fortunately, it didn't happen.

Three Gs, eight minutes into flight, and suddenly it was like the count—we could hear a count. We knew what we were looking at in terms of shutdown time, and all within, it seemed like, two or three seconds, the acceleration went from three times the force of gravity to zero, and I was thrown up against the straps. I say it that way, even though you're cinched in so tightly that you just—you lurch forward, but you really don't move more than a fraction of an inch. Everything is, and you are, weightless. You're now in space. Out the window is completely black. I can't see. The attitude was such that I could not see the limn of the Earth yet at this point, just the blackness of space out the window.

"Engine shutdown. We have main engine shutdown," was the call, and everybody is—I don't know that I did or not—let out a big "Yahoo, we're here." On the flight deck there immediately begins Henry and Coats and Hawley going through, calling to each other about flight procedures, main engine shutdown procedures, getting ready to turn the rocket ship into now an orbiting spaceship. I think I must have reached over to Judy again, shook hands with her, and we gave each other the high sign, and then I remember Judy like, after the high sign, she's like giving me this sign like, "Just calm down and stay seated," you know.

The plan had always been, well, okay, you're the payload specialist, even though nobody but Hank on the crew had been into space before, so basically [five] of us were rookies. But still the procedure was that I'm the payload specialist, so I've got to stay seated until she and they get unlatched and have started checking things out. And it was probably a good thing, because it

was probably about a minute after the engines stopped and we went weightless that my little bit of breakfast showed itself again, so I had a bag in place. I could tell it was coming, and I wanted to be ready for that kind of circumstance, so it really didn't embarrass me too much or upset the rest of the crew too much, because I caught it.

But that started about three days in which I did not feel all that well. Space adaptation syndrome had me by the neck, and the symptoms were not only occasional nausea, and only to put it in medical terms, what the docs call episodic vomiting. Would just feel the urge, and then once I threw something up, I felt fine again.

The only other symptoms were a malaise and slightly sweaty palms, like symptoms that I have, and I think probably others do, too, with a cold or the flu. You just feel low energy, a little stuffy, maybe, in the sinuses, and I felt with weightlessness, this tremendous, in the first few minutes, sense of—well, it was like I was turned upside down and blood was rushing to my head, which is exactly what the case was. It's like the body says, "Oh, I know what that is," after a few minutes, and you get used to it and you don't feel that fullness anymore.

But I still had these other symptoms for about seventy-two hours, almost literally three days. And they went away just like that, within an hour or so of my starting to feel like the symptoms are going away. Three days into flight, I felt just fine. And looking ahead, now projecting again historically into the future, the same was the case for my subsequent two flights, except that the magnitude of the symptoms was essentially the same, but the time period was less.

It's like my brain, after that first experience, each subsequent experience, my brain was like this mushy computer. I think of it as a mushy computer, a little slow on the uptake, like, "Wait a minute, I know that there's something familiar here." And each successive flight, it was

like, "Okay." The second time it took like maybe sixty hours to figure out what was going on, to adapt to the sensory inputs, and to say, "Forget about the symptoms. Now I know what's going on, you'll feel fine. Okay, I do." And the third flight, it was like two days, forty-eight hours into flight, I felt fine. So it's like each successive time, the brain is like, "Okay, I know where this is. Wait a minute, wait a minute. I'll think of it in a moment. Oh, yeah, I know what this is. Everything's fine. Don't worry about it."

But this first flight, I went ahead and after it was clear to everybody else that this guy is a little bit motion sick, got the SAS, the space adaptation syndrome thing, they told me just to slow down, don't move your head too much. Just stay still, you'll be okay. So I was feeling kind of bad that I was feeling bad, you know what I mean? It's like everybody else is like, "Here we are, big thing, in space. Got plenty of things to do."

I'm like, "Well, I've got plenty of things to do, too, but I don't quite feel like it." But again, it was like the flu, a mild case of the flu, and we all can do what we've got to do when we have the flu. We may not feel the best. So, yes, I was slow that first day. I didn't eat. I think I may have had some water or maybe some juice that first evening on orbit.

Crew time, by the time we get into space, by the crew and the Orbiter clock, it's probably like afternoon or early afternoon. You're six hours from going to bed, so to speak. For that remaining six hours, I just didn't do very much. I did manage to get my boots off and the launch harness off and stowed away, but I basically kind of stayed in the corner and didn't do too much and felt bad about feeling bad, even though everybody else, I mean, they were all great. Probably a couple of the other crew members didn't feel that well, either, but I don't think anybody was experiencing anything like the symptoms like I had.

