NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

IVY HOOKS
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is March 24, 2009. This oral history with Ivy Hooks is being conducted for the Johnson Space Center Oral History Project in Boerne, Texas. Rebecca Wright is the interviewer, and she's assisted by Sandra Johnson. We appreciate you letting us come into your home this afternoon and take your time. This is a continuation of your oral history that we started earlier this month, and I'd just like to see where you want to start today and what topic you would like to begin with.

HOOKS: I thought I might want to talk a little bit about involvement with the different programs and how that felt as a person working in that at NASA. I'll probably repeat some things from last time. But when I came to work, the first job I was given was to try to come up with the lunar lighting, and I talked about that last time, about what the lighting would be like on the Moon. I'm a student; I went and looked things up in the library. There were math models. So that's how that began.

I left that job and went to work in the area where they were doing cost models, and the leaving was because it was not a very pleasant place to work; it was not going well there. It was in the same division, another section. I worked on cost models for a couple years, and I learned a whole lot, and I talked quite a bit about that. But then I was told by the deputy division chief I needed to get out of what I was doing and get back into technical. It was Caldwell [C.] Johnson. You guys have done interviews with Caldwell. He said, "You need to get back in the technical

world," and so I ended up going to work in a branch that had been in the same building and in the same group with us—we were all in the same division—but they'd gotten moved out to Ellington [Field] for space reasons or some reasons.

So I went out to Ellington Field to work with them. I walked up to the building, and somebody was dropping teeny-tiny models of parachutes off the second-floor balcony, and that's where I got introduced to the guys that did the flight dynamics and flight mechanics and those sorts of things. At that time, our branch chief was Milt [Milton A.] Silveira. I actually got to work with some of the brightest engineers I think NASA ever had. So when I would be told to do something, here were all these people, and you could ask questions of, you could talk to. They would come to me for the real heavy math problems, because my degrees were in mathematics and physics, so we worked very well. Most of them were engineers, but probably the best dynamics engineer I ever knew in my life was a man named Joe [D.] Gamble, and his degree was in civil engineering. He just was very, very smart—no problem, he could learn anything, could do anything. He was my officemate for a long time. That was a really wonderful environment to work in. It was a group of people who loved to solve problems, who would go find problems that people didn't even know they had to work on.

[Our group] was trying to build empirical models for parachutes and could we have steerable parachutes. One of the issues on the Apollo flights—not on the first ones where we were just launching the unmanned and where we were launching off the launch pad that was closer to the water—but on the subsequent ones. When we were going to the Moon, the issue was, we've got to launch from a launch pad that's further back, and if we have an abort, if we can't control the parachutes, we're afraid that depending on winds, we would drift back on water. Well, control or not control, we didn't even know how to model the parachutes and how much

they would drift back. So there were people doing modeling, and they were doing things with the controllable parachutes—you know, like the parasail things. We were also taking every piece of data—I was working with Joe Gamble on this—and modeling having three parachutes and different winds and all the conditions.

The computer programs were—for that day and age, on those programs—were very complex because we could do this with multiple bodies. So we could have the parachute and the vehicle and the suspension risers and all. I remembered one time, I kept going and turning in my computer runs. Of course, the way you did computer runs in those days, which is just so foreign to today's world, was you would write on these little green pieces of paper that had blocks on them what you wanted cut in a computer card. You'd take those over to the key punch ladies, and they would type all that in. The cards would be cut; you'd put them in a box, and you'd haul them over to the computer center. We didn't haul them to the computer center; we had to put them out for the driver to pick up and take in there. Then he would come back the next day with our computer runs or not.

One time, I couldn't figure out what was wrong with my computer runs. They kept coming back and failing and coming back and failing, and I was just sure something was wrong with the computers, right? Finally, one of the guys said, "Let's look at a couple of things. Let's just look at a couple of things." Well, I had to put in numbers to indicate the angles relative between these vehicles, and the sum had to be 90 degrees. If the sum wasn't 90 degrees, it didn't work. Well, I'd put in 45 and 55. It didn't work. So it was crashing all the time, and I was sure that was a computer problem. From then on, I looked really hard to find out what the problem was before I would go over and tell the computer people it was their problem.

But one time, I got a job back—and they were in metal trays at that time—and when I picked the tray up, it rattled. It rattled because it had gravel in it, which meant the guy had dropped the tray. Well, now, the cards have to be in the order that they're in. So he'd stuck a card upright and said, "box dropped" or "box jammed" or something. I went, "Start all over." You can't sort those cards again; you had to start all over.

So they were really fun times. The group that I worked with, they pulled a lot of pranks on each other, teased each other. They didn't pick on me badly. Whatever picking on they did on me was exactly the same as they did each other—you know, the other guys. I was just one of the guys, and that was a very fun environment to work in. We all helped each other, worked together.

Another thing that I worked on that happened early in that period was something that they call plume effects—and I may have mentioned this earlier, too—but it's the exhaust that comes out of an engine. If it hits something, what does it do to the thing that's hitting? For Ed [Edward H.] White's walk in space, there was a real fear of what's going to come out of the plumes if the reaction control jets go. They gave me the job of running this computer program that could make some of these predictions, and I discussed that last time. It was another technical thing that I got involved with that nobody else knew anything about, and I didn't either. What difference did it make if I didn't know anything about it? Neither did anybody else. I certainly could not have created that program, but I could set it up and run it, and I could make estimates from it and do things with it.

So that really—I'm thinking back to Gemini—that was the only thing I remember doing in the Gemini program, was that particular job for White's mission. It had a lot of meaning

because I happened to go to the same church he did; I knew him. Not close friends or anything; I just knew who he was and all. It makes it more personal when you've met the people.

What we were really working on in our group was Apollo stuff, and mostly the Apollo abort stuff. This worrying about coming back and hitting on the land was a big thing. For the Apollo 8 flight, when we just circled the Moon, I was in the mission control center in a back room looking at the winds to see if there was any problem at the Cape because of that. Because what we did was we finally came up with a model, we came up with a way to estimate if we had certain winds that if we had a pad abort, we would have the crew in danger of landing on land instead of in the ocean. Of course, there were no winds that morning, so there was no problem.

WRIGHT: I remember reading you being recognized for what you created that lasted through the whole Apollo program. So that's pretty remarkable.

HOOKS: Oh yes, they could just keep using that over and over. In fact, we in the Engineering Directorate came up with it. The guy I worked with most on that was John [E.] DeFife. We worked on that and came up with that, and then we taught the Ops guys how to use it. We didn't ever go back over and do it again, because it was very straightforward thing to do. You just plotted a plot, and if you were on one side of the line, it was okay to launch; if you were on the other side, please don't do it, it might be a risk. Your hope is that you can make something that you can use for the whole mission, and yes, that was used then for all the missions. That worked out real well.

The other job they gave me was the Apollo launch escape system. For every flight, you had to do this set of calculations. You had to set the motors, the little thrusters, so that when it

came off the pad, it would pull it off right, and depending on the center of gravity of the spacecraft itself, which you didn't know 'til not too long before—when they got it all together down at the Cape [Canaveral, Florida] and ready to go, almost. I learned how to run that program. I came up with my numbers every time, and I said, "I hope I did this right," but we never knew. We never had to do one of those aborts. I worked on a lot of things that never happened. If they'd happened, it would have meant we didn't do the mission, so you didn't want them to happen, but it's like, "Was I ever right?" You don't really know were you ever right.

WRIGHT: Did you feel like those projects that you worked on were extremely necessary?

HOOKS: Oh yes, oh yes. In between doing those things, we were working on future spacecraft things and simulations and improving our ability and looking at what we might do next. I mean, by the time Apollo launched, engineering is virtually done, and so you want to go to the next thing you're going to go build. You want to start thinking about that. We were doing that, and then things would pop up. Like on one of the unmanned flights of Apollo, they didn't get the response out of the Command Module that they thought they were, and it was a plume hitting. They reasoned that they were making the Service Module go away, and that when they did that that the plumes could have hit the Command Module, and therefore, it reacted strangely. I may have mentioned this one earlier, too, because the way we got that was we got the data from the flight of what each vehicle was doing, and it's on a big oscillograph trace, so I could run it from one end of Building 16's hall to the other, the longest direction you could go, and crawl on my hands and knees and measure and get the numbers. That was a case where I could go do a

prediction and say if it did this, this is what you would have seen, and then I could go measure it all, and it was.

That said, some of the predictions we were making were correct. But it also made a lot of people around the Center a lot more worried about this whole effect of these plumes, and you just can't ignore them when you're designing or building things or when you're working missions because of all the problems they can cause. It's kind of like—recently had the carpet upstairs done. They had 17 years of whatever the dirt was under the carpet up there, and then they opened the doors with one of our giant winds going. Instead of a black piano, I had a white piano. That's kind of the way the plumes work, you know; it's what all is it going to mess up. I didn't do any design on the escape system; I had no control over any of it. I just ran those programs and got those answers and provided them to somebody.

I must have been at home when I heard about the Apollo I fire. I just remember being sick. You know, the only feeling I could feel was sick, and feeling what those people had to go through and how frightening that must have been—and having no clue at the time, of course, how we could have ever gotten in this mess. In fact, not really understanding that until a lot of books were written later, as to how we could have made those kind of mistakes. I didn't feel any responsibility; I hadn't worked on anything to do with it. I didn't feel in that sense, but just as part of NASA, and that's all.

