# NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
# ORAL HISTORY 2 TRANSCRIPT

HENRY W. "HANK" HARTSFIELD, JR.
INTERVIEWED BY CAROL L. BUTLER
HOUSTON, TEXAS – 15 JUNE 2001

BUTLER: Today is June 15th, 2001. This oral history with Henry Hartsfield is being conducted for the JSC Oral History Project. Carol Butler is the interviewer and is assisted by Kevin Rusnak and Kirk Freeman.

Thank you for joining us again today.

HARTSFIELD: It's good to be back.

BUTLER: It's wonderful to have you back. Last time we were talking, we had talked about your first mission and were moving into your second mission, and we had talked some about the payload specialists and how that all worked, and with Charlie [Charles D.] Walker. And you talked about the electrophoresis experiment that he had done and that you all participated in to some extent. There were other experiments, obviously, going on on your mission. In fact, one of them was the OAST-1 [Office of Application and Space Technology]. If you could tell us about that and maybe a little bit about some of the other things you were doing during that mission.

HARTSFIELD: Well, we had four major payloads. There were three satellites. We deployed three satellites, two PAMs [Payload Assist Modules] and a SYNCOM for the Navy. That was the first time they had launched three satellites on the same flight. Later that repeated a number of times. But the OAST was really a test of a solar array. It was extended out of a canister that

was mounted on a truss in the payload bay. When fully extended, it was 105 feet tall, really spectacular to look at.

The array did not have very many real solar cells on it. The purpose of the experiment was to really look at the dynamics of the array. They had tried to predict how rigid it would be and how well it would work. The truss or the beam that deployed the array was a rather unique design. It was three linear like fishing rods, composite material for an array, so its rods and its cross rods and cables and the rods were in compression and the cables were in tension. It was really unique, and the whole thing coiled up on a lazy susan in the bottom of the big cannister in which the thing was stored. The same arrangement is what's being used in the [International] Space Station today, if you watch those arrays being deployed. They come out of a big can, the poles that push them up, the beams, and to get more redundancy, those beams are four full rods go up instead of just three.

Surprisingly, once the thing is deployed, it's fairly rigid. In fact, one of the big experiments we did was to turn off the control systems on the orbiter and let it get really stable, and then fire the thrusters and then measure how the array oscillated. We had to fire a series of thrusters with timing in between. The idea was to excite the structure. What was interesting was the array was an order of magnitude stiffer than the engineers had predicted, which was a big surprise to them. In fact, by the time we got ready to fire the second set of firings, which was supposed to increase the motion, the thing had almost stopped completely, I mean it was so stiff. You know, the damping ratio was very high, much higher than they had anticipated.

So, it was an interesting experiment, they learned something from it, and I don't know how much of that technology paid off in the design of the truss for the Station, but I think it was the same company built it, if I'm not mistaken. So they've learned from it, I'm sure.

BUTLER: Oh, I'm sure. Well, it sounds like they got a lot out of it.

HARTSFIELD: My crew, we had different ones assigned to be the lead, and the solar array was Judy [Judith A.] Resnik's project. I let her be the lead, or I assigned her to be the lead for that. She did a good job with it.

BUTLER: Talking about the crew, and, again, we had earlier talked a little bit about Charlie Walker and how you integrated him in to really build a good team there. If you could mention some of the other, like some of the training and how the crew dynamic was as a whole.

HARTSFIELD: Well, we had a good crew. We had a lot of fun. I think I told you we called ourselves the "Zoo Crew." It was probably, in my view, of course I'm prejudiced, but it was the best crew we ever put together, because I mean everybody was extremely talented. As the commander, I just sort of had to stay out of their way. I was reminded of that two-billed hat, you know, that says, "I'm their leader. Which way did they go?" But they were good.

The important thing is we got along well, and we had a lot of fun training. [Michael L.] Coats and [Steven A.] Hawley were sports nuts. So a lot of the training sessions, when they would be waiting for to reconfigure the simulator or some lull, they'd be spouting sports trivia. Mike [Richard M.] Mullane, he was funny. He didn't know anything about sports, at least not very much, not as much as Hawley and Coats. So, one of them would ask the other a question, and Mullane would always say, "Earl Campbell." He was always throwing in a funny, you know, because Earl Campbell was his only name he knew out of sports. But we had a lot of fun. It was a good time.

BUTLER: That's good. That's certainly important, as you've mentioned. Did you, as a commander, have any input into the crew selection at all, or was that handled separately?

HARTSFIELD: I was asked before they announced the crew did I have any problem with it. They obviously wanted to see if there was a personality conflict, and I said, "Absolutely not."

It's kind of funny, Mr. [George W. S.] Abbey used to tell the crews they'd been selected. I had gone over to Mr. Abbey's office earlier, and the crew was given a notice to report to his office. When you got a call to Mr. Abbey's office, you were never quite sure why you were going. You hope it's good. But as I heard this story from them, they just happened to all arrive at the elevator at the same time, you know. As soon as the elevator doors closed, they looked at each other and said, "Yippee!" Because they had figured out kind of what it was going to be for, you know.

BUTLER: When you have a group of that many folks, and all in the astronaut corps, it should be a little giveaway there. That's good. That's good. Well, it sounds like it was a good team that all came together, and things did go very well on the mission.

HARTSFIELD: Yes, the flight went really well. I don't remember, did I discuss the plumbing problem we had?

BUTLER: No.

HARTSFIELD: Well, I think I told you about the first try at launch and we had the pad abort.

BUTLER: Actually, I don't think we had gotten that far.

HARTSFIELD: Oh, we didn't? Oh, okay. Well, we went out in June to fly, and the countdown went real well. When we got down to four seconds, you know, the engines had already started to come up, and then they just shut down. We looked at the countdown clock on the onboard

computer display, and it was stopped at four seconds. We were really checking to see if there was anything out of the ordinary. We were going to make sure that things were still okay.

There was a good moment of tension there, and Hawley broke the tension. As soon as we looked at everything and everything was okay, Steve said, "Gee, I kind of thought we'd be a little higher at MECO [Main Engine Cut Off]." [Laughter] So we were working with the launch control center. They were trying to figure out how to recover and get everything safed.

Then for some reason or another, they picked up a fire on the pad, a hydrogen fire. That got everybody excited, and they wanted to get us out of there in a hurry. Of course, they'd already brought the swing on back, and they turned on the water spray and all that stuff. They got us out of there pretty quick.

The trouble with a hydrogen fire is you can't see it. You know, hydrogen and oxygen burn clear, and you can just see some heat ripples when you're looking through it, but you can't see the flame. I think one of the sensors picked it up, a UV [ultraviolet] sensor, which can see it. That turned out to be a positive thing in that after that there was a great deal of attention paid to training the launch control crew to recycle. So it became a standard part of their training somewhere to have an abort and then go through the recycle. They had procedures for it, but you could tell when they were going through it, it wasn't smooth. They were a little rough with it because they'd never done it before.

BUTLER: That's interesting.

HARTSFIELD: Then we found out later, talking to the launch control director, that when they found the fire, saw it, that they wanted us to get us out in a hurry, and their first inclination was to have us use the slide wire. But no one had ever ridden the slide wire, and they were afraid to tell us to do it. That bothered a lot of us in that they were concerned enough about the fire that they really wanted us to do an emergency egress from the pad area, but since the slide wire had

never been ridden by a real live person, they'd thrown sandbags in it and let it go down, they were afraid to use it, which was a bad situation, really.