But still everybody was adapting at their own pace in their own way to gravity, or zero gravity. But everybody was doing their job. I remember, I was opening up my procedures, and I really wasn't—the plan, since this was my first time up, the plan was for the first day to be really slow for my payload, anyway. I wasn't going to do any serious research the first day or even the first day and a half, necessarily. But starting the next morning, yes, I was supposed to turn the machine on and get started and everything.

So I remember at the end of that first day, Judy kept checking on me, and I'd tell her, "Well, I'm still not feeling that good." We were making plans for how she could work with me the next morning, if necessary, to help start the electrophoresis device up and start into the research procedure.

So we went through that first day just fine, and I remember it was on the afternoon of that first day—again crew time, on-orbit time—that I got my first chance to really go up to the flight deck and look out the big windows. So I had had a chance to look out the porthole and see this nine-inch view of part of the world out the window there, and I could hardly wait to go out and see the big picture upstairs.

When you say upstairs, of course, thinking about the flight deck, there's two openings in the flight deck floor that are in the middeck ceiling, and a ladderway going up through one of those openings. With your weightlessness, you don't need the ladderway, of course; just handholds to float your way up to the flight deck and get yourself back down to middeck through the opening. But I very carefully, after a couple of hours—probably, yes, about an hour and a half into flight, I remember saying, "I want to go up and take a look."

"You sure you feel okay?"

"Ah, I'm feeling good enough. Let me go up and take a look."

"Okay, okay." And I think it was probably like, "Clear the flight deck. Walker's coming up."

So I go over and grab the handholds, and I carefully—I'm trying to keep my head from moving around to get my inner ear too agitated here—and I float up, and I remember in the overhead windows—of course, now we're flying in the classic and almost always the heads-down attitude, so the windows are looking down at the surface of the Earth below us. I can remember looking out, and there's this blue, deep blue and green, and the puffy white clouds, and I'm thinking, "We must be over the tropics or close to the tropics somewhere." Because I wasn't quite sure where we are in the flight path; I hadn't put that together in my head yet.

I'm just taking in the awesome nature of this ocean, and there's clouds, and there's sun. There's some island down there, because there's blue around a white beach, and there's a little band of white around the edges of this island, a lot of green on it, and occasionally some orange holes in this island there. I'm looking at it, looking at it, looking at it, and finally I say to Hank or Mullane or somebody, like, "Where are we?"

I remember them looking at—they didn't have the PCs on board yet, the portable computers the size you could carry with you at that point in the program yet, so we still had the little print maps to follow. So they had out the flight plan with a map, an orbital track, like, "Okay, well, we're over the Caribbean."

I looked down, and sure enough. I remembered my geography well enough. "That's Jamaica, and right over there, that's the Dominican Republic, and back there, that's Cuba, and my gosh, look at, there's the Bahamas, and way up there, that's Florida. Oh, my gosh, this is just the most marvelous geography lesson one could ever have."

The other amazing thing about it was the motion, because it wasn't like a still picture at all, of course. It was moving. No, we were moving. Five miles a second we're moving over that, and so the scenery is always changing. I was awestruck by this, and I think I probably started moving my head a little bit, and I started thinking to myself, if not saying—I probably started looking a little green, as well—"I'm beginning to feel a little rough again."

Okay, so I started creeping back down, and I'd go back down into my hole. So I spent the rest of the evening resting, and I think I did take a little bit of food, maybe managed to keep it down. And I was thinking about, "Oh, gosh, I'll get started the next day. Got to be my best tomorrow morning."

The first night in space, we were—didn't have Spacelab, of course. No sleeping quarters outside the middeck, and we just had the sleeping bags. Now, we had to choose our sleeping bags before we launched. Now, I say choose our sleeping bags. The Shuttle Program had designed and had developed—I say developed—there were designed some specifically Space Shuttle sleeping bags, and they were the blue Nomex, the same color as the astronauts' coveralls, with a head strap to go over your head to hold you down to the little Nomex pillow under your head. You could tie this off to the wall or the ceiling or the floor or somewhere.

Of course, I had to sleep in the middeck. The pilot and the commander get the discretion as to sleeping on the flight deck. They get the big picture window view at night, of course. Ah, okay. Rank hath its privileges. But I wasn't feeling like sleeping anywhere else, anyway. I just wanted to be over in my corner and just be still. But somehow—I don't know why I did this; maybe it was just a sense of history. But I remember being offered—again, in the preflight equipment selection; this was months before—being offered this Shuttle sleeping bag, or you can have an Apollo era sleeping bag. We were still flying with Apollo stuff.