When we had the first launch and Apollo 11 went to the Moon, somewhere I have written up where my thoughts are on that. I actually tried to write down what I felt like, and I can remember—I lived over in Friendswood [Texas] at that time—sitting in front of that not-very-big television set, watching Neil [A.] Armstrong say, "One small step for man." I decided that what I felt like probably was maybe what a sail-maker might have felt like who worked on the

ships for [Christopher] Columbus. Those people worked on things than went on board ships, and those people went off around the horizon—for them, further than going to the Moon for us, almost—having no idea if they could come back or not. Knowing that some of what they'd done might make a difference about whether they made it and made it back, and then being there when they returned and knowing that your contribution at least worked. I think that's the kind of detachment feeling of that. Awed, just awed that we did it, awed that it worked.

I mentioned last time I'd worked on, again, the plumes effect on the Lunar Module as they controlled and set down. We didn't know until they did simulations how long they were going to burn the jets, and so we hadn't built the protection for the area right underneath those jets that would take care of it. So we came up with a solution for that. We called them the coal chutes; we put a deflector. You want a plume to go somewhere else, you put something in the way and deflect it. We did that, and that worked perfectly. Never was a problem with that. That took care of that little problem on the landing.

It was so exciting at that time to be involved with something that was good news. I mean, let's face it, whoever started the saying "no news is good news" knew what they were talking about. The news media just focuses on negatives all the time, and the worse, the better. I knew a lot of people in the news media closely at one time in my life, and some of them were awful. "Oh boy, a train wreck! Maybe somebody died; I'll be on TV!" It's like, "Ew." Anyway, not all of them were that way. A lot of them just reported the news, and that was it. But it really is. The only thing that I ever really saw in the papers that was really positive, unless you count the funny papers, was the NASA programs.

I went out and did a lot of speaking for NASA at schools and at Rotary Clubs and at garden clubs—anything they needed somebody to speak at, just about—but I did a lot in colleges

and university and a lot in public schools. It was just so much fun to see the enthusiasm. I mean, fourth-graders—it was astounding to me how much they knew about the space program and how much they knew about technical things. They cared; they were interested; they wanted to know about that, and they all wanted to go be astronauts, or at least build something. It was a great time to have been at that place. You just feel really fortunate to have been there and gotten to do the things that you did.

WRIGHT: I guess also as an engineering or a math and physics background, to see students look at those and want to aspire to go into your field, as well.

HOOKS: Apollo 13, I know where I was. I had gone to Langley [Research Center, Hampton, Virginia] to meet with some folks up there. They were the ones we got the programs from to do all the plume analysis with, that particular group, and they were the ones who were advising me on how to do some testing in wind tunnels, where we were trying to simulate plumes and do things like that, which really hadn't ever been done very much. So I went up there to meet with them. Well, I didn't make very many trips for NASA for a long time. They let me go to Fort Worth [Texas] once in the first probably ten years I worked for NASA. It was sometime in the early seventies. Up until that time, I probably made one trip for NASA. A woman I worked with at NASA had moved to California, and as she was moving, she told our boss, "You need to send Ivy on a trip out to California so she can come visit me." "Well, we can't do that." She said, "Why not?" "Well, we can't send you by yourself. I mean, something could happen to you. You know, you're a girl, and you can't travel by yourself. We can't travel with you or our wives would have hissies." So that was kind of the attitude.

But anyway, I went to Langley, and I'd never been up there. The other thing that was going on near that time was an awful lot of race problems. So I landed I guess at Newport News [Virginia], and then driven out to the Chamberlin Hotel, which is at Fort Monroe. They closed it so you can't go out there. But at that time, you went on the military base and then went on out to the hotel.

It was rainy and dark, and I had driven through Hampton, Virginia, which at that time was horrid. Horrid, horrid. They had a lot of riots, and things were torn up and all. It's dark, and it's night, and I don't know anybody. I'm driving a rental car and wishing I were not alone. I pulled up back at the hotel, but there's nothing there, except you pull under this portico, but there's not a desk or anything there. Obviously, you have to go up an elevator to get to the level where the desk is. I'm standing around there for a few minutes, and finally this black man shuffles up. "Can I help you?" So I told him I needed to register. He helped me with my bags. He did the shuffle better than anybody I've ever seen outside of a movie. So he got a very good tip. He did it really well.

I parked the car, went upstairs. There was just nobody around the hotel; it was almost deserted. I went up, and I got my room—it was on the second floor—I went up, and I got in the room. It was a small room, and you kind of had to squeeze between the bed and the TV set to get to the window, which I wanted to open because it was kind of stuffy in the room. When I opened the window, I realized that you could open that window and walk out and go to any window in the whole hotel on that floor. Okay, well, this can't stay open at night, so I'm looking. In the closet, I find a fan, and it's the kind that has kind of a cloth blade on it. I mean, it was 50 years old if it was a day. This was a really exciting trip, okay?

Then I go down to eat dinner. There all people in the restaurant; they have now come out of meeting rooms and things. Every one of them is a Catholic priest. I am in a sea of Catholic priests. I had my dinner, went back to my room and the phone, and I called home, and I got told that the spacecraft had a problem [Apollo 13, April 1970]. I was like, "Oh, no. Oh, no." Not only that, I'm here, and I can't get any data. I don't have anybody I can call. The only thing I can get is what's on TV that anybody else could get, which wasn't a whole lot at that point, not that I could have done anything anyway. Oh, that was an awful night. Being there and being not with anybody else and nobody to talk to.

This was long before cell phones, and you had to make real long-distance calls and pay for them, that kind of stuff. It was horrible. Of course, we didn't know a whole lot more the next day when I got out to Langley, except that [the crew] was okay and they were working at bringing them back. But you realized that you just expected everything to go okay. Not only did the public think everything was going to go okay, but we did. We just weren't ready to have a problem.

WRIGHT: Were you at Langley the entire time that the [crew was in space]?

HOOKS: Yes. Well, no, I think I got home about the time they were landing. In fact, that may have even been something they told us on the plane. I can't remember now; it's been too long ago. But I'll tell you, knowing they were back and on that ground safely was [a relief].

WRIGHT: Through your years, did you have a lot of interaction with the crews?

HOOKS: Well, it was different at different times. We were in the same building with them for a little while during a couple years when I was working on advanced projects. You'd mostly just see them coming down a hall or something, and other than that, there really wasn't that much. Then in '72 when we were doing—or maybe '71, I guess—when we were selecting the prime contractor for Shuttle, Fred [W.] Haise [Jr.], Joe [H.] Engle, and—they were all on this source evaluation board stuff. So I was at this table of about 20 people, and we were working aero and flight dynamics, and I was doing sep. [separation] systems, and you know, everybody had their own thing. I think Fred Haise was at our table. At the table on the other side was Joe Engle; he must have been at the aero table. They weren't at our table; they were at another table. The aero and the aerothermal were together, and Joe was with them. Then the other guy—[Russell L.] Schweickart, his chair was always right behind me. Apparently he was known as a ladies' man, so they all thought that he would flirt and tease and everything, and he may have, but I just put him down or whatever. It didn't make any difference, anyway; it was good, fun humor, when you're locked up in a building, rereading all those pages over and over and over and writing hundreds of pages to justify. Because we were all there, we would talk to each other some and all.

It was either Schweickart or Haise that went, "Somebody has got to be kidding. Has anybody looked at this page of this cockpit layout they've got? Just hundreds and hundreds of switches." Good God, you can't fly an airplane that's got hundreds and hundreds of switches. I have no idea whose proposal it was in that was that way, but then they got to comparing how hard are the layouts—from the standpoint of what would make a good layout, how good or bad are the layouts. They would just be marveling.

Then, of course, the contractors had their ideas about doing different aborts off the pad and everything, and all this kind of stuff. Fred Haise [said], "You couldn't do that. You couldn't go off the booster, go over on your back, twist it around, come back, come back and land." This was the time when still had a reusable Orbiter and a reusable booster; it was before we ended up with the configuration we have now. Joe Engle says, "It's a piece of cake. I did it down at Galveston [Texas] on the beach the other night," flying a T-38 down the beach (makes airplane noises) up and around. So then Fred looks at him and says, "Bet you couldn't do it in a fog." Who was going to win that battle? Which was the first time I'd been around the astronauts enough to start seeing their senses of humor.

At some point in there, Fred invited several of us to look at a film he had. The astronauts make films when they're doing all their training, and then they make up funny films out of their training for right before their launch party, I guess, or at some point in that time—or they did back in that era; I don't know whether do it anymore or not. But it was the only party I ever got invited to look at it. It was just hysterical. I mean, it was so funny, because they'd be out there in those spacesuits, running around the fake Moon rocks. I remember the takeoff on the Clairol or one of the commercials—you know, "the closer you get, the better he looks." Well, they're doing a take-off on that in their spacesuits, coming toward each other, with the music in the background and all. Those were the fun things that, of course, never got publicized. I'm sure PAO [Public Affairs Office] would think it was horrible to publicize that because we're wasting taxpayers' money. Well, no, you're keeping sane is what you're doing, because these people are risking their lives, and they have to do some things to let off steam and to have some fun with it. That was fun to get to see that as well.

Then after Skylab, I was at the hospital visiting Fred Haise, because he'd been injured in an automobile or motorcycle or something accident. I don't remember what he did, but he had been injured. Jack Lousma and his wife, Gracie, came into the hospital at Galveston. Jack had been in space about 154 days. She said, "I don't know when he's going to know he's on the ground." He said, "This morning, I was putting on my aftershave, and I just let go, like you do in the spacecraft. Crash!" She said, "Yes, and that isn't the only thing he's done." Those stories are neat, and it's fun to get to know those people a little bit better and all.

When the first six women were selected, it was really neat knowing that we were finally going to have women in space. I went to all the parties, the dinners, that they had when they were interviewing all of them, and of all the women they interviewed, I'm absolutely convinced they picked the six best. There was another one or two that were superb but for health reasons or other reasons didn't get picked, but they had good candidates, too, to pick from, and that made it really nice. They were all so different, but they were very supportive of each other, it seemed to me, that they recognized that—well, the whole astronaut corps does that, and they did it very well, too.