As a result of that pad abort, they revamped all the procedures, trained the launch control center, and they also went out and relooked at the slide wire business and Charlie [Charles F.] Bolden [Jr.] rode it, and it was a piece of cake. So from then on, they didn't have any qualms about, if they needed to, telling the crew to go jump in the baskets and head to the ground.

BUTLER: Did they initiate some training where they would do training exercises with the crew and have them—

HARTSFIELD: Oh, yes, we had the training. We had to practice egress to get out of the orbiter, charge, and jump in the baskets. And then where the basket is tied up with a rope, and they have a lever you hit and it cuts the rope, and away you go. When they're not in a launch configuration, they also have a chain holding it. So if you accidentally bumped and cut the rope, you're still not going anywhere, you know.

So, on launch day, they take the chains off, so that the basket is armed now and it's ready to go. So we were getting that training, but the problem was that the launch control center is the one who initiates it, the egress, and they had a number, and I can't remember what the number is, which means you go to the slide wire. In our case, they were afraid to do that because no one had ridden the basket. So, as a result, everybody revamped their procedures, and their worries about using the basket went away.

In fact, the next pad abort we had was, I don't know, about maybe a half a year later or something. They didn't have any fire or anything, but it was a piece of cake. They just recycled real quick and went right through it really smooth.

They also put more sensors on the pad to look for hydrogen fires. See, I think we had a small leak in the engine area, something like that, they had little sparklers, you see. That's

supposed to catch any kind of leaking fuel to spark it off. So it was a disappointing experience, because we were two months later getting our real flight and to recycle.

The second time we recycled, it just went beautifully. I can't remember if it was the first one—the second, we had some one-day scrubs where we had some problems, I remember, with the computer once, and we elected to let them put a patch in the software and fix it.

But once on orbit, the orbiter worked very well, except for the icicle we built on the side. That was what I meant by the plumbing problem. *Discovery* was not the same. It was basically the same design, but it had different thermal protection in place. Like *Columbia* had tiles all over it, *Discovery* was built with thermal blankets on the sides and the later ones had that, too, and they were a lot lighter than *Columbia*. *Discovery* was about 8,000 pounds lighter than *Columbia*, had a different structure in the vertical tail, as well as the whole back end, and then getting thermal blankets instead of tiles was different, made it easier to maintain.

But in doing so, I don't know if they redesigned the dump nozzle or what, but early on they noticed that the—well, the dump nozzle we could tell—we had dump nozzle temperatures when we'd do a water dump, and when the temperature craters, it's not good news. It tells you that it's frozen. We tried a couple of times to thaw it out, but we couldn't dump wastewater.

It was a wastewater nozzle. The wastewater consists of urine and condensate. We have a humidity control in the orbiter, and there's a condenser that condenses water out of the air, moisture from the breath and everything, keeps the humidity right inside the spacecraft. So it's not clean water, and the tank was getting full when we tried to dump it, and we got this icicle. I don't know if you ever saw any pictures of it, but it was this long and about this big around [Hartsfield gestures]. There was a lot of concern.

We had to get rid of the icicle because if it stayed on there, the concern was that when we started entry it was just about the right place to break off and then hit the OMS [Orbital Maneuvering System] pod. If you hit the OMS pod and broke those tiles, that's a real high-heat area right on the front of that pod, you could burn through. And if you burned through, that's

where the propellant is for the OMS engines, you know, and that's not a good thing to have happen.

So we spent a long time with that side of the orbiter facing the sun, and after about three days, or whenever, we were convinced that the ice was not going to sublime off the orbiter. It reduced in size somewhat, but it was still there. I had people ask me, "Gee whiz, you got it right in the sun, why didn't it melt?"

I said, "The same reason snow and ice don't melt on a mountain. It's in direct sunlight, but it doesn't absorb much heat. It reflects most of it." That was the same thing as this icicle. It wasn't going anywhere. Slowly it was subliming, but not very fast.

So they were looking at options, and I forget what day it was, four or five, we dumped the cabin pressure down to 10.2 [psi] in case we had to do an EVA [extravehicular activity] to go out. We were so concerned about how you would do an EVA because the dump nozzles were on the side of the orbiter, under the payload bay doors while they were open. So it was how do you get there? There are no handholds to do an EVA. We were worried about that on board, and they were worried about it on the ground. If I have to do an EVA, how are you going to get somebody down to it?

In the meantime, they came up with the idea of breaking it off with the arm, and they worked that procedure out in the lab down there, the trainer. Sally [K.] Ride did a lot of work on that. Then she read the procedure up to us, and I forget what day it was, I operated the arm and broke the icicle off. Michael Mullane got a picture of it. He said, "There it goes," and he grabbed the camera and snapped a shot of it. They released that picture. It's kind of like in the black of space, but there's this great big old icicle floating away. We were really relieved to see that go away.

The only other thing it did was it made us change our activities on board, because the wastewater tank was filling up and we were running into a problem collecting urine. So they told us to not put any more fluid into the waste tank and suggested that we use bags to collect

urine. In retrospect, that was a fun problem, but it wasn't so much fun at the time. But we learned very quickly. I mean we had lots of plastic bags, fortunately. We had some fecal collection bags that could be used. If the toilet broke, you had a bag you could collect feces in. So we could use those, and we had other storage bags.

The problem was that in zero-G, Newton's third law is very apparent to you. If you just try to use a bag, when the urine hit the bottom of the bag, it turned around and came right back out, because there's no gravity to keep it there. Didn't take long to figure that wasn't going to work. So after we got cleaned up, you thought about a new approach.

But what we found out is very funny. We took soiled underwear, soiled towels, washcloths, and put that around in the bag, and that absorbed the urine. In fact, we had a lot of socks we hadn't used, some dirty socks. We took a picture, and nobody ever understood that picture. We put the camera on automatic and had it mounted on the wall. We all lined up and each of us had a sock in our hand. [Laughter] And no one on the ground ever figured out what the heck we were doing. They said, "What the heck is this all about?"

But I made a decree, because Judy, as you can imagine, had a hard time with the bag, so we had a little room in there. I said, "I don't care what the ground says, you use the bathroom. The rest of us will do the bag trick." But it got messy. We have a waste storage tank under the floor, and it was filling up. We had a wet waste, there's a tank to put wet waste, you know, wet trash. At least one instance we had where one of the crew members was stuffing a urine bag down there and the bag ruptured, you know. So it wasn't a very sanitary situation. It was uncomfortable.

Randy [Brock R.] Stone was the flight director, and he knew we were having troubles. Twice he sent a chit up [to management] to let us convert. It was easy to do, just a quick plumbing thing, but convert one of the water tanks to a waste tank. If you remember, there was a big concern, I think, at the time, about turning the orbiter around. They had the idea that if

they converted a water tank to a waste tank, it would add another week to the flow at the Cape to get it ready to go again, because of they had to change the tank out and all that sort of mess.

You know, I sometimes think I made a mistake. I probably should have called for a private med conference and told Flight, "Hey, we've got a real problem up here." Twice Randy asked for that. Twice he was turned down by the Mission Evaluation Room [MER]. They denied the chit. I talked to the guy that headed that room up when we got back, and he apologized. They later found that it wouldn't have impacted the flow at all. I said, "Joe, you just don't know what we're going through up there."