I picked the Apollo sleeping bag. It was a white, probably a white Beta cloth sleeping bag, and it had something stamped on it. I think it probably just had a serial number stenciled on it. But I put this sleeping bag, my white—and I was the only one with a white sleeping bag. In fact, I remember it vividly, because I've seen it any number of times in pictures. We kind of said—the crew said we had a six-and-a-half-person crew, because this was the second flight of the IMAX camera in the crew compartment, and Mike Coats trained as the IMAX camera operator.

The footage that we shot became incorporated into *The Dream Is Alive* IMAX movie. So there's a scene in there. One of the planned scenes was, okay, we're going to film ourselves sleeping. How do you do that? Well, okay. So Coats was behind it. So the only person you don't see in the picture is Mike Coats, because he's behind the camera as he floats through the middeck.

The first person in the picture is me. I'm in my white sleeping bag, and everybody else has got this nice sky blue sleeping bag, but here's this first guy in the picture that has got this white Apollo era sleeping bag. But I'm right over here. I'm on the port side of the middeck, next to my electrophoresis equipment. I lash my sleeping bag up against the middeck lockers, the forward lockers, so I'm literally going to be right next to the electrophoresis machine.

I arranged it that way, since it was supposed to operate twenty-four hours a day during three or four days of the flight, and the electronics had a beeper. The beeper was disabled at night; disabled when I would plug in an earphone, a headset, which would alert me through my ear. So I had to be real close by so I'd get alerted, and if I had to get up, then I wouldn't disturb anybody else, hopefully; take my little flashlight and try to fix whatever the problem might be, if that were the case. But I had to be real close by the electrophoresis device.

So anyway, I lashed myself to the wall there, and I remember doing that pretty early that evening, and the lights being turned down. I remember there was a light on in the WCS, the waste collection system, which was nearby and on the aft wall of the middeck.

After we got into orbit, Judy's first task, after unbuckling herself and checking on the payload specialist, was to open up the water closet, the WCS, the waste collection system. The reason for that, of course, is classic and physiological in nature.

It was readily found, from the earliest days of the program, that one of the initial physiological outcomes of spending time in weightlessness is that the fluids in the body achieve a uniform distribution. My head felt full when I got to orbit, because more blood's rushing to my head. Blood is leaving my lower extremities, where it tended to be under the force of gravity, and that includes there's more fluid around the kidneys.

There is a cellular sensor system around the kidneys in all of us that senses when there's a lot of fluid pressure there, and when there's a lot of fluid pressure, it says, "Uh-oh, the body's got too much liquid. Let's go to work." So literally everybody has to go to the bathroom within probably an hour and a half or two hours of getting onto orbit. So the water closet is one of the first things that you turn on up there, so Judy's task was to turn that on.

Well, at nighttime, we left a little light on over there. So there was a night light over near the waste collection system, and other than that, turned the lights out. I remember I took a sleeping pill, because I wanted to really kind of doze off and try to feel like I was getting a good night's sleep.

It was probably within that six hours that first afternoon on orbit and before sleep started that night that one of the other primary symptoms of adaptation to space happened to me, which was back pain. Without gravity pulling down on the body, the disks between the vertebrae in

everybody's spine, the disks, flexible disks, expand. So everybody grows by about an inch or thereabouts in height. Okay, an inch in height, but that means the back muscles are also being stretched, and unless you're a real limber gymnast, your muscles are not loose enough to take that stretch and take it comfortably.

So most everybody has back pain, and I had back pain for two, three nights, days and nights. I can remember waking up that first night wishing I had an aspirin and not knowing where to get one, but the next night and two and three, remembering to take an aspirin before I went to sleep. But the back pain, you ached for a little while, unless you took an aspirin to deal with it. At the same time, I was trying to get my sleep.

The atmospherics were okay. The cabin lights were out, but, of course, every ninety minutes it's daylight outside—or every forty-five minutes, and then the next forty-five minutes, it's dark outside. I couldn't stay away from trying to peek out the porthole, either. I wanted to see what was going on out there, what the world looked like.

The other thing was that I wanted to wear, and I did put in, little earplugs to silence the background noise. The ground went radio silent, so the ground didn't communicate with us. They were always listening to us. Now, this was in the days before TDRS [Tracking and Data Relay Satellite]. I say "always listening to us." Anytime we went over a ground station, they were able to listen to us, but we were in radio silence for, on average—it varied from orbit to orbit—but half of every orbit we were in radio silence with the ground below, unlike today and unlike it's been for the past fifteen years with continuous coverage via the TDRS satellites.