WRIGHT: You were on Dr. [Christopher C.] Kraft's staff at that time?

HOOKS: Yes. I was on the staff when they selected [the Class of 1978]. I guess probably the week I went on staff was the first week they all started coming in for all their exams and physicals and everything, and so every Wednesday night, we'd go down to the Gilruth Center and have a barbecue dinner, and John [W.] Young would make a speech, and somebody else

would talk, and we would meet everybody and visit with them. That was senior staff—a few members would go down and meet with them to get to know them a little better.

WRIGHT: Did you have input in the selection at that time?

HOOKS: Oh, no. I was just there because I could. Because I was on staff. That's a perk. Another perk was, Prince Charles [Prince of Wales] came to lunch one day. It was on a Sunday, and I could have gone to lunch with Prince Charles. I decided I'd rather come to San Antonio [Texas] for the weekend. Looking back, I think, "Ivy, you really should have gone, so you could have said you actually met Prince Charles," but. I'm not a really great fan of Prince Charles. I guess I figured, "What difference does it make? All you can do is tell people that, and then it's like you're name-dropping, so what difference did it make anyway?"

WRIGHT: Were you on staff long enough to see the women go through their challenges of being accepted as part of the workforce and in that position?

HOOKS: Not really. I went on staff; we went through the selection process. They were picked in January, I think is when we had the orientation dinner, and they knew they'd been picked. Then they didn't come back until July, and by that time, I had gone to flight software.

WRIGHT: Did you stay in touch with them?

HOOKS: Well, I saw them off and on around campus and all. Kathy [Kathryn D. Sullivan] came and lived with us for three months. At the orientation dinner, she sat at our table, and after dinner, I told Bruce [G. Jackson], "She's a graduate student. She has no car, no furniture, no money, and she's going to come here as soon as she graduates, so she has no place to stay or anything." I wrote her a letter and said, "If you don't mind sharing a bathroom with a sixteen-year-old and having a cat litter box right outside your door, I have a bedroom for you." So she accepted. The first thing she did was go buy her a car, so she had that immediately and started looking for a place and all. But she sort of lived with us for about three months. It was hectic because they were going through all their initial training and more testing and more everything—you know, running, running, running. They were on such a high. I mean, everybody was on such a high. It was a fun time to watch them.

I was at something with Judy [Judith A.] Resnik one time, or in the room with her talking—I don't remember where this happened and how it happened—I don't think I was talking directly to her. She must have been up on stage and people were asking questions. I wanted to take her out and wring her neck, because somebody asked her about ERA [Equal Rights Amendment], women's rights, or whatever, and she was just totally flippant about [it]. She'd done just fine, and she didn't need any of that stuff. I thought, "What a silly, stupid thing to say. You are sitting here making alliances right and left. You are a politician of the first degree"—and she was; she was very good at it—"and you're saying none of that matters. It does, too. If you had not been as pretty and been female, you wouldn't have gotten where you are. You don't think that, but I can guarantee you it would have been that way."

But occasionally, you run across that with women—"I did it all myself, and nobody ever helped me"—but it's not true. Nobody ever does anything all themselves. Well, [Albert]

Einstein probably did, and [Isaac] Newton, but you know, the rest of us rely on other people to help us. We rely on other people; they rely on us, and we work together. Whatever we produce is better than we could have done singly, and whatever success we have has a lot to do with those other people. I don't even know how deeply she felt about it. I kept thinking, "I really ought to go talk to her," and I just never found the time, kept putting it off. Then there was no longer a chance to talk. But I never heard anybody else say anything like that or ever intimate that. I don't know if that was the mood she was in that day. You cannot take one thing that somebody says when they're asked a question in a public forum and make anything out of it.

But I know Kathy, when she decided it was time to—well, it was after she'd decided to quit being an astronaut and she'd gone up and gone to NOAA [National Oceanic and Atmospheric Administration]. She made that decision on her own, but then she came back and said, "Now, I need to leave NOAA, and what am I going to do, and how do I make that decision?" Bruce spent a lot of time talking to her, and I just sat back and listened. "It's what matters. What do you want to do?"

"I want to make kids love science. I want to make them want to go into those kind of careers. I want to do that."

So he said, "So why are you considering going to work for a company like Lockheed when you've got opportunities to go do the other? You might not make as much money, but what difference does that make, if you've got enough you're happy with?" There were others in that corps, that that's really a lot of what they wanted to draw out was that love of science, that love of exploring, the love of learning. I think they had a big impact on the county over the years, but now, I just don't know if we're getting there at all.

WRIGHT: Well, I know that one of the things that you said before is that was one of your drivers, that you just had a love of learning, and so you moved—

HOOKS: Oh, yes. Curiosity.

WRIGHT: —from Kraft's staff, and you moved into software.

HOOKS: I'd left my own section, and they'd replaced me, because that's the name of the game when you leave. I went over to Kraft, and because I was a jack of all trades—because I did systems-type stuff—every other division in Engineering was structures, propulsion—and Dr. [Maxime A.] Faget didn't think that you could manage in one of those unless you were an expert in one of them. So it was obvious I couldn't stay in the Engineering Directorate. So I started looking for where to go.

I decided I'd call Ops and talk to them. I didn't want to go to Ops, but I thought it might be a fun thing to talk to them. So I went in and had an interview with George [W.S.] Abbey and Gene [Eugene F.] Kranz. I said, "I'm leaving Kraft's staff, and I have to find a place to go." Of course, by that time, I'd seen a lot of them, because being on staff, you were seeing a lot of those guys. I think it was Abbey who just blurted out, "But we don't want you." Then poor Kranz tried to fix it by saying, "Well, we don't mean we don't want *you*, but we don't want anybody who's like a GS-14 because we want people who are like GS-12s, that we can mold." I said, "Okay, fine." I'm sure they both went back and worried for two weeks that I was going to go file a suit against them or something. I hope they worried about it, anyway. I had no intention of doing anything that silly.

I went to program office and said, "Have you got anything?" At that time, somebody said, "Well, you can go to work in this group." I went to that group, and I don't remember what it was called or who they were, what they did. It was a bean counter–type group, and there were guys that had been technical but never really did anything very technical. I believe that if you want to soar with the eagles, you've got to go get with the eagles; you can't go running around with the buzzards.

So I went to Dr. Kraft, and I said, "I'm going around interviewing, and I don't have any idea where I need to go and what I need to do next." He said, "That's easy. Everything is going to be run by computers, and the more you know about computers and the more you know about software, no matter what you decide to do with your career, the better off you'll be." So he said, "I think you should go talk to Dick [Richard P.] Parten." He was the division chief of flight software. One of the jobs you have when you're on senior staff is to play hostess—or host—[and] to take senior staff around to the different places where the equipment was being built and things. We'd gone down to the Cape and seen things there. He had been on that trip, and I had met him and talked to him, but I didn't know him. I knew some of his people, because obviously I had software for my sep systems, and I had worked with the John [W.] Aarons and some of the people from his group. So I'd met some of them over time, and we were in change boards together all the time for software and avionics.

I didn't really know Dick, but I went in, and I said, "I'm over here because I'm hunting a job." He said, "Oh, that's great, because I have a job. I need somebody to do verification of flight software. This is how I work, this is what I want you to do, this is how you would report." I mean, (makes swooshing noise) laid out, clear as a bell. You knew what your responsibilities were, who you were responsible to, what was expected of you. It sounds like a good deal to me.

It was. It was a good deal, and it was a great job, and it was really fun, and it was really interesting. It was the first time I got to really work with the IBM [International Business Machines] people. Some of those were just awesome people. It was kind of fun to get on the other side. I'd been writing requirements to get the software to do things I wanted, and it wasn't always working out. Now I was on the side having to deal with those requirements coming in from other people to work with and to make sure we're doing it right.

I had no idea how to verify flight software, so I went back to the library. There wasn't anything in there. I said, "Well, that's okay; I've verified other things before, and I have written requirements for and gotten deliveries of software and tested this stuff myself, so I can figure out what we maybe ought to be doing." Then I went and looked at all the things that IBM had set up to do and how they were doing it and then just got in the middle of it. Again, you're at the front end of things that nobody's really done before. Nobody's built a fly-by-wire airplane; nobody's done these kind of things with software before that we're trying to do and the whole mission and people's lives depended on it.

WRIGHT: Would you talk some about—because you were so instrumental in the verification of I think the particles when it separated and how important that was and some of the work that you had done on the plume work. Did that help at all with that?

HOOKS: In a way, it does because all those things require that you look at all different cases that something could happen. What can be the cause and effect, and what could be going on around you, and what the environment is. What else could go wrong at the same time that would change your conditions? It's the ability to kind of just try to see big pictures and to try to walk

through every scenario you can of what might happen. So yes, a lot of that just keeps playing over and over and over. It even came out of the doing the cost model stuff.

WRIGHT: What was different this time? What was different with the Shuttle in this type of separation that was different from the others that you had done before?

HOOKS: Well, I didn't do the separations before, except for the approach and landing. I was looking around to see, but we don't have an Apollo in here. Okay, everything on all of the vehicles that NASA had ever separated before, they were stacked up. On the bottom is the booster, the one that's going to go off first, and it burns and pushes everything up until it burns out. Now it's not pushing anymore, okay? So everything's going to want to start falling. Then what you do is you sever the connecter here and fire off this one, and it goes, and this one falls down, and you do that two or three times; however many times you've got stages to do it. Now, you have the Shuttle, and you've got the Orbiter. Of course, you see I don't have any of the real Orbiters except on the 747, and then I had an Orbiter/747 model, but it got broken by the cat.