"Well, you should have told somebody."

"I don't want to put that on the loop." I mean, in fact, Gerry [Gerald D.] Griffin, the center director, when we got back, he expressed his thanks for not putting that on the open. The media would have had a ball with that. The crew was saying, "Let's tell the ground."

I said, "Don't worry, they're working on it." And they were. I had confidence in the ground crew. I said, "They're working it." But they never gave us the go.

In fact, we were hoping to stay another day on orbit, because we had enough fuel to do it, but this was not a very good situation. By the time day six came, we were ready to come home. [Laughter]

BUTLER: Yes, I can understand that.

HARTSFIELD: There were a lot of pleasant things, a lot of funny things happened. I remember when we trained, one of the things that happens when you get in flight, everybody's got a job to do, so everybody goes their own way mostly during the day. Most of the jobs are individual jobs. There's not a lot you do together. Some are coordinated.

But you get up in the morning or wake up and you've got six people to run to the bathroom to get personal hygiene done and all that, and, you know, it just takes a while. And

everybody's got to get breakfast. Because of this crazy schedule and getting the orbiter turned on, there's no time for crew to get there, because one eats while the other is in the bathroom. You know, you get a quick breakfast snack, and the first thing you know, you're off on your daily do list. You eat lunch, normally, on the run where you've got a lull in your activities.

But I had decreed that the evening meal we were all going to eat together. I want one time for the crew to just get together and just chat and have a little fun and say, "Okay, where are we? What have we got to do tomorrow?" and talk about things. I remember one of those evening meals, we had just got our meals prepared, and we were all in the mid deck eating, and all of a sudden we heard [knocking]. What in the world? It sounded like somebody was knocking to get in, you know.

We're on the night side of the Earth, so it's pitch black outside. We had a traffic jam getting up into the hatch end of the flight deck. The rapping was coming from the starboard side, right side of the orbiter. It wasn't the side the hatch was on, which was kind of a relief. [Laughter] But we couldn't figure out what it was.

Hawley is a pretty sharp guy. He caught it immediately, when he got up and looked at the readouts up there. It was the KU band antenna. So he flipped the power off. In the meantime, I was trying to get the payload bay lights on, because it sounded like it was outside. And it was, it was the KU band antenna just on the starboard seal, just aft of the bulkhead. What had happened, it had gotten into a gimbal flip region and it was kind of doing this [Hartsfield gestures], and every time it would do that, the gimbal would flip around. So it was making that banging noise.

Steve turned it off and we recycled, and by that time we were at a different angle for the satellite, TDRS [Tracking and Data Relay Satellite], and it worked fine, you know. But at the time, it really got our attention, you know. I mean here we are in the middle of space, and somebody wanting in, you know, is what it sounded like.

BUTLER: Boy, that would be a little startling, wouldn't it?

HARTSFIELD: We got a big laugh about that.

BUTLER: You certainly did have some interesting times for this mission, but it did all work out pretty well.

HARTSFIELD: It worked out real well. We had an uneventful landing, and we filmed some of the IMAX movie on our flight, *The Dream is Alive*. Fortunately I made a good landing and hit the spot. That was when Cronkite says something about landing on the spot.

BUTLER: Well, you'd certainly trained enough for it to make sure that you did, I'm sure.

HARTSFIELD: Well, really, you don't try to hit the spot. You want to make a good landing and get the orbiter down. Your setup is hopefully going to get you close, I mean, obviously, but the landing process itself, you take what you get. I just lucked out and landed right on the spot. Even though I'd set up for it, there's no guarantee. You're going to get the little wind variations and slight variation in touchdown speed. You know, you might miss it.

BUTLER: Well, you landed right on the mark, so all went well there. After this mission, of course, you came back and went through some post-mission activities and such. But then with a pretty short turnaround, you were assigned to 61-A, which in light of what you were talking about here with organizing several people for the bathroom and activities like that, 61-A had actually eight crew members on board. That was a pretty full mission. If you could tell us some about that with the assignment for the crew, and this was a very unique mission, Spacelab, and it

was oriented with the German side of things. If you could tell us about some of the early parts of assigning the crews, and beginning the training, and then we'll kind of work through.

HARTSFIELD: Well, about the time I was to fly 41-D, I was told that I was going to fly 61-A. It was in that time frame, because it was about just a little over a year away, and I was real pleased with that.

During the intervening—in fact, on post-flight of 41-D, I had a post-flight trip to England. The *Discovery* was named after the Royal Research Ship *Discovery*, which is a floating museum now anchored in the Thames [River, England]. *Discovery* was Robert Scott's ship when he went to try to reach the South Pole. Royal Dalton had manufactured the ship's china, which is these plates all had a little logo with a penguin on it. I don't know who turned them on, but what they did, I guess maybe the connection to the ship, they specially made three of those plates, just like the ones for *Discovery*, and put our mission patch in the middle of it in addition to the penguin logo, and we flew those plates in the administrator's kit.

One plate went to the Smithsonian, one went to Royal Dalton's museum, and one went to this ship *Discovery* in the Thames to be on display. Well, I drew the short straw, and got lucky to go take the plates that went to England back to them.

So when I went on that trip and got that done, then I was already assigned to 61-A, so I went from England to Germany and met with the German officials. Part of my crew was there as well. Bonnie [J.] Dunbar and Guy [Guion S.] Bluford [Jr.] were over training. I went to Bremen and met with them, and it was rather interesting. I'm not fluent in German, but I knew a little German. I took German in college. In fact, when I went to the University of Tennessee Space Institute after the MOL [Manned Orbiting Laboratory] Program, I had entered there in the Ph.D. program and then decided I'd switch to the master's so I could finish. But I had taken my language exam. You had to have a language to get a Ph.D. Every school is different, but they gave me an article in German, a scientific article, and I had to translate it. They gave me two

hours to work on it, and I passed the German exam. Another grad student there told me, "I've taken that thing three times, and you just walk in cold and pass it. How do you do that?" [Laughter]

But I was fortunate, too, but mastering the written language is not the same as the spoken, as you know, because you've got to get a ear tuned to it, but I did pick up enough that I could tell what the conversation was about. But what I was getting at was the story about a press conference I went to while I was there. I was sitting right next to Ernst Messerschmid, who was also one of the crew members from Germany that was assigned to D1, and the reporters were quizzing the general program manager. I got the gist of it, and I wasn't sure I heard it right, and I asked Ernst, I said, "What did he say?"

He said, "He wants to know how much Germany has to pay the United States to use their Spacelab," because Spacelab was built in Germany. It was built in Bremen, you know. They were very sensitive about us. I think Germany had paid 80 million dollars for that flight. But this reporter was taking a very nationalistic look at it. "We built it and now we have to pay to use it." But it was a barter agreement that they had with the U.S. They built it, and in return for giving it to the U.S.

What happened is that he was wrong for the first part. The first Spacelab, which was STS-9, was a gift to the U.S. in return for flying a payload specialist, Ulf Merbold, and flying experiments on it. It was a barter arrangement.