So, in fact, we were experimenting with—there was one TDRS up at that point in time, launched on STS-6, one in operation. So we were—yes, we were using TDRS. I think we may have flown with the very first Ku-band antenna on the Orbiter, an antenna that literally had to be,

after the cargo bay doors were open, had to be unfurled, that is, its arm moved out of stowed position, and the antenna could track the TDRS satellites probably over the south Atlantic Ocean at the time. So we could be in contact maybe over half the time, maybe close to two-thirds of the time, around the world. But there were plenty of times when we weren't. But still there was occasionally a burst of static would come over the intercom from some radar or something tracking us from the ground below or radiation or whatever. And then the fans were always going, circulating the air in the cabin. So there was some noise all the time, and it was not all that silent in the crew compartment, even during the crew night.

But [I] woke up the next day. Still felt a little soft in the head, as I put it, and yet started in the procedures. Turned on the apparatus, and I'll quickly summarize some of the rest of the mission, in terms of my research. The work that was done with the device, went through the preplanned procedures, inserting the various chemicals and biological samples I had to process. The machine worked, for the most part, pretty well, but there were some electronic software glitches that I had to work out on my own or in consultation with the ground.

Now, again, at that point in time, without full TDRS coverage around the world, communications with the ground was considered a precious commodity. So I was granted—every so often I'd tell Henry and/or Judy and Mike, "Hey, I've got to talk to the ground. I've got this kind of—." I'd then describe to them what my problem was, what I had to talk to them about. At the beginning of the next com pass, unless it was all full of already planned conversation, they would let the ground know that Charlie's got a question for his back room, or he's got some information to communicate to the ground, and so I'd get a little bit of radio time with the ground.

So I had to work out some problems with the computer, some bubbles in my electrophoresis apparatus, with ground assistance, but mostly I was on my own up there in resolving issues and questions with it. But the device worked well enough through that first flight [of mine] and had the work done by the fifth day into the mission. We only had a six-day flight. The accomplishments, I think, were as we expected in flight for my research.

As it turns out, only after flight did we find, in analyzing the samples, that there had been some biological contamination. In other words, a little bit of bacteria had gotten into some of the fluids during preparation before flight, and the bacteria had grown during flight and contaminated what we intended to have as a biologically pure, uncontaminated by extraneous bacteria—it was, in fact, contaminated.

So the work that I had done had been, so to speak, technically productive. We learned new procedures. We validated the procedures. But the veracity of the biological sample itself for the medical testing that we were going to do postflight turned out to be a problem, turned out to be bad. So we were not a complete success in terms of our mission accomplishment because of that. So that was the way that flight turned out in terms of my work.

The personal experiences, I mean, here again, spaceflight, my first time into space. Again, as far as I knew at that point in time, it was my only chance in space. I took some pictures. I took pictures—I was not allowed to take my own or a company camera with me. NASA didn't want me taking—no personal pictures or camera equipment allowed. I could use the NASA camera.

So I used some NASA Apollo-era, Skylab-era Nikon cameras and thirty-five millimeter film, but I was only supposed to use those to take pictures of my apparatus, of it operating, and it

had certain visible dye, colored dyes, in it I could use to track my sample and note the fluid dynamic nature of the work. So I was supposed to just use it to take those kinds of pictures.

Well, I actually snuck a couple or three pictures up on the flight deck now and then, and I don't know if Henry or the crew actually ever saw me. Well, I can't imagine in a space that's no bigger than a big kitchen that they couldn't have seen me.

But most of my viewing was just eyeball viewing out the windows when I had a chance. And, of course, all of us would take the chance at any opportunity to look out the window, and to do the other thing, which was to experience the weightless environment in any number of ways, like playing with your food at mealtime.

I remarked about the IMAX movie. Again, there are scenes in there. There's one classic—I would call it a classic scene—of us in the middeck. It's very nicely done. My hat's off to Mike Coats and to the IMAX team for having planned it so well. They set up the lighting with overhead lights to have on in the middeck, where to put the camera, and we kind of positioned ourselves around. I was over near the water dispenser and preparing the drinks. In the IMAX footage, you can see us finding various places around the middeck, up against the wall or on the ceiling, and I'm passing food containers across the cabin, floating it through the air. I think it's Mullane that's trying to—no, it's Hawley that's trying to, in the picture, eat a shrimp cocktail, and he's twirling the shrimp in front of him before he grabs it in his mouth.