So I'm looking at an Orbiter here, and when it flies, it has the tank under it; we'll just let this be the tank, okay? Then on that are the two boosters, and they're firing, and so is this. When the boosters quit firing, if we do nothing but let go, well, first of all, you have to understand that the thrust vector is such that if we were to see this in the sky, it would look like this. That means that we're flying up, and we're pushing up. Pushing up means we're pushing into those boosters with the main engine, because it's thrusting through that tank. This thing would just want to go hit those boosters, so we have to get the boosters out. They have to be pushed away so that we can't hit them. The other thing is they had to do it really fast. Rockwell

came in with—their solution was to use jets that you'd fire back toward the Orbiter and tank, and then that would push the boosters away, except literally, they were going to fire these big hummer jets that had a lot of solid particles in them right back at this Orbiter with these dainty tiles and a tank. It was apparent we were not going to do that that way.

I went to Marshall [Space Flight Center, Huntsville, Alabama], who were building the boosters, and said, "Don't use those solids that have all those solids in them. I need as little stuff in them as possible. I'm going to need you to cant them out and do other things with them so they won't spray on here," and they said they couldn't. Even Rockwell said I didn't know what I was talking about. So I went to Bob [Robert F.] Thompson, who was program manager, and said, "You're going to destroy the Orbiter with sep system, so it's got to be changed, and I need to run some tests to prove how bad that is." I had people at Marshall who were working on the tank and the boosters who totally—the tank in particular—who knew they were going to get blown away with those jets who believed me and people who worked in materials at Marshall who believed me. So I worked with them, and we got a few tiles and some carbon leading edge, and we got some boosters. We took them to Tullahoma [Arnold Engineering Development Center, Tennessee], and then we ran a test and showed it would all be gone if you did what they wanted. Then the next day, everybody could reduce the solids.

The way I actually knew how bad this was going to be—I hadn't even started looking at it yet, when a rep came in and said, "Do you know that you can't do that separation that they're telling you?" I said, "Haven't even looked at it yet." He said—because it was right after the contract was awarded—and he said, "You need to see what it looks like when a Titan separates," because a Titan has a center, and then it has two side rockets, and they do, they blow toward the center and push away, but they're all just all-metal. So he showed me films, and I mean, it's just

nasty, dirty stuff. You can go down where they fire off off the launch pads with this stuff, and it just eats up launch pads. It was obvious you couldn't do that. Other suggestions had been mechanical systems, to make them move out in a way, and you're like, "No, no, no, no, no, no, not going at mach 4," none of those dynamic pressures, that would never work. So it was, you know, how do you solve it?

The other thing we ran into with the boosters—and this was a really hard problem. On Titan, if you had trouble with the booster, you could blow off the front end of the booster—the nose cap—and since it's just like a big rocket that you could fire—a firecracker-type thing. If you don't have a front end, you don't go any further; it just quits going. So people wanted to talk about, "Well, we need to do thrust termination in case something goes wrong with one of the boosters, so then we can push them away," and all this kind of stuff, and you're going, "You're doing all this dynamic blowing-up stuff, and you're going to push something away—yes, right—that's the size of this building."

So we looked at thrust termination, and what happens. This is the thing you have to do in so many things you do in space and other things—a lot of things are a tradeoff, but if you build something so that it can come apart, there's the risk that it would come apart when you didn't want it to, or that if you tried to use it, it wouldn't work exactly as you thought because it's such a one-of-a-kind. If we had tried to do thrust termination, it looked like we would have destroyed all the stuff on the Orbiter doing it, and then we couldn't bring the Orbiter back in because it would get too hot coming back in. So that didn't look like it was any good at all, and then they could go off when you didn't want them to and other things.

I went and looked at all the reasons that a solid rocket ever blew up, because they said, "Well, solids blow up a lot." If you looked at how many times they blew up and what blew up

and what caused them to blow up, it could have all been prevented. It was either somebody didn't want to spend that much money, or they were willing to take the risk or whatever of whatever they were launching, but if you designed them right, they shouldn't be blowing up. So that said, there's such a small probability it would blow up, and then there's such a big probability that the thing might not work at all or it might destroy the Orbiter anyway, so we didn't do anything with it.

When the solid did blow up, that was not a good day. In fact, I thought that the main engine had gone. When I saw them replaying it on TV, I thought the main engines had gone, because Lord knows, we had so many problems with main engines. It never occurred to me that the solid would blow up. I thought when I had left work in sep systems and gone over to Kraft's office and all that things were in shape at Marshall and everything and it would never blow up. I have no idea why anybody stacked a booster like this so that rainwater could go in and then freeze. I have no idea why anybody would have launched, having been told that when they got those boosters back, when they'd been real cold, that they had leaks in those seals, because that's what will make them blow up.

But the people that operate things are not the people that did all the engineering, so they don't know the trades, and they don't know why you did things or anything else, and they just, I guess, think, "I didn't have a problem last time, so I'll do it this time." But it was like, I still couldn't have done anything different. I could not have made thrust termination work. By the time they had known that booster had gone, you wouldn't have time to anything. It was still going to be ass over teakettle. You don't go into space believing that nothing can go wrong. In fact, every time we go, I've marveled at how many things go right, because there's just so many chances for something to go wrong.

In building anything—like when they started working on Constellation and I was talking to them, they said, "We have a requirement for the Constellation program that the vehicle, the crew vehicle, have good handling qualities." That is something you ask for in an airplane, and it is actually pretty well-defined for airplanes. I said, "Well, first of all, you don't have an airplane, you have a capsule. It doesn't even have handling quality. Why did you want that?"

"Well, because the Shuttle's so hard to fly. You didn't build it right."

You're like, "Okay, the amount of time that Shuttle 'flies' like an airplane is milliseconds compared to its whole lifecycle, and it wasn't out there for somebody to go do joyrides in, or loops, or something. We've never had anybody turn us down to be an astronaut because they didn't want to practice flying."

But that's kind of the disparity between the Ops world and the Engineering world, is they don't understand what you do to make decisions about what you can and can't make happen. You want to go take giant leaps doing things—going to space, going to Mars, going under the ocean—it isn't going to be all perfect. So you make decisions. You don't make them by yourself. You and your peers argue and fight and debate and "what-if" and "why couldn't you do this?" and that is the great joy to me of engineering. That is one of the most fun things about working in engineering, is that together, can we make it better?

For the most of my career, it was so neat because people I worked with, it was never personal, and it was never "get somebody." It was what can we do to make it the best we can with the money we have and the time we have and everything else we have, and it was always a team. It was really a wonderful team thing.

WRIGHT: How about the interaction between the Centers? You mentioned having to talk to Marshall, and you've talked about going to Langley. How did all of those Centers come together, or how did you reach the consensus?

HOOKS: On Shuttle, there was some conflict between Centers. There's always conflict because of the money. You know, it gets divided up, and it's who goes and says they need the money the worst or convinces somebody they're doing the best job. It's very hard for the small Centers, like the Langleys and the Ames [Research Center, Moffett Field, California] and all that make small projects, because JSC and Marshall, with our big stuff—and Kennedy [Space Center, KSC, Florida]—we just suck up all the NASA money. So it's hard for them to like us—to like the manned space program. I don't blame them.

Our money just flowed and flowed and flowed. We could have never built anything if we hadn't had those Centers originally to do all the research that let us build everything, and yet, once things started being built, their research money always was going down the tubes for something else for manned space. So there was that, and certainly, I'm sure, that was between Center directors more than anywhere else, but it was people who were working on a project, and their project wasn't going to get funded because we had something we had to spend money on on the manned program.

I truly never had a problem, and I loved working with the other Centers. That was more learning, right? So that was the joy of it. We didn't have all the resources to do everything we [wanted]. In Apollo, we worked with Marshall because they had the launch vehicle, and if you were going to do aborts off that launch vehicle, you had to have all the conditions. For years, I talked on the phone—mainly that, and then we got faxes! Boy, that was really exciting.

Otherwise, we mailed stuff with people that I didn't meet for years, to get data, and to work back and forth. Those were the experts, so you went to them.

Then, of course, I met the Langley guys with the plume stuff, but that was all during Shuttle. Then Marshall had the boosters and the tank, and we had the Orbiter, and they had the main engines in the back of the Orbiter, too. So none of us were going to fly without the other, and I was in charge of separating things, so I was right in the middle of all of it. They were going to make it all stick together, and I wanted to make it all come apart. It was necessary to know as much about those things as possible. The section head I was working for when we first started on Shuttle was Jim [James C.] Young, and he was head of the aerodynamics section, and he had been at Marshall before he moved to Houston, so he knew everybody. The people I had learned the most about plumes about in earlier years, the experts, there were a lot of them with Marshall. So I went to people to help me and acknowledged the fact they were the experts and learned tons and got lots of help, and together, we just did lots of really good things.

WRIGHT: Well, talk to us about how it all came together for the Shuttle Carrier Aircraft and your participation with that.

HOOKS: That was funny, funny. They started talking about we needed to fly the Orbiter before the first flight when we launched the whole thing and brought it back. There was talk around about—oh, there were all kinds of drawings on people's walls. Rick [Richard L.] Barton just had walls covered with funny drawings and a slingshot-looking thing with the Orbiter sitting on it, a new airplane built just to carry it up and drop it off. Then they had it hung under a C-5A—that makes really long legs on a C-5A. Then they had it on top of the 747. They kept doing all

these drawings. Then they said, "Okay, now, Ivy, to make this work, we have to separate, so what are you sep guys going to do?" I said, "We'll look at all of your ideas." I figured they weren't going to build another airplane for it, so we looked at the C-5A and the 747. The C-5A has a T-tail, and up here's another piece of—it's like this. Well, with the Orbiter sitting on top of that T-tail, the wash from the Orbiter was going to do something to that thing—who knew what? We hadn't run any wind tunnel tests or anything. But we went like, "We really don't want to fool with that T-tail if we don't have to, because we'll have to look at a lot more things than we would if they used the 747."