The second Spacelab the U.S. bought, and the program manager was pretty right. He told them that. He says, "This is not ours. The United States bought this one from us." So our flight was the first with the new Spacelab, the second one. So I worked with that.

It was a kind of interesting arrangement. The negotiations with the Germans were sometimes delicate. Let's put it that way. They were very—I won't say demanding. That's a strong word. They pushed hard to get what they wanted out of the contract that they had signed

with the U.S., and they took an approach where they would hang up on words, on what a word meant, in the agreement.

I know one of the biggest controversies we had is that they wanted to use the German language and talk to the ground crews in Germany and speak German. I opposed that for safety reasons. We can't have things going on in which my part of the payload crew can't understand what they're getting ready to do. It was clearly up front, the operational language will be English.

We finally cut a deal. We fought that one hard. We finally cut a deal that in special cases, where there was real urgencies, that we could have another language used, but before any action is taken, it has to be translated into English so that the commander or my other shift operator lead and the payload crew can understand it. So we cut a good deal, but it took us a while to get there.

Interesting, Hansulrich Steimle was the mission manager, and Steimle was a very interesting fellow. He liked to philosophize. We became very good friends. I'll never forget one day we were sitting in my office, and he was talking about philosophy. He says, "You know, in the United States, when a new policy comes down, the Americans, they look at this and say, 'Okay, here's what we've got to do,' and they salute and go do it." He says, "In Germany, when a new policy comes down, we study it very carefully, and decide how we can continue to do what we're doing under this new policy." [Laughter] I thought, "Boy, is that ever true." I know some people in the United States that do that, too, you know. I worked with some of them.

But it was an interesting mission. I would say it was probably the most diverse mission ever flown. We had a black, a woman, two Germans, a Dutchman, and a Marine. I mean, how diverse can you get, you know? [Laughter]

BUTLER: That is pretty diverse.

HARTSFIELD: But it was a good flight. We had a lot of fun. It was a lot of hard work, too. And there were some funny things happened from time to time. One thing happened, it was just serendipity stuff that's funny. We were training in Building 5, and once we went into quarantine, you know, we can't be around most of the people because of the quarantine and the crew health concerns. So we had to use the back door, and they issued keys to us. The keys had two letters and a number on it that identified that particular key. We had to sign for them, and then we could go in that back door to get to the simulator and to the one crew training room upstairs.

Well, when we issued the keys, Ernst came to me, and he was pulling my chain, because he's a wonderful personality, he said, "Is there any significance to the fact that I got a key with SS on it?" [Laughter] So we got a big laugh out of it. He did. "No," I said, "it's the luck of the draw."

BUTLER: That is funny how little things like that when you are in an international arrangement can be different than normally, and obviously that was just a light example. But this was a mission where you did have to begin all these different diplomatic angles, like you said, working the agreements, even figuring out the language.

HARTSFIELD: Well, it went real well. The Germans, this mission was the first one that a part of the mission was directed from outside the U.S. Germany had built its own control center over in Oberphaffenhofen, which is southwest of Munich. I remember we went over one time. They had an integrated sim, the first one they'd run, and the whole payload crew was over there working in the simulator and doing this sim to get their controllers up to speed.

Well, they were also filming a documentary, you know, on how Germany was preparing for this thing, you know, and so there were camera crews walking around in their control center

taking pictures, and it got to be lunchtime. Things are different in Germany, you know, about drinking. I mean, to have wine and beer at lunch is a common thing. Well, in the basement of the control center, like in a lot of German businesses, they've got machines like Coke machines, but it's a beer machine. The flight controllers had all gone down and got a beer, and here is this crew, all of them got a beer, sitting on the console, you know, and eating lunch. [Laughter]

I called Hansulrich Steimle, and I said, "Hansulrich, I know how things are here in Germany, but you're filming for posterity here." I said, "If this film goes outside of Germany, some people may not understand your flight controllers drinking on duty." [Laughter] Then I became very unpopular, because some of them knew that I had said something, because he made them put their beer away.

BUTLER: Well, it certainly would be, if anyone here in the U.S. had seen that film, they certainly would take it different than—

HARTSFIELD: But it's very common with them. They don't drink heavy, but they don't drink hard liquor, but their beer and wine is very common over there. We had a lot of fun.

There was several times we did use the language during the flight, they asked for German, and it all worked real well. In fact, one case, I think it was national pride. Somebody wanted to talk to Wubbo, he was from the Netherlands, and they wanted to speak Dutch. Somebody insisted they had this urgent thing, and a friend of mine that spoke Dutch, he said, "You know what the guy wanted to do?" He wanted to say, "Hello, Wubbo, how's it going?" He was translating. [Laughter] The translation didn't have a lot of good stuff in it. It was like trying to justify it.

We got a lot done. I don't think we had any major problems. It was probably my most enjoyable flight because I didn't have to work all the time. All the work was being done in the lab. We had five crew members working around the clock. We split into two shifts, those of us

that had to keep the ship running, you know. Steve [Steven R.] Nagel and I were on the same shift, and he was my pilot. Jim [James F.] Buchli was on the other shift as the lead to run everything during that shift. I forget how—actually, I think Bonnie—I can't remember how Bonnie and Ernst, I don't remember who was on shifts with each other. Then, Wubbo chose to freelance. He didn't have a fixed shift. His shift would overlap the other two shifts. So it was kind of a weird arrangement.

But it all worked, and they had ideas about taking pictures, and then they got busy with the science and couldn't take any. So we used their film, with their permission, they asked us to. We wound up taking 3,300 pictures of the Earth on that, so I got to look out the window a lot. Interesting thing.

And there was some funny things happened. We launched on October 30th, and, of course, October 31st was Halloween. So I took a back off one of the checklists, ascent checklists we weren't going to use anymore, cardboard, and I drew a face on it, cut out eye holes, got some string, and I made myself a mask. I took one of the stowage bags and went trick-or-treating back in the lab. Of course, they don't do Halloween in Germany, you know, or Europe, so they didn't know what I was up to. I decided not to pull any tricks on them, you know, but I didn't get much in my bag.

But somebody took a picture. One of the guys took a picture of me with that mask on, holding that bag, and somehow that picture got released back in the U.S. About a month after the flight, I got a letter from NASA Headquarters. Actually, the letter had come from a congressman who had a complaint from one of his constituents about her tax money being spent to buy toys for astronauts. She was very upset. So it was sent to me to answer, you know, and I had to explain, hey, nothing was done, and it was made in flight from material we didn't need anymore. It was just fun. I never heard any more, so I think maybe that satisfied her. She had the notion that we had bought this mask and bag and stuff just to do Halloween with.

BUTLER: You must have designed a very good mask, then, for it to look that good.

HARTSFIELD: Yes, some people really don't have much to worry about, you know, getting hung up on things like that.

Let's see, what else? Wubbo brought on board with him, with approval, of course, a big bag of gouda cheese, individually wrapped gouda. Do you like gouda? I love it. The coolest place in the vehicle was in the tunnel that went from the orbiter mid-deck back to the lab. So he just took some tape and taped that bag of gouda up in the tunnel. Well, it was so convenient. Anybody that went back there, on the way back and forth, you reached in. About the second or third day, "Who's been eating my cheese?" He was upset because about two-thirds of his cheese was already gone. "That's good stuff, Wubbo." [Laughter]

BUTLER: Should have brought a little more.