I mean, that scene just kind of epitomizes the little games that we would play with just the simplest things around us, because it's just this magical environment, magical from the standpoint of normal human experience. And it's human experience that I think—I know to myself; I think to others—after we've had that weightless experience for hours, days, and for the folks that are lucky enough to have months on end at Space Station, once you come back, you

see the world around you, experience the world around you, in a different way. I mean, now it seems amazing that this bottle in front of you on the table will sit on the table, because now we've had the experience of having that bottle just float anywhere around.

In fact, you could lose it when it floats away from you and you don't know where it's floated off to. And you certainly don't think twice about necessarily keeping the top off the bottle here on the ground. In space, you wouldn't keep the top off the bottle too long, because the fluid inside would start crawling up out the opening. It would form a sphere and would eventually break away and float around the cabin in front of you, and if you were so unfortunate as to find it running into a wall or your face, it would tend to cover the wall and/or your face, and it would be a nice little mess.

So these things you start thinking of now in your experience, and up there you're experiencing them for the first time, and it's a magical new reality. It's somewhat dreamlike, but it's all real and right there. You're a part of it, and it's a part of you. So I don't think you ever, at least in a six-day flight, of six-day length, do you lose the desire to play in this environment as often as you can, and again, to look out the window and to see a constantly changing landscape below you, and to take the opportunity to turn your eyes occasionally away from that home planet out into the blackness of space.

While the view of the home planet is—well, my experience was that it's amazing in the starkness and the brightness of the colors, and they're the basic colors. There's blues in the ocean; greens, green and orange and brown on the land; and clouds, white clouds, gray clouds. But they're bright and so crystal-clear.

The night side of the Earth, very different. If there's a Moon out, literally you can see shapes and textures on the surface in the moonlight. You let your eyes adapt to seeing that low

light level. You see thunderstorms. You see the thunderclouds are like flashbulbs going off; miniature flashbulbs going off, so it would appear to the eye, when of course they're enormous thunderstorms, sometimes over tens or hundreds of miles, especially in the tropics, and you can see strings of lightning flashes, one right after the other, going off over dozens of miles at a stretch beneath you.

Seeing orange glows, spots of orange glows, and they're twinkling, over the Middle East or African or Southeast Asian countries, and you know, after a while you figure out that those are oil burnoff or gas burnoff at refineries. Oil refineries, you especially see those in the Middle East. You see even, if you look closely, over Africa particularly, you can see the tribal fires at night, cook fires or ceremonial fires in villages in some of the old tribal countryside of African countries.

There's just so many amazing things, and the more you look, the more you see. This amazing planet that you're orbiting, you look to the edge of the planet, and here's all the air that we breathe, and you could hold your finger out in front of you as you look at it and pinch your finger with just a half inch or an inch between your fingers, and that's all the blue that there is at the edge of the Earth fifteen hundred miles away. But it seems like it's so little compared to this enormous planet that you're flying over. So you get a sense of how delicate the environment is.

Then I turn my eyes even beyond that out into the depths of space, and I tell you, even now as I recollect it, the hair on the back of my neck stands up, because there is—to me there was a sense of infinity. I mean, it's more than a word, and it's more than the color black, because the word does not describe the infinite nothingness of the depths of space as you look out into it, as my eyes looked out into it. I felt like my eyes, my mind was literally being drawn

into it, and that there was no end to it. I mean, that was the feeling. It was more than the words in my head, but it was the feeling.

There was depth to it, and I was seeing this planet, or a portion; with every view out the window, all I could see was a portion of the Earth. But beyond that was this infinite blackness, and if you let your eyes adapt on the night side of the Earth where you didn't have outside sunlight to restrict the sensitivity of your eyes, you could see the stars at night on the night side. The stars were like these solid laser beams of light. I mean, they were solid. I've used the term occasionally, "diamond-hard points of light."

They weren't twinkling stars. The atmosphere was below you. It wasn't in the way between you and that light now, causing the light to twinkle. No twinkling stars, but just solid points of light, and you knew where to look to see the occasional planets.

You knew where to look to see Venus. You knew where Jupiter was or Saturn or Mars, and when you looked at those—when I looked at those, they actually looked closer. To my eye, they actually looked closer than the diamond points of starlight, and it added to the sense of depth.

So it was just this very powerful sensation of the physical nature of the universe in which we live. I'm an astronomy buff, so I love to go out in the dark night and find mountaintops and take a telescope or binoculars and go out and look at the night sky. But the night sky never looked down here like it looks up there. It was just an amazing experience. Lots of perceptions.

And I haven't let you ask one question in the last thirty minutes. [Laughter]

ROSS-NAZZAL: Well, it's always a pleasure, Charlie, and I think we should probably end on that positive note.

WALKER: Okay.

ROSS-NAZZAL: So thank you so much.

[End of interview]