I was at Downey [California] one day, and they were having a telecon on the subject, and Bill Schlish, who was my counterpart on separation systems out there, left the room, went to a telecon, and came back. He said, "Well, we're going to go with the 747, and we're going to buy it from Continental Airlines and have them move their tail for us." The Continental ads were "Let us move our tail for you." So we all giggled about that a whole lot, and a few days later, they came back, and they had done the 747, but they weren't buying it from them; they bought it from American Airlines. You could always barely see "American Airlines" on the side if you looked real good under the paint. So then, here we go, we've got to separate something else.

We needed wind tunnel data; Boeing had a facility they thought they could get some data in, and of course, they had 747 models, which was handy. So we took the Orbiter models and the 747 models and did some testing; I didn't go out on that test. Rockwell came back. When you're doing wind tunnel testing, there's always an error. I mean, you know there's error, and you have to take out all the error out of your calculations, and they call it a tear. The tears were bigger than the data. We can't do anything with the data if we have to plus or minus a hundred to everything you've got here. It took a while to get some decent wind tunnel data.

Then everybody decided it would be really neat if we could practice this—since this is done by the crew—if we could practice. Of course, we were running simulations and putting our wind tunnel data in and seeing how we thought it would work and how it would do everything. So they actually did some at Boeing where they actually have a two-plane simulator. A.J. Roy and Fitz [Fitzhugh L.] Fulton [Jr.] and all, who were going to fly the 747, they went up and flew that part, and Joe Engle and company and all flew the Orbiter part. For all the separations, it was absolutely the easiest one on the planet to do. We had the tail cone on that first time we were flying it around before we did a sep or anything to make sure, because we were worried about the effect on the tail, that we really hadn't gotten good wind tunnel data—how good was the wind tunnel data that it would affect it. It turned out to be fine, so thereafter, we could pull off the tail and fly the Orbiter.

WRIGHT: Were you monitoring the actual testing?

HOOKS: Yes. Every time they flew, we went out—a couple of guys and I went out—and we were getting loads off load sensors between the two to know that they were pulling apart at the rate we are trying to pull apart. They would go up and fly through the pitch-over maneuver; you could tell that the lift between them and all was exactly what it was supposed to be. Then, of course, we had some of the best pilots in the world flying—didn't hurt anything to have that, because they were cool. The first flight, we lost a computer. [C. Gordon] Fullerton was in the right seat, and he said, "Computer" whatever number—big X. I'm like, "Ugh, I'm so glad we simulated hundreds of these," you know.

Then when we got on the ground, as soon as I got back to Houston, one of the safety guys came up and said, "You know you were one failure away from losing your vehicle." I never understood how the software worked. This was before I went to flying software. I thought we had those four multiple computers, and they were all listening and all talking, so they would all get the same data. Turns out that one particular computer, if it failed, you were not getting one of the signals that you needed to say that it had released. Because we had it set up that you had to get a signal that said it released before the elevons would start moving on the Orbiter. So when it failed, nobody else was getting that signal, so it was one signal away. Anything else had gone wrong, we wouldn't have gotten it.

That's during the time I was on Kraft's staff, we were flying these flights. It didn't happen until I was already up there. So when he said, "You need to go to flight software," I said, "Yes, I think I do. I think I need to go over there and make sure that everybody else in Engineering understands what they're really doing over there, because it doesn't work like I thought it worked." Of course, I'd simulated all these things of a computer going out in the SAIL [Shuttle Avionics and Integration Laboratory] and in the SMS [Shuttle Mission Simulator] and all these things, but they always made one computer go out, and it wasn't the one that had any of those measurements on it, so you never saw the loss of the measurements. I said, "Wait a minute, that's a bad way to simulate this, guys. Since different computers do different things, we ought to make different computers fail at different times to make sure we're getting it all. Or at least run all the traps for it." But it's so complex, you don't get it all at once.

WRIGHT: I think sometimes people don't realize just how complex the Shuttle really is.

HOOKS: Any spaceflight. Any spaceflight. People—we get complacent. We get very complacent. The San Antonio paper had a FedEx plane displayed on it this morning—it happened in China, I guess, or Korea.

WRIGHT: Japan, I think, was where it went down.

HOOKS: It was overseas; it wasn't local. But you know, one of the pilots was from here. I'm sure they may not have done that if one of the pilots hadn't been from here, but again, you've got to remember those things don't just stay up by themselves.

WRIGHT: Well, you certainly have such a history as part of the design elements of the Shuttle. Watching the Approach and Landing Tests must have been very personal and gratifying for you to see, and then of course, the STS-1 launch. Can you share with us what it felt to know that your spacecraft was—

HOOKS: Was doing it? What it was supposed to do?

WRIGHT: Just doing it, yes.

HOOKS: Out at Edwards [Air Force Base, California], we were inside a room to call sep, to say we had the right conditions. So we were on a console like the Ops guys. We had to call, "Go for sep." Then we would drop our headsets, run through the building, run up the stairs, and get on the rooftop, and I never could find the Orbiter coming down until the dust was coming up. Then

I'd see the dust, you know. So okay, it did it, but I didn't see it. Then I'd go watch the playbacks.

We had had a lot of questions about, "Was that really going to work?" and everything from [NASA] Headquarters [Washington, D.C.], and we had at that time a computer called an Adage computer. We could actually take our trajectory data and do a 3-D drawing on the screen. This was, you know, in the seventies; this was way out, then. You would actually see the Orbiter and the 747 flying along and doing the pitch-over, and then you'd see the Orbiter come off and go like this, or this one go this way, whichever way we did it. I guess these guys peeled off and these guys went straight. Then we could, because it was three-dimensional, you could see it from head on and all other directions. I got so tired of the questions and I was tired of cutting out little paper airplanes and pasting them together to show them how it was going to work. So we did the film. We put the camera under a hood and took a picture of the screen and played it in Kraft's conference room one day for the folks from Headquarters. No more questions. You're like, "Guys, that's just based on the same trajectory I've been telling you works, so if that trajectory is wrong, this is not right." If the simulation's wrong, the result doesn't mean anything. You're having to trust my simulation, but you didn't trust it until you could see a picture.

Then when it did separate, that evening, everybody's all over us: "It looked just like the pictures! It looked just like the pictures!" My guys and I were the center of attention by the Headquarters guys being told—because they were all on the roof the whole time, watching. "It looked just like the movies." I said, "Oh, I'm so glad it looked just like the movies." It would have not been good if it had not looked just like those movies.

WRIGHT: Tell us about the STS-1 launch.

HOOKS: I was in the control center because I was on Faget's staff at that time, and we were in the back in the viewing area, and we had the hold. We didn't launch. They said, "We have a computer problem. Backup won't load." I said, "Oh, just go without it." I never liked the backup computer anyway. I thought it was an extra piece of redundancy that probably wasn't ever going to do any good. It cost a lot of money. Dr. Faget came by me, and he said, "You're wrong. It's your system"—because I'd just come off flight software work—"It's your system that didn't work." So a few hours later, we heard yes, it was. We had updated the primary with patch at some point that had to do with timing. Everything has to do with clocks; if you really want to mess up software, do it with clocks. It had to do with timing, so when they tried to load the backup computer at the Cape, which happens at T minus nine minutes, and bring it online, it just skewed and missed, and it couldn't load.

We had had that problem in SAIL one time, that we couldn't get the backup to load. We could never figure out why. Nobody figured out why, so they just restarted and went through it, and it loaded fine. But it only happened once every 75 times you did it, on the average—or once every 59 or something. I think 59 was what they calculated, but they had to do it in SAIL 75 times that day to get it to hit the same problem again. But it was so embarrassing.

We had been told when we had our review, from the folks that came in from other Centers to do the review on the flight software, that we had not done enough testing where we went across the time barriers. So you run on a certain set of software when you're sitting at the Cape—the VU software—the Vehicle Utility. Before you get ready to launch, you've got to load the GPCs [General Purpose Computers] with the guidance nav [navigation] for launch.

Then you've also got to load up the SMS computer with the right stuff for launch that's all the housekeeping stuff and the arm and the payload data and everything. You load all that up, then—that takes a while, and you go through all these long checkouts. Well, you can imagine, if you're a crew sitting in there waiting for them to that, that's not fun; if you're in the control center waiting for things to happen, that's not a fun time. What we do is we do it some, and then we would just take a snapshot that you could start from all the time and not go through all those pieces. They said, "You know, you really probably should have done some more of that. At some point, you're going to get caught on that." First day, get caught.

We all went home, and we came back the next day, and of course, it launched beautifully. It was truly amazing. When those SRBs [Solid Rocket Boosters] came off, oh! Of course, I didn't know if we damaged the tiles. We had no way of knowing for sure what we'd done would ever really fix everything. I got a call from one of the other buildings saying—I think it was 44—"Get over here; we got pictures for you." The Air Force had taken pictures of the Orbiter as it went up and as the separation occurred, and really shot some of the underbelly and everything. It all looked good, and it looked just like the movies, too, which we had, of course, done the same thing with, ultimately, to look at that.

The hardest separation is the booster, no doubt about it. You've got to get out and away. You don't want that motor firing any longer than it has to because you don't want it strafing your Orbiter. You just—(snaps) as fast and as hard as we could kick them, we kicked them. But then you got all the aerodynamics in play of all these vehicles and the tank trying to go through. The tank pushing on the Orbiter—that dynamics and that simulation—were comfortable, but what the boosters were really sensing and feeling, and especially with sep motors going off and hitting the

plume as they came back through the main engine plume and that kind of stuff, what all that would do—we just multiplied every number by some huge number and said, "It still works."