HARTSFIELD: Brought a little more, you're right.

Let's see. I don't think we had any big problems on that flight. Everything went real well. I think we got most of the experiments done. There were seventy-six experiments, as I remember.

I can remember one thing that happened during the night. We had designed bunks for the orbiter that would be along the starboard side of the mid-deck. There were three bunks. Since we had eight people, they redesigned them, and we had four bunks. I was given one. They decided rather than mess around, the commander ought to have one that's all his, because if we get into a contingency, he might need to rest at a different time or something. So the other three bunks were shared between the seven crew members.

Wubbo chose, because he had this crazy shift, to sleep in the airlock. He had a sleeping bag, a design of his own, that he had flown in the airlock, and then the only trouble was people

going back and forth would bump him when they were going through there. But he didn't mind too much.

But one thing that happened was the crew that had—let's see, I'm going to tell you who worked together. We had Bonnie and Guy Bluford, and I believe it was Ernst Messerschmid, and they were in the stack like that. Guy was in the middle bunk. Steve and I were up on the flight deck. All of a sudden, we heard this bang, bang, bang! It sounded like somebody was tearing up the mid deck.

We peeked our heads down in the hole on the side where the bunks were, and I was looking, saying, "What's going on?" About that time we saw the bottom bunk come open and the top one. Bonnie is sticking her head out looking up and Ernst is looking down, and all this banging is going in this little bunk.

So they slide Guy's door open to his bunk, and he kind of looks around, "Oh," and he pulls it back shut and goes back to sleep, and the rest of them are like this. Apparently, he had awakened and didn't know where he was. He had a little claustrophobia or something, and he was completely disoriented, you know. But when he finally saw where he was, he said, "Okay," and he went back to sleep, and the rest of us [unclear]. [Laughter]

BUTLER: I guess that's certainly happened to enough of us just sleeping in a hotel room or something like that. At first when you wake up, you're a little confused. You don't—

HARTSFIELD: It's a little confusing if it's new territory for you.

BUTLER: So, if you're in a box, it would be even, especially if you'd had a bad dream or something, that could be a little bit disorienting.

HARTSFIELD: But you tend to orient yourself by what's familiar. For example, in the orbiter, because of the way the orbiter sits on the ground, mentally when you're in the mid deck or somewhere, you have that Earth orientation, even if you're working in the overhead, like working on a light or something, and you're upside down floating near the ceiling, you know you're at the ceiling or you're working at the wall. Or you're upside down doing something. It doesn't bother you.

But what is really weird, and I did this a few times, just experimenting, to get in that tunnel that goes from the Spacelab back to the mid deck and then rotate as I go down the tunnel, spin myself, and not paying attention as I go through the airlock, and pop out on the mid deck, and I think mentally you're looking for that 1-G orientation. If you come out in another one, there's a moment of confusion like, where am I? It doesn't look right. Sometimes you'd almost have to get in there, and you can recognize what should be down and you get in that position and, click, everything falls back in place.

Another thing we used to do, I learned even on my first flight. The orbiter flies a lot of times with a minus Z LV attitude, we call it, but it's the Z axis, which is the axis out the top of the vehicle, flying in the local vertical. Essentially, you're flying upside down as you orbit the Earth. But what this does, it put the windows, the front windows like this [Hartsfield gestures]. I mean they're slanted toward the Earth. So it's a good way to look at the Earth, is to float upside down in the cockpit up around the front windows, it's like a gondola view, especially at night, you know, or something. But what's weird, you fly along like this and you're looking out, and somebody will say something from the aft flight deck and you turn around and you're used to being in your seat or something, and what you're going to see is completely reversed, and, boy, there's confusion there for a minute. You look back and it just doesn't look right. What is going on here? That's not the aft flight deck. But then you can get it to click back. And those sensations have been reported by a lot of my friends. You can get your mind temporarily confused by what you see.

BUTLER: Certainly one of the unique aspects of microgravity, the whole reaction of the human body and all. We've certainly been trained for the 1-G environment. That's interesting.

Well, everything did go well on this mission, and very successful, as you said, and the crew interaction went well and you did return then. Was there anything else you can thing of from that mission that you had wanted to mention before we move?

HARTSFIELD: No. We pretty much launched on time. We had one two-week slip. I think the date of the flight had originally been October 14th, and we launched on the 30th. We had selected that date, the October 30th date, early in the year, and it stood. The Germans were impressed with that.

My first flight went on time, too, STS-4. That was picked right after STS-3 landed, at White Sands. Ninety days later, we launched. The second flight was the one we had trouble with. We had a couple of scrubs plus the pad abort. A lot of flights were plagued with that kind of thing, you know, whether it was just luck, or bad luck.

BUTLER: Well, Shuttle certainly is an intricate vehicle.

HARTSFIELD: Well, it is. It's a wonderful vehicle. It still, like I said, takes a lot of care and feeding, but it's still the only one in the world that can do that, can carry things to orbit and carry them back. I mean the Russians can carry a lot of things to orbit, but they can't get them back. Don't have much carry-down capability.

BUTLER: Which everything that goes up does have to come down eventually, as we saw with Mir just a little while ago. When you came back, you did go to work in the astronaut office as deputy chief of the astronaut office. What did your duties entail in that role?

HARTSFIELD: Well, there were a lot of things, responsibilities I had. A lot of it was working with John [W.] Young and helping him keep things going. Most of it was handling the nuts and bolts of the office. John was more "Mr. Outside" and setting policy. As deputy, I was responsible for making assignments for the crews when they weren't flying, you know, technical assignments. Those, of course, had to be approved by John, but I mean I put it all together and wound up being a listening post, too. I mean a lot of people want to complain about their assignment or complain that, "I'm not getting a crew assignment. What's going on? How am I messing up?" So it's a little bit of counseling, you know, trying to make them feel better. I said, "If you're trying to get sympathy for waiting, I waited sixteen years, so I can't sympathize with you there." [Laughter]

BUTLER: Right. You know all about what patience is, absolutely.

HARTSFIELD: But it was a fun job. I enjoyed doing that. I worked a while in safety, too, but the chief of the office was a good assignment, and deputy chief, I enjoyed that.

BUTLER: Good. After that, you moved into deputy director of flight crew operations. This was eventually, in between that time, unfortunately, the *Challenger* accident occurred, and so there was a lot of recovery going on at this point. Obviously, that was hard for everyone and very hard for the astronaut corps especially. What did you do as deputy chief of flight crew operations during this interim period? And you were there through the return to flight, so I'm guessing you were involved with that some, as well, if you could tell us how you worked all those areas.

HARTSFIELD: Well, I had a number of things I did as deputy to George Abbey. I learned a lot from George, but again, it was more doing some of the nuts and bolts of running the directorate. I had interface with aircraft operations, working on getting another Shuttle carrier airplane going, that contract, working a little bit on overseeing. The guys at aircraft ops did most of the work, but overseeing, procuring another Shuttle training airplane. It was that kind of thing.

But as far as the recovery, I participated in a number of meetings we had to look at the design review. It was a long process. John participated in most of that, of looking at all the subsystems on the orbiter. We went back and we looked at everything. Should we do any mods? And we kind of identified a number of modifications we said had to be in place before we flew again, and they made those. They redesigned the joint on the solid rocket motors, for one.