WRIGHT: So your confidence level was high, considering it was NASA's first time to launch a new spacecraft with a man in it.

HOOKS: It was like, "Are we really going to do this? Guys, why are we doing this? We've never done this before!" Again, there really wasn't much option. We had an autoland but the crew has never used it, doesn't want to use it, and we didn't even make the wheels where they'd fall down. They have to punch a button to do that on entry. I said, "Well, why don't you just let it?" "What if they fall down too early?" It's like, "Guys!" So there are things that we didn't do to—at one time, I imagine all that was in the plans, and at some time, you run out of money, you run out of time—the ability to put everything in there that would do it both manned and unmanned, totally. I wasn't party to those discussions. That was way above my pay grade at that time.

WRIGHT: Were you involved with STS-2 as well?

HOOKS: I think with the second mission, I think I was in Bangkok [Thailand]. I think that's where I was, or somewhere else. No, I'm trying to remember even STS-2, 'cause I have no memories like STS-1. The launch was scary enough, and that's my separation stuff, right? The tank I wasn't worried about, as long as we didn't have an abort. An abort would have been a really scary day because then the tank gets to be a real fun thing to get rid of, too. So that went

fine, but I'd also worked with all the aerodynamics guys all those years and worked on—we also have reaction control jets all over the vehicle that move it around in space, and then when you're coming back in when you're real high angle of attack, you blank at the tail and you blank at the elevon, because you're coming in like this. The angle of attack is so steep that the air is just blocked, so you can't get to any of these surfaces. To control it until we're ready to pitch over and start flying like an airplane, you're still using the jets, and they're in the nose, and they're back here. We did all the work on those, since we did all the jets. Dave [David B.] Kanipe and Barney [B.] Roberts did a lot of that work in my section.

On orbit, you could be firing this jet here, and it would cause the vehicle to do this, but when you're in reentry, because of all the flow coming over, our tests would show you could fire that jet, and you might go that way. We had to do lots and lots of work on this. We had that part to deal with, plus all the reentry, plus, unlike airplanes, that taxi and lift off and go around and come land, or just taxi a long time, this thing didn't do anything. It starts, you know, halfway around the world—a hundred miles up—and it comes in and lands at a spot on the desert. It was scary. That reentry was really scary. It probably would have been scarier if I'd known more things about more pieces and parts, but just what I knew was scary enough from the aerodynamics standpoint, and the whole control system and everything.

When it landed safely, I felt like I'd been holding my breath for two weeks. I think everybody did. We went over to a friend's house that were all in the software group that night, and it's the only time I've ever seen Bruce drink so much that he said, "We need to go home." He never over-drinks; he never over-drinks. He just doesn't drink that much. But he was responsible for that up and that down arrow; he had a lot to worry about.

WRIGHT: It was a day for celebration, wasn't it?

HOOKS: Yes.

WRIGHT: You left NASA in '84.

HOOKS: I'd gone to flight software, and about three months before the first flight, I left and went over on Faget's staff. The organization had changed. Parten had gone up to the division staff because [Howard W.] Tindall had retired. I was working for John Aaron as the division chief, and I loved working with him as a peer, but I hated working for him. It was just very unpleasant. So I thought, "This is crazy. I'm not going to hate coming to work every morning. This makes no sense." So I found out that they needed somebody on Faget's staff. I don't even remember how I did that or who I went and talked to. I have no memory of that, but I knew it was time to go do something. So I went over on Faget's staff and was over there for nine months, and that's when first flight happened, and got him retired, and then Arnie [Arnold D.] Aldrich came and said, "Come over to the program office. We need you to fix the MMDB," as they called it then—the Master Measurement Database.

I had told Tindall when he was still there—he said, "Why don't you go fix that? It's a big mess." I said, "Yes, not until they beg me." You go tell them you're going to go fix a problem they have that they don't admit is a problem yet, you won't get any help. So I went over to fix that. Then Arnie took off and Dick [Richard H.] Kohrs took over, so I was working under Dick Kohrs. I stayed over there for a year or two I guess. Let's see, '82—a year or more, anyway. Then it became real obvious that to really pick the problem, that part of the software—

because it really gets used by the software—needed to go back and be back in the same division as flight software, so it took it back over there. Bruce said, "Why are you doing that? You didn't like working there before." I said, "Yes, but I promised I would fix this problem, and part of fixing it is to take it back over there, and then I'll do something else; I don't have to stay."

So I took it back over there, and then John did a reorg and put me in charge of flight software instead of the MMDB. I had the MMDB sort of fixed; he and John [R.] Garman messed that up because they wanted to go with IBM software for part of the fix, and even IBM didn't use that software. But you know. They wouldn't listen to other people, because they'd been on Apollo 13; they were the smartest two guys on the planet. That was a long time ago, guys! Anyway, they swapped us, and now I'm in charge of flight software. I found some really great challenges almost immediately—things that were screwed up that nobody was watching, and causing problems.

I had a reputation that you could come to me and tell me there was a problem—anybody could—and people would. People who may not have ever said anything to whoever else was managing something, or they would, but if they didn't jump on it right then, they just would never bring it up again, or you know, if anybody said anything to them like, "Well, you don't know what you're talking about," they'd just shut up. Why would a contractor do otherwise, you know? So they came, and they said, "We got a real problem." We had a problem with the compiler. I didn't even know what a compiler was. As far as I was concerned, it was a black box; I had no idea it was software. We got that fixed.

We didn't exist. We had a person trying to get attention at one of the contractors—not local—but that finally got sorted out. But there were challenges and all, and there were just challenges about how complex we'd made some things, and paperwork, and other things. Got

those things fixed, quit signing documents that I didn't need to sign, quit getting documents I didn't need to get, or just get the secretary to throw them away when I couldn't get myself off the list.

They had these red documents, and they were manifests, and they were flight schedules, and they would put them out every few months. They never released one that was right, because you couldn't, because the way they had to put them together was so archaic that things would change. I mean, it was just horrible. So I called, and I said, "I don't need to get these. They're not any good anyway; if I need to know this, I will go find out what the latest is." I knew where to go find out, and I'm not going to look at these because they'll just confuse you. "Well, you have to, because you're at that level. You're branch level, so you have to get them." I said, "Okay." So I just told the secretary, "Don't get them into my office. I can't help it if they won't quit cutting down trees."

Before that, when I had the MMDB stuff, we were printing up for every flight—you could have backed a truck up to that Building 30, dumped all the paper off of it, and then printed these things out and put it back on and shipped it to Kennedy, to all over our Center, to every other Center, and out to Rockwell and every other contractor, with all this data. I said, "Nobody needs all that. Most people need a page or two out of it. Why are we printing all of this?" I went looking, and there was no reason for any of it. I mean, 155 copies went to KSC; couldn't even find out who they went to. The propulsion division was getting 30. I said, "Come on, guys. Every one of you needs a different page. You can get one copy and take your own pages out." So I started figuring out what it was going to cost and how much paper it was going to take if we kept going at the rate we were going, if we ever flew the number of flights we were talking about.

I said, "Well, okay, the first thing I'm going to do is I'm going to microfiche." The first thing I did was I just cut down the number of copies and said, "If you need more copies, you have to come justify getting them." Nobody came, okay. Nobody. I just slashed it by huge numbers. Nobody showed up. Nobody called; nobody complained. Then I said, "Well, let's go to the next step, and let's just go to microfiche," and then I left for the day and left a temp on hand who could say, "I don't know."

WRIGHT: That's a great plan.

HOOKS: But my guys loved that I would do things like that. We were flying flights; software wasn't changing very much between flights. We still had board meetings, and we'd still look at new software and stuff. Then I looked, and there was all this software that had been approved to be put on whenever we had time. I said, "We can't do that," because the way they wrote their changes, they'd take the existing write requirements and redline them. Well, in the meantime, this change happened and that change happened and another change happened, so the existing book didn't look like this book. You wouldn't dare just go apply that; you'd have to go back and figure out everything that was affected. So I decided that wasn't going to work either. Some of those changes have been out there for years. They always came from the guidance, nav, and control guys, because they always wanted to do it a little bit better. But the fact was you didn't need to. People were running out of things to do, and so they were refining and refining and refining.

Bob [Robert W.] Moorhead was head of the avionics then. I went up to him, and I said, "I want you to flush the queue. Just send back everybody's change that's been approved that's

never been scheduled to be put on a set of flight software, and if they need the change, they can redo it against current documents and come back." You know how much came back.

WRIGHT: Zero, huh?

HOOKS: Yes. I've taught that lesson to lots of people. You got to be really careful about that. You can't go apply changes that were approved at one point to something that's changed itself. It doesn't make any sense. So that's the kind of thing I was doing. It was really not very technical or exciting, I can tell you.

Then we had a flight. There was a software problem. My guys, who were supposed to get called by the IBM guys sitting on the console; they should have called the guys that worked in my section that were responsible for that piece of software and told them, and then we would have gone up both sides of the ladder at the same time. Well, they didn't; they just went over everybody's heads to John Aaron, directly. So my guys—I came in, and I don't know anything's happened; nobody's told me anything—and they're like, "Oh, we had this problem, and John got the call, and we didn't know about it for"—or actually, "We heard it from somebody else in the hallway. It's our job and our system," and na-na-na-na-na-na. Oh, their feelings were so hurt. I said, "Okay," so I sat down with IBM and said, "That isn't protocol, and that's not what you're supposed to do. These people have that responsibility, and they have a right to get that phone call first. You're going up our side, and we're going up ours, and then we'll all cross."

It's next flight or two flights later, and I'm driving in. I live right outside the back gate, and I'm driving in; I have the radio on, and they say, "We've had a computer failure." I went, "Uh-oh. I wonder why we had a computer failure, and I didn't get a phone call?" So I drive in,

and I park. I go inside, and I go into Building 30. Here's this mass of about ten guys. Arnie was in there, Arnie Aldrich, Bob Moorhead and John Aaron and the top five or six guys from IBM and a few other people, and they're just hunkered. None of my guys are in there; they're all standing in my office, waiting for me to walk in the door. Of course, they grabbed me. I said, "What's going on?" "Oh, well, we're having to run all these special tests on software because the computer failed." I said, "Well, it sounded like the computer failed because we kicked it with an 850-pound jet that we weren't supposed to be firing under those conditions." You know, because they fired one of the big RCSs [Reaction Control System] instead of one of the little ones. That will knock a computer wire loose if anything will. Well, they've got to prove it isn't software. I said, "Well, did they call you this morning?" "Yes." I said, "What happened to my phone call?" "Well, we didn't want to wake you up." "Oh," I said, "Thank you very much."

I had two section heads working for me, and they were the ones that were always—I mean, I had three, but I had these two that were already giving me trouble. One, I inherited, and the other one I got forced on me. So. (sighs) I said, "Oh, that's nice." They said, "They're out there, and they're deciding what cases to run," and blah, blah, blah, blah, blah. I said, "Fine. What are you doing? We have other software for other flights; we have jobs to do. Go to work. I'm going to work. There's more power out there—first of all, it's not the software, and secondly, we don't play in that arena. Just let them go do theirs." "Oh, we're at the center of attention. We have all this stress. We're going to be the heroes again." They love the stress. I don't love stress. I have to have a little stress, like deadlines, to get things done, but I don't like that other stress and that "The sky is falling! The sky is falling!" stuff.

I just put everybody back to work, and I went to work. I never said anything to anybody, except to myself: "I'm leaving. They don't listen. They don't care. They don't think I know

anything, they don't want to talk to me, and my troops are so screwed up. I can't fix them. They're 50 years old. I mean, they were older than I was, and I didn't pick them. I've done all I can do; I can't make anything better at this Center. If I can't change anything and make anything better, out." That was when I started looking to leave. We had seven GS-15s in the division, and five of us left, or maybe it was seven and six of us—it was huge.

WRIGHT: All about the same time, you left?

HOOKS: They all left before I got out the door. Three of us walked with 20 years, and two took early retirement. I think it was three and two. It was me and Bill and Fred—well, I bet Jack left then, too. But I think he and Stan [Stanley P.] Mann—maybe they were the two that took early outs. So years later—or six months or a year later, I asked John Aaron, I said, "Didn't it bother you that all your people left at one time?" "Oh, no, it just happened." I said, "How come you always treated me like you did?" "I didn't trust you." "Why?" "Because you didn't do things like me. You didn't do what I would have done." I said, "John, if I would have done what you would have done every time, we didn't need but one of us. Then you're redundant." I said, "Was I ever wrong? Can you name one time I ever led you astray on anything?" "No." Off and on, I worked with him from '81 to '84. What do you do? You don't do anything about it. You leave. Pick up your marbles and go.

WRIGHT: After 20 years, you had a lot of lessons learned on what to do, what not to do.

HOOKS: The first time I became a section head, I told the people that worked for me, I said, "I don't know that I know what to do to do this right, but I know a whole bunch of things to not do that I've learned from other people messing up. So I'm going to avoid those and make my own mistakes."

WRIGHT: I believe one of the things that I've heard you say was that effective communication is so important.

HOOKS: Oh, yes.

WRIGHT: Could you share with us some of the ideas that you have used for effective communication during your leadership time, or maybe just in your interpersonal skills of working with all types of personalities and skills, to pull them together?

HOOKS: I won't tell you I don't mess it up regularly, either, because like everybody else, there's at least once a day in the household where somebody didn't hear somebody. "I thought you said." So one of the cartoons I use in training shows BC with his monorail and his other friend with his two rails, and trying to meet up. BC said, "I distinctly said 'monorail,' and the other guy says, 'Did not.'" I said, "That is one of the rules; write it down." When I've had trouble with people at work, when I had to get rid of a secretary one time—well, John made me write her up. I'd already exchanged her for the other secretary, but he said, "You have to write her up."

When I sat down with the write-up—why she wasn't going to go from temporary to permanent employee—she said, "Well, but, but, but I didn't know; I didn't know that." I said, "How many times did I bring you into my office and tell you you had to get that work done?" She didn't like one of my guys, so she didn't want to do his work. I said, "I need his work. You have to do it. I don't care if you like him. You don't get to pick." How many times she didn't come in on time and how many times she didn't do these other things, and I wanted her to make it up, but she never did. You know, it was just one thing after another. I had never written it down because I'd figured out a way to get her out of my office and into someone else's—get rid of my problem. But when I had to write her at that eval, it was like, "Well, you didn't tell me." I said, "Yes, I did, over and over and over again. You didn't hear me, but I told you." But put it in writing is especially shocking.

Somebody was talking about this—but I can't remember who I was talking with—oh, it may have been a friend of mine that used to own a store there—that owned Gayle's Just Pretty Clothes there on Bay Area Boulevard for years. That's who I met yesterday for lunch. She was talking about having told employees over and over and over, and they would say things like, "Well, you didn't tell me today." I said, "Put it in writing; post it everywhere." She said, "Well, I did that for the kids, because they would call me at work about things that they didn't need to call me about," so she said, "I wrote everything down, said, 'This is the list that tells you what to do. You know, if you have this question, this is the answer. So don't call me about that. By the way, I've got the same list at work, so when you call me, I'm not even going to discuss it until I check and see if it's on the list. If it's already on the list, you won't get a call back.'" She said, "That cut down on the 50,000 times a day of picking up the phone and calling Mommy about

something." I think we don't think to put things in writing often enough, when we should, and it would help people.

I liked it when NASA went to an eval [evaluation] system, so you got written down sort of what somebody expected and sort of how well they thought you'd done. But I found most the bosses didn't do it well. I mean, they'd tell you to go do it yourself or something. I felt like you owed people telling them what you expected. So I've tried to do that, but I think a lot of times, I'm very lenient with people. I know I am. I kind of expect the best, and so many times I've gotten it, that sometimes I trip up, and I know that can happen too. By putting it in writing, there isn't a debate about what it said, what I heard as opposed to what was said. I don't have that problem anymore. There's not enough of that.

In all these meetings to discuss things—I mean, I don't know how much you look into these types of things. But, I'm very interested in communication in general and how people communicate, and how they remember and how they don't remember, and what works and what doesn't. Study after study after study says that a meeting is the worst place in the world to make a decision. The bigger they are, the worse they are. I think a lot of it is because nobody wants to make decisions. They don't want to be responsible, and so they want to put things off. I've seen people who would just put off decisions forever in board meetings and things. You'd go, "You know, this is costing a lot of money putting this in limbo"—and eventually, if you don't make a decision, it's almost made for you. So I think that that's a part of it, too.

If I put it down and say this is the decision and put my name on it, then I'm responsible. I didn't ever mind doing that, but I also didn't mind coming back and saying, "I made the wrong decision." I think I told you before, that's because being female, that's easier. It's hard for guys. We're supposed to do it. So heck, I always thought that was a plus. Because people need to be

able to move forward, and limbo is to me the most uncomfortable place in the world, and I think it is for a lot of people, because they're just spinning their wheels, wasting time and all. By having these big meetings and discussing things forever and on and on, nobody's responsible, then I can't be held accountable. But it's not really true, although NASA doesn't hold people very accountable for anything. I mean, they really don't. You have to hold yourself accountable. In that, there was a lot of, in the old days, at least an awful lot of holding yourself accountable.

WRIGHT: Did you find the culture changing quite a bit from the time you walked in the door to the time that you left?

HOOKS: Yes. In the early days—well, I wasn't even aware of what was going on for a long time. It takes you a long time to even start piecing things together, especially when you're off in your first real job. You're not smart enough to do any of that, but I saw things change as we went through Shuttle and stuff. As the Shuttle was getting built and was starting to fly and all, then the engineering workload wasn't the same anymore. There weren't new things to work on. When you've got no people coming in or you're in Engineering, you need to be working on new projects or working on payloads or working on something—or doing research, or doing something, not going and sitting in meetings. The meetings just got bigger and bigger and bigger and bigger because everybody goes and sits in a meeting because "That's my job." Well, that's nobody's job. You could just spend all day going around to meetings and never do any work—ever. I think we actually have people who have spent years over there doing that and have never done any work. Couldn't do any work. Can't do any work.

Then Space Station came along, and three-quarters of Engineering wasn't needed. I mean, you don't need the aero, and you don't need aerothermal. You don't need some of those things because it's not going to lift off, it's not going to reenter, so it's a somewhat different ballgame. But nothing was done to change any of the balance of the Center in skills or anything, so you've got people sitting there who knew how to do that other stuff, probably dreaming up new vehicles that they could go fly, and hopefully building new models and things to get better at that kind of stuff. I don't think at any Center, there was any direct effort at "how do we get ready for the future?" Then they made JSC an Ops Center, so it killed Engineering, and the same thing at Marshall, essentially. So we didn't have any Centers to build things anymore, and we have none now.

Poor Langley is now building its first cradle-to-grave vehicle I bet in 25 years, and they have not a person who's ever done it before. So the guys that are retired are back in working with them. You get all excited about the ops and what's on television and everything. If you don't have the right people there to put the emphasis—and by the time Kraft left, he had populated every job with an astronaut or a flight director, including head of Engineering, and it's never changed. Then there were no Centers of excellence for anything. Every Center had to be on everything. You're going to build something this big, and you're going to divide that between eight Centers, and you have no travel money. It doesn't work.