That was a tough period for us. I had flown with Judy [Resnik], and Judy had flown her first flight with us, so, you know, you sort of become family when those things happen. We worked together for thirteen months, whatever it was, and partied together, and we do get close, you know, and things happen. I flew the D-1 mission on *Challenger*. Judy used to, every time, she, of course, had the assignment for that January flight, and she kept telling me, "Now, don't break our airplane."

I said, "I'll try not to."

In fact, they were having a hard time getting off. If you remember, they aborted a number of times or got scrubbed. I was on post-flight. I'm trying to remember where I had gone. But it was after the D-1 mission, I was back in Europe, and I had called a couple of times back to the States to talk to the crew and wish them the best. Then when they'd scrub, I'd call back again. "What the heck you guys doing?" And they'd tell me what's going on.

On the [28th of January], as a matter of fact, I was on the way back to the States, my wife and I, on a Lufthansa flight when we stopped in Atlanta. I called back to the astronaut office and said, "Did the flight get off?"

They said, "You haven't heard?"

I said, "Heard what?"

They said, "It blew up." It just about destroyed me. I went back and told my wife, and she couldn't believe it either. About that time, somebody came running into the gate area, the Lufthansa guy, and said, "Hey, we lost the orbiter." At that time, of course, nobody knew what the heck had happened, you know, just that it was just going and all of a sudden it came apart.

So we couldn't get out of that room. We actually had stopped to refuel, so they kept us penned up, because we hadn't gone through customs. We went through customs in Houston. So it was a bad period, going home. Got home and, of course, there was a zillion replays of that launch, you know. You got so tired and sick of seeing it, you know.

But there was a long recovery period to find out what had happened. It was really startling when we found out what really had happened. It had had the burn-through, and then the history began to unfold, and I became very angry, because those of us flying the vehicle never knew we had a problem with solid rocket motors. The fact is, as far as I know, we only had one person in the office that knew they had that problem, was Bob [Robert L.] Crippen, and he had been at one of the launch readiness reviews and it was mentioned. Then it was kind of like, "Well, we've seen this before. It's just a little bit of a blow-by with nothing to worry about." So he dismissed it.

I was angry because the word wasn't passed back to us. I think, even in my view, everybody that flies, somewhere along the line they do a risk assessment, and I had a piece of data that wasn't in my risk assessment. I probably would have elected to go fly anyhow, but at least I would have flown knowingly and there wasn't something being kept from me. That's what made me mad.

I expressed my anger in an interview. They had a big day at JSC where they brought the press in to talk to people. I got some, I won't say negative, but I got some coverage out of my angry statement, and not many people wanted to talk to me. And I was mad. It just wasn't right.

To read the transcript—and then I wound up having to testify before the Rogers Commission, and I was, at the time, working some crew training issues. It was what I was going to be what I was working on after D-1. But the thing that was happening was that there was a lot of pressure to get the flight rate up to twenty-four, twenty-five flights a year. At the time of the accident, or close to it, we were getting to a rate of about twelve a year. We were flying one a month, and it was killing the system.

I mean, it's not to say that the solid rocket wasn't—I mean that was a bad thing, but the whole system was starting to crater. One of the big things was we couldn't build the flight software. That's one of the things I told the Rogers Commission. I said, "If we even had not had *Challenger*, the program was in danger of coming to, not to a halt, but to a big slowdown, because we couldn't generate the flight products fast enough to support."

At that time we still had the Centaur mission. I don't know if you're familiar with that one or not. But I mean that was still on the books, and a lot of us thought that was a dumb idea to be flying that kind of stuff inside the orbiter.

So it caused a relook at the whole program. Sometimes I think we overreacted, you know. They passed a law that we couldn't fly commercial payloads anymore, and I think I mentioned something about the payola thing I didn't like, offering a ride to somebody if you put your payload on. It was a way to market and get the country in the commercial business.

But, now that we have privatized a little bit, there are a number of questions, for example, that USA [United Space Alliance] has to deal with. They've been told they need to privatize, but there's restrictions on what they can do. There's some real questions to answer. If they contract to fly commercial payloads, the law has to change to allow them to do it. Secondly, there's the issue of who crews the Shuttles. Do you go hire your own crews or do you use government employees? You know, there's that kind of issue. Some of the work is still being done by government employees.

How about indemnity? You're going to fly this thing and if it goes to Orlando instead of out to the ocean, who pays the huge bill there's going to be for the damage and death that's caused? Right now the government indemnifies itself. So there are a lot of questions similar to that that have to be answered. In some sense, a commercial company is a little averse to taking—you know, that would kill them to take on that kind of role to indemnify themselves. To make it work, you're probably going to have to have some form of government insurance to cover a disaster. Hopefully you won't have one, but who knows. I didn't think we'd have *Challenger* either.

Then, here, again, I always talk about, think about fate. I had a friend of mine, an instructor there, I say he wasn't a close friend. I knew him as an instructor at test pilot school, that was killed in an accident testing a vertical takeoff airplane. It was an airplane, I don't remember which contractor built it, it had big fans in the wings so it would lift up on those fans. The thing was built like helicopters, but built in, and they were thinking of using this airplane as a rescue airplane in Vietnam, so they had a drop cable they could hook something. Bottom line is, he was doing a test with this hook hanging out the bottom, and it got to oscillating and it flipped up into the fan, and, of course, banged one of the wing fans. He went down.

The airplane had ejection seats. Of course, he was at low altitude, because he was trying to pick something up, so he ejected just as this thing hit the ground. It was hitting one wing low. His rocket-powered seat was already going up the rails and the airplane hit one wing and it flopped. Just as it flopped was when his seat hit the top of the rails, and one roller came off just before the other one, so when the thing flipped, it spun the seat. So when the rocket deployed the chute, it pulled the chute out, and the seat was spinning, it just spun up the shroud lines and the chute never opened. So it was the bang that killed him.

I thought, boy, there's where a fraction of a second either way and he would have survived, just the timing was wrong. I thought about the same thing in *Challenger*. Where that burn-through occurred to burn that strut through that caused the thing to come free of the tank,

and made the whole stack fall apart, I mean it could have just been ten degrees. They would have gone to orbit, they would have gotten the solid rocket motor back and looked and, said, "Holy cow, look at this." Then we'd have had a shutdown, but the crew would have been all right. It was just a fluke, you know, the fate, where this burn-through was. I mean but that's the way life is. It's little things that can do you in.

So it was a tough period for us, but we'd made a lot of those changes. I helped George [Abbey] from the standpoint of what we were doing in FCOD [Flight Crew Operations Directorate] to support that work. Also, I think, somewhere along in there, and I don't remember when it was, Don [Donald R.] Puddy came on board. George had gone to Washington, and we got that flight [STS] 26 off, great colors, you know. The thing went well, I didn't think it wouldn't go well, but, you know, with everybody watching this two-minute, one-minute, whatever, fifty-seconds, everybody was, "Oh, we're through that, we're okay."

We had fixed the solids. I wasn't worried about those anymore. I still worried more about the main engines than anything else. They've had a good record as well. They're doing better than their design goal. I remember when we were designing the orbiter. The design goal for those engines was one failure per engine in 100 flights, which says that you got a three out of 100 chance of an engine failure on any flight. That's not incidentally; that's 3 percent probability you're going to have a failure. It doesn't mean it's a critical failure, but something is going to happen.

Of course, then, we've had a little better luck. We have had some engine problems. We've had some premature shutdowns. I think we had one on 51-F, as I remember. But they had made it to orbit. They've improved the engines. The engines, in my view, are working a lot better, and they still are making improvements. Always remember the old adage, "Better is the enemy of good," so you've got to be careful. You remember they made an improvement in the pyro [pyrotechnics] system on STS-4 that deployed the chutes for the solid rocket motors. Something happened and they fell, and both our solid rocket motors went in the ocean and we

never got them back. No chutes. I can't remember whether the chutes didn't deploy, or they deployed and immediately released, or something, but, anyhow, I know we lost the solid rocket motors.

BUTLER: That was a good example of that adage there. Absolutely.

Well, everything did go well with the recovery, as you said, the STS-26 went off with flying colors and things have progressed very well since then. I mean there have been minor problems here and there, but they have been going pretty well.

You, eventually, moved into work in several different areas with the Space Station. You worked both here, out of JSC, out of Marshall [Space Flight Center, Hunstville, Alabama], out of headquarters, in several different roles. During all that time, Space Station went through a lot of changes, configuration, budget problems. If you could make some sense out of that whole time period for us, and tell us what your involvement was with all of that and leading up to what became the ISS today.

HARTSFIELD: I first got involved, in a sense, in 1989. Dick [Richard H.] Truly asked me to come up and work in Washington. I went up there and it was the summer of '89, June, I think. Before I got up there, as a matter of fact, Truly was Code M [Office of Space Flight] when he asked me to come up there in the spring, and then he became the Administrator. He still wanted me to come up there, but I wound up working for Bill [William B.] Lenoir, who became Code M. They still had Code S, which the Station was under its own code.

Well, there was an office up there called Space Station-Space Shuttle Integration, I think, and Bob [Robert A. R.] Parker had run it. That was the job I was going to. But Bill wanted to expand the scope of it, and we renamed it as to Technical Integration and Analysis. I staffed it to get the extra people to do the engineering analysis work. That was an interesting time for me. Part of the old job was still there. I not only did the independent assessment work,

but I worked closely with Code S folks, and Dick [Richard H.] Kohrs, particular, who was a Level 1 Space Station *Freedom* program manager in working out the integration issues, because the Station parts were going to have to fly on the Shuttle.

There was a lot of, in my view, infighting between Shuttle and Station. The overall Shuttle attitude was "Station is just another payload. They've got to play by our rules." They were very arrogant, in my view. So there was a lot of that that I had to deal with to make things work. Not only I but everybody else in the Station program. Station had, even then, had already gone through gosh knows how many redesigns. Station had been totally out of JSC, run out of JSC, and then there was this flap that one center shouldn't lead it, you know, and they moved the headquarters up to Washington. Actually, they put it out at Reston, Virginia, because I think the program manager wanted to be there. Had a home out there or something, I don't know what the real reason was. It seemed kind of strange to me.

This was after all these concepts here. They had the single beam and double beam and whatever they call them, double-truss concepts and boxcar trusses. You remember seeing these pictures of all these different designs and hangars and different sizes. They finally got into something that it was like you could build with the Shuttle. Anyhow, it became *Freedom*, the real *Freedom* Program, at the time I joined it. So my job was to try to keep the relationship between the two programs going well to help everybody out.

As an example, some of the integration work that Shuttle had to do to accommodate the Station had to be paid for with Station funds. So, you know, the Shuttle Program would send over their amount of money they needed for this year's work. I remember one year I was up there, they wanted 10.3 million dollars or something to do some of this analysis. Dick Kohrs, program manager, asked me would I help him, that he really didn't have that much money to put on that, and could I find out what they really need. He said, "I want to fund what's necessary, but I don't want to fund extras."

So I went and called back down to JSC and asked for some details, I mean on the number. "You can't just give me a number. Tell me what's in it." I got an answer back the next day that "My management says that you don't need to know those numbers and those are the numbers." What I saw was the side of JSC I had always heard about and had seen it once before, myself, already in leading the scrub program we had.

In any event, with Kohrs' concurrence, I told them, "Fine. Your budget is zero." Well, this forced some people out of work, and they got really upset. I said, "I'm sorry. I'm not going to just send money down there without knowing what it is. It's zero."

"You can't do that."

"Well, I just did it, and I have the backing of the program manager for the station and you're not going to get any money."

So in any event, the guy I was working with, he was on my side. We eventually got it resolved, they gave me all the details, we came up with a number that met their needs and ours, and it was about half that number, a little over half. Kohrs was happy and the Shuttle was happy. From then on, we had a good working relationship, but their stonewalling was embarrassing to me, being a JSC guy. I couldn't believe it. I was a JSC guy and they were stonewalling me.

After I left there, I went to Huntsville, worked a year. Jack [Thomas J.] Lee asked me to come down, he was center director, to help him with the ops. That was a good year. I enjoyed that. They had work packages then, and I was working as a deputy for ops on Work Package 1. I went there in June of '90. The deputy, George Hopson's deputy, retired along that fall, and I became the acting deputy. I never did have the title. I was acting deputy project manager down there.

I enjoyed that summer. I got to see how Marshall thinks and how they do, and there's a lot of inter-center rivalry, as you probably know. Each center has its own culture and they're very loyal to it. I have found that a lot of people hate JSC. It's really interesting when you go

around to Headquarters and other centers, you can pick that up. They don't hate the people. They don't know the people that well. But they see a little bit of arrogance in JSC, and some of it is rightfully so. I mean they have been the leader in the human space flight program. But these other people feel that they've got a part, too. But they're all different cultures.

Like Marshall, for example, is the old von Braun culture, the German culture way of doing things. Everything is run by engineering. They recently reorganized for the first time down there and changed that concept a little bit with Art Stevenson. JSC was formed by the Langley [Research Center, Hampton, Virginia] bunch that came down to form it, Chris [Christopher C.] Kraft [Jr.] and Bob [Robert R.] Gilruth and all those folks, you know, at the core, and Max [Maxime A.] Faget. They just made this thing go and really gave us the Apollo Program and all the things that led up to it, so there's a lot of history there. But they do things different.

I think that's one thing that hurt the Station Program, when they decided to break it up into work packages and assigned the work packages to the centers, they made an almost impossible thing to manage, because the work packages, there were four to start with. They had a teleoperator at Goddard [Space Flight Center, Greenbelt, Maryland], which got canceled pretty quick.

So they wound up with three work packages, one, two, and four. They all reported to their center directors, the work package leaders did. The program managers didn't own his projects. It was kind of a weird thing, and they got into a conflict. On several occasions, the program manager asked that the project directors be assigned to him. The center directors revolted. "No way. They belong to me."

It's not a way to try to run a program. I mean, if I'm trying to run something and you three in here each work for somebody else, who are you going to respond to? You're not going to respond to me very well. Now, if I have your performance appraisals in my hand, guess who you respond to. I've got your career and your paycheck. And they never let that happen. It will

work fine if you've got the right people, but there were some personality conflicts, and, unfortunately, they did not want to give the program manager authority to drive this program.