The whole Space Station layout was the biggest mess in the whole world. Karen [M.] Morrison, who recently died—at only age 58—she was over at the Space Station early on. She had come into our organization in about '74, I think. She was a UT [University of Texas, Austin] grad and then worked at TRW [Thompson Ramo Wooldridge] and then came to NASA. She said, "Ivy, I just got an MBA [Master's in Business Administration] over at U of H

[University of Houston, Texas]"—and she was an aerospace engineer, she'd gotten in—she said, "If I'd ever proposed what they proposed for managing this Space Station program, I'd have been kicked out of graduate school." It was unworkable. Calling things "work packages." Part of this thing is yours and part somebody else's and part somebody else's. Nobody's responsible. They really did it, and wanted to divide that stuff up so they couldn't cancel the program. Well, it's still up there.

WRIGHT: Looking back over the years that you were there and all the different areas—as you call yourself a jack-of-all-trades—if you had to pick one, what would you consider your most significant contribution to what you did there?

HOOKS: Really that design of the sep systems, and I didn't do it by myself.

WRIGHT: Do you have one that you would consider the most challenging time or the most challenging project that you had, as far as all the different aspects?

HOOKS: Getting that test run on the sep motors, to show that there really would be a problem was just—it was terrifying; it was exhausting. Then when we fired the engine off and we finally got to go down there and see what happened, and we see all these tiles destroyed and huge pieces of metal melted and everything else, I just sat down on the floor. We were on a witch's cap test facility, and I just kind of backed over to the cap and sat. Then here come the guys that have been telling me that I was wrong and that nothing was going to happen, and they said, "How are you going to fix that?" How are *you* going to fix that? I felt like the Little Red Hen, because

that's what I was. That's what they meant, too. They weren't going to help. The others were, that had participated and gotten involved, but it was mine. It was my baby, and I was going to have to go fix it.

WRIGHT: Were you under a lot more pressure because of the Shuttle Program being behind schedule?

HOOKS: No, no. The main engines and the tiles kept everybody else so that we never were that pressed. Some of the hard things were you had to put in what trips you needed to take, and then you had to justify them 55 times, and you had to be at certain things at Downey at certain times. You had to meet face-to-face with people. Then people would want to argue about them, and you're like, "Okay, I won't go; I don't care."

I really got in trouble one time, because it said, "What's the most significant thing that will happen if you don't get to take this trip?" and I said, "The Shuttle will never fly," or something really tacky. I wasn't dating him or anything at the time; he was my boss's boss. Oh, he was not amused! I really was in trouble. It was like, "Oh." Well, I just got tired of answering those stupid questions, you know? I'm an integration manager—my job is to be there at those meetings once a month. We go through everything we have to go through—that's when we do it. Lord, we didn't have cell phones, we didn't have e-mail, we didn't have any of this stuff. The only way you could talk to somebody is pick up the phone and call and then mail things back and forth. Like I said, faxes were wonderful.

That's the other thing. I don't care how good we get at this; there is a certain amount of face-to-face time you have to have, and not having it costs more than getting it. I have not seen

any of these video things that have worked a damn. Sorry. It might be, if you just want somebody to lecture you on something, but to have a meeting where you're trying to talk to people and communicate, go back and forth? We're not there yet. Kids are doing better with their text messaging than some of the other stuff. They may actually get better at it. They keep trying to find shortcuts to communicate. But they want to communicate all the time, so that's not necessarily a bad thing, even though 99 percent of it is like meeting necessary.

We would hold quarterly meetings on the separation systems. The various contractors involved and the various Centers involved and everybody would all come in for a day or two of meetings, to go through all the status: where we were, and where the problems were and everything. I objected so badly to so many badly-run meetings and waste of time—you go sit there for four hours, and they never even get to your topic that you went for. So I had taken a time management course, after my section told me I didn't manage my time well, I went and took time management. I came back, and my meetings had set times. You would speak at this time on this subject, and you had this long. You don't get through? Too bad. So people could just come in and out when they needed to be there and do their own work and everything.

People were just astounded that anybody could even do it. I'm like, "Anybody can do it." It just takes discipline. It only takes once or twice before they realize that if they don't fit the agenda, they're out, and they're not going to talk about their subject, and then we'll have to deal with it next month—or next quarter or whatever—or you'll just have to write a report or something. Some really cruel thing, "Write a report." Amazingly, then after that, there are no problems, if they believe you.

WRIGHT: Speaking of time, I'm noticing that our time that I promised that we would watch for is getting close to the end. Before we end, I want to give you a second to think about some of the things that we haven't had a chance to talk about, to see if there's some other thoughts or stories.

While you think, I'll take a look at these ideas and, I know one of the things that we did want to talk about was something that Bruce Jackson had shared with us when he was your boss's boss, was he gave you a special gift to hang into your office, and I didn't know if you wanted to share the story behind [it].

HOOKS: Well, since lots of people know about it, I might as well tell it. I was in an office with one, two, three, four, five—four or five male engineers, okay—we shared an office. They all had Playboy calendars on their desks. They all had pin-ups [photos] inside the big cabinets, those big cabinets that had big doors, so when you opened the doors, you'd get the pinups. They'd always had that; I mean, that was just the way it was. I didn't pay any attention to it.

WRIGHT: This was back in the early sixties, or seventies?

HOOKS: This would have been in the late sixties, early—yes, late sixties. I guess it could have even been early seventies. Yes, we may have already started on some Shuttle stuff then, so it could have been early—yes, it was probably early seventies. I never paid any attention to it. You know, they're there; it's okay. I didn't care. I grew up with four brothers. What is the big deal here? So I just never made any big deal about it, but I came back—I'd been on a trip—I came in, and I walked in the office that morning, and they're all in a huddle. That either means that they're going to pull a trick on me or that they're telling a dirty joke that I'm not supposed to

hear. So they just kind of back away and snicker, and I go sit down at my desk. My desk faces outside. I sit down at my desk, open things up, and I'm waiting for whatever the next thing is.

The next thing I know, they're gathering around my desk, and they're ahem-ing a lot. "What is going on?" They're pointing to the wall beside me, and I look up, and there is Burt Reynolds' *Cosmopolitan* picture torn out of the *Cosmopolitan* magazine. I had not seen it before; I had only heard about it, and I hadn't seen it. I just broke up laughing, and I said, "Who did it? Who did this? Who put this in here?" "Not us. Not us." Now, they were adamant it was not them, which meant it wasn't them, okay, but they weren't going to tell me who it was. So I waited until everybody else had gone to lunch, and one of the guys was still there, and he can't keep his mouth shut—and we won't mention his name. If he ever reads this, he'll know who it is, and so will all the other guys. But anyway, I just kept bugging him. "Who did it; who did it?" "I'm not going to tell you. I'm not going to tell you." I just kept nagging. Finally, he told me it was Joyce. Well, Joyce [H. Koplin] was the division secretary, and her office was right next door to ours.

So I went over to Joyce's office and sat down and said, "Do you want your picture back?" Of course, she's a very good professional secretary, and she just looks me straight in the eye and says, "What picture?" So I start in on her, teasing—I said, "Look, I think it's really funny, but how in the heck did you get that picture? And why did you bring it in there?" She said, "Who told?" so I tattled. She said, "Well, Mr. Jackson asked me to do it." I said, "What?" She said, "Well, I was talking about having seen it at the beauty shop one day, and he said, "You know, that would be so neat if Ivy had that picture over her desk, because all those guys have all those pinups in that room. Ivy could have her own pinup. So you think you can get it?" So she did. She tore it out of the magazine, brought it in, put it above my desk. So it stayed there.

Well, one day, I came in, and we're back to the same huddle again. I go to my desk, and Burt's still there, so I go to work. Then the guys started ahem-ing, and I said, "Okay, what is it now?" Well, Bass [Redd], Bruce's deputy, had come in, and he had decided it wasn't nice—now, he never decided this for all those years before, but now that *I* have a picture up, it isn't nice for them to have all those women's pictures up there, all those Playmate pictures up there, and share an office with me. He makes them take all theirs down, so now I have the only picture on the wall. I took mine down and took it to have it framed. The frame shop I took it to—there were two women who owned that frame shop—I like to have never gotten my picture back. They kept making excuses for why I couldn't have it back, because everybody was having so much fun with that picture. Then I took it home and put it in my guest bathroom, and that's where it lived for a long time.

WRIGHT: On a different note of exhibiting things, we noted that in '76, you were part of a NASA exhibit about women and science and engineering at the [Houston] Museum of Natural Science. Do you remember being at that and why that exhibit was done?

HOOKS: I don't know who started the whole thing or put it all together. I had already known at that time the young woman who was head of the planetarium there, and she was very big on getting women into science and stuff, so we'd talk a number of times. I don't know whether she'd talked to other women at NASA. I can't remember whether she called me, whether she called somebody that was in the Women's Office or something, and wanted to put something together so that we could come out and do panel discussions and talk to people and all as they

brought kids through the facility and talked to other people. I had forgotten about it until I saw that written up, and it was like, "Oh, yes, we did do that, didn't we?"

WRIGHT: That must have been fun.

HOOKS: It was fun. It was fun. Coming over here to San Antonio and talking to all those junior high students was fun. What you'd like to know, of all those kids you talk to—maybe I'll talk to the San Antonio paper one day and say, "You know, I did this at about this timeframe. Are any of those kids still around, and did any of them go into science? I'd like to know."

WRIGHT: That'd be a great time to do that, and then ask them about that. Well, if you don't have anything else you can think of—thanks.

[End of interview]