What that led to was, believe it or not, a little background, there was not a set of engineering standards that were universal across NASA. NASA did not have some of those standards. Each center had its own design-to standards. Marshall's was different from JSC. When we set up in projects, designing the software for the Station parts that they were going to build, sometimes we found that each of the projects had named the same parameter with a different name. Now you're trying to integrate this software. How do you make that work?

Or this thing was designed to a certain safety factor, because it was being designed by Marshall, with this piece it was being designed by JSC had a different safety factor. How do you make those play? So those kinds of things were going on, and I think there was a lesson to be learned by NASA that this was not the way to operate. It plagued *Freedom* something fierce.

I saw examples of what I would call total insubordination on the project managers not taking direction. When it was challenged, things fell apart. It's easy for me to say those things. I mean, I'm not being accusative. I probably shouldn't be saying this on television.

BUTLER: You're not alone in your thoughts. We've had several people express similar.

HARTSFIELD: But it is kind of sad, though, trying to make this thing go, watching that kind of thing happen.

Then I led two design reviews at Reston for the *Freedom* Program. After I left Marshall, I was asked to be the MTC phase manager—man tended capability. It was modeled after ALT for Shuttle, approach and landing test, in which Deke [Donald K. Slayton] was the ALT manager. So the thought was that when we got close to flight, that I would be given responsibility to run the first six flights, have a daily board and do all that sort of thing from the program manager, would be delegated to me, just ALT was delegated to Deke from a program

manager. "Okay, Deke, you run the approach and landing tests." So he had his daily change board reviews, and that was the thought that we'd run the maintaining capability. In the design of *Freedom*, it took six flights to get a station up there that could now be manned, would take people up to it and operate it and tend it. That was what I was working towards.

Then we had a lot of problems with the program, as you always have, underfunded, and try to deal with technical design, trying to make these complex things I was telling you about, different standards, make them work together. But we were slowly getting there. So it was a little disappointing, as you see things beginning to come together, about that time the thing gets the ax.

We go into a viewgraph redesign in Crystal City. There was a lot of viewgraph engineering down there. The Russians were brought into it. Mr. [Daniel S.] Goldin says if he hadn't brought the Russians in, we wouldn't have a program, that they were getting ready to cancel it. I don't know what the real story is. I know I was extremely disappointed in what I would call the politicization, or however you say that, politicizing the program, because we'd been a national program. We were running with partners, but there were no politics or international cooperation and intergovernment agreements and so on.

Bringing the Russians in was purely political. There were five agreements made relative to Russia. The whole thing was centered around keeping Russia from transferring technology to Pakistan and some of these Third World countries that would destabilize peace in the world. In return, we would give them some money through the Mir cooperative program. Also in that five pacts, there were at least two pacts that allowed American companies to explore for oil in Siberia and other parts of Russia. So there was big politics got into it. It was all a political deal to prop up the Russian economy, which is noble, but let's do it some other way. Let's don't do it with the space program and hide it on the space program. And Mr. [Al] Gore went over and signed all those agreement with those folks and got it all set up.

The Russians, in my view, turned out to be a very unreliable partner. They're very arrogant. They see themselves as the real leaders in the space, and maybe rightfully so. They've done a lot of things we haven't done. But their technology is certainly not leading-edge. The Russians really believe in the adage of "If it isn't broke, don't fix it." I mean, the Soyuz booster that's used now to launch crews and payloads was designed in the late sixties. There's been a few upgrades to it, but it's working great. They've had well over 1,000 launches in a row without a failure on that booster. So, I mean, you know, that's the way they do things. It's a different approach to technology, but it works.

But in some areas, in my view, they are backwards-looking. They've got a national identity crisis. It's just tough, I understand that. Some of the cosmonauts are good friends of mine, and they've got a different view. They're a little bit—how would you say it—despondent that their program has come to this, that they're broke, they don't have any money. Back in the Soviet system, they were big guys around, got a lot of benefits from the government, and now it's all gone in the toilet.

But they had a program. It was the one thing that the Russians could look up to, the people could look up to. I mean Yuri Gagarin is a god over there. They damn near worship Yuri. There's statues of him everywhere. But that heyday is gone. They don't have a lot to show for it. When the Mir went down, it was really a blow to their national pride. I think some of that leads to their arrogance.

But it's tough to deal with folks like that who've got their own ideas on what should be done and how to do it. Technically, they're sharp people. They've done some things that are remarkable. The little mechanical arm that they designed over there to move the modules around on Mir is just one of the most clever things I've ever seen. They dock the Mir on one port, and then this little arm just reaches around and grabs it and they move it to another port. It takes about an hour, but it all works great. We don't do any of that.

They do automatic docking, which is something we've never done. They've welded in space. We've never done that. They've done a lot of things like that. They decide they want to do it and they just go do it. In some cases, they're a little bit lax in their procedures in the safety approach to things. We would do things a little differently, some say more bureaucratic, and there's probably some truth in that as well.

But the thing that irks me is that they make big demands on us, and we cave in, and they're not bringing a lot to the table. They put a couple of modules up after we gave them lots of money. Right now they don't have any money.

You call a guy a partner. When you have a computer problem on board and ask him to delay their launch for a couple of days because we have enough fuel to stay up another couple of days, and they say, "No, we're launching." I mean, that's not a partner. That's just the way they are. They'll never change. Maybe they will. I hope they will.

As people, they're good people. The cosmonauts are nice folks, their families are nice, but they've got a different way of doing business, a different culture. The experts will tell you it's an Oriental culture. That's something the U.S. don't know how to deal with. Time is not important to them; personal relationships is. You can't just go over. That's one reason we have trouble is we're impatient and we want to deal so bad, we'll cave in. They don't deal that way. They know we deal the way we do, so they just hold out and they get what they want. Works great.

We had culture briefings here about Russia from experts who said, "They wear Western clothes, but they've got Oriental minds." There's a lot of truth in that. The Oriental way of dealng, time is not important. Personal relationships. They like to deal sometimes in stories. They tell lots of stories. I thought it was really interesting, I had that training session over there. It wasn't too long afterwards that they had a thing about World War II and Churchill, Stalin, and Roosevelt. In one of these depicted in TV meetings, Stalin told a parable, a story, and then kind of left the meeting. Then Churchill and Roosevelt, "What did he mean?" But that's the Russian

way of telling you how he sees things, and you have to interpret it from that story. If you can't, you aren't worthy of talking to them.

BUTLER: That's something we'll certainly have to figure out for ISS to—

HARTSFIELD: Well, they're getting there, and we have had successes. But those successes were based on forming personal relationships. When Frank [L.] Culbertson [Jr.] was heading the program, he was on that job long enough that he began to establish relationships with the people he dealt with on a daily basis, and then things started improving. You're talking real people. When you get to the point that you get invited to their home and you can invite them to your home, the way the relationship becomes personal, and when they make a commitment, even though it's verbal, that's the commitment. It isn't something you write on a piece of paper. When they tell you that, "I can do this, I will do this," and you have that kind of relationship, you can count on it. But until you have that relationship, you're probably not going to get anything on paper, except delays.

BUTLER: Well, it will be interesting to see what comes of it all.

But, yes, we are at the end of our time here. I want to thank you.

HARTSFIELD: Are we through?

BUTLER: I think so. I think we've covered everything pretty well. We've worked our way through your time with NASA, and we appreciate you sharing all that with us.

[End of Interview]