

# NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

## ORAL HISTORY TRANSCRIPT

JEANNE L. CREWS  
INTERVIEWED BY REBECCA WRIGHT  
SATELLITE BEACH, FLORIDA – 6 AUGUST 2007

WRIGHT: Today is August 6<sup>th</sup>, 2007. This oral history interview with Jeanne Crews is being conducted in Satellite Beach, Florida, for the NASA Johnson Space Center Oral History Project. The interviewer is Rebecca Wright, assisted by Sandra Johnson.

Thanks again for letting us come in your home and visit with you this afternoon. We'd like to begin today with you sharing with us your educational background and how you became interested in engineering sciences.

CREWS: How I became interested is a tough [question to answer]. My father was an Air Force pilot, and I was always interested in how things work and science, and I love all sorts of science. When I was about eight, I looked up at the stars and [was fascinated] by them. I guess I thought, well, I'd be an astronomer. I just didn't know. I loved [all of] the sciences.

My parents were wonderful. If I liked astronomy, I'd get a telescope. If I liked looking at water to see what's in it, I would get a microscope. Whatever I wanted, so they really encouraged [me]. I think that's one of the basic things, and [they] never said "You can't do this. You can't do that." That was wonderful.

When [we] finally start[ed] into [the] space [race] with the Russians, I remember seeing Sputnik and [saying], "Oh, boy." So then I decided, "I want to be an astronaut." [I] didn't realize at that time, [that] they were all going to be test pilots, [but now] I understand that.

I went ahead and got my degree, and when I was [at the] University of Texas [Austin, Texas] [majoring] in engineering, I went into aerospace engineering—or aeronautical, at the time; they didn't have the aerospace [program then]. It was just being developed. They had a test at the very beginning for all the freshmen [majoring] in engineering, and I was in the top ten people [taking] the test, and they asked us if we'd like to be guinea pigs for an experimental engineering science program, and I said yes, not knowing what I was getting into.

Well, we found out, the ten of us. It's funny now, but we were absolutely blown away. They had us in, I think, in "P. Chem.," which is physical chemistry, which we'd barely had freshman chemistry. They threw us in there with all these graduate students—we were freshmen—second-semester freshmen—[and] we were trying to pass that. Well, we were all failing, of course, so they had to get us off to the side and give us some help in it. And everything went this way. They just crammed [us with] a whole bunch of stuff; they were experimenting, of course.

So that's how I got into engineering science. It wasn't any plan. In fact, it was just developed, I think. I don't even know if it existed anywhere else but at the University of Texas. So that was an interesting—and I went four years there, and I hadn't quite finished because of the way they [had] designed [the program, as] an undergraduate degree that would be nothing but [to] go towards [a] Ph.D.

I was anxious to get on with my career and try to be an astronaut, so I went my last year at [the] University of Florida [Gainesville, Florida]. [I] took a lot of graduate courses and stuff, [and] I got my degree there. So that was more in—I don't think they call it "engineering science" there; I think it was just aerospace engineering.

Then I hired in at NASA, I don't know, September either 4<sup>th</sup> or 6<sup>th</sup>, 1964. I was one of the first women engineers there. They didn't know what to do with me. They really didn't know what to do with me. They had interviewed me out at KSC [Kennedy Space Center, Florida], and that was funny. They really didn't know what to do with me. In those days people smoked. They had one kid following me around with a little ash tray. [Laughs] They just didn't know. "There's a woman. What are we doing?" you know.

They had the simulators and everything, because I was interviewing for a job. I wanted to get as close to working with the astronauts as I could, because I felt that would be the—if I was going to have a chance. No one even mentioned women astronauts, of course, in those days, and I knew that. ...

I hired in as a GS-7, and I went to Houston [Texas]. I think Warren [J.] North was my Division Chief, and—let's see—Jim [James R.] Brickel was the Section Head. I just read Dean [F.] Grimm's write-up the other day. Dean and I worked together a whole lot to start with. In fact, he was the one I first started working on projects with. I remember he discussed the lighting for the Agena, Gemini and Agena, where we got out on the back of the site with the astronauts, [with a] truck mounted up like the docking vehicle, and the other [stationary vehicle] was hanging from a crane. I coordinated all of that stuff. I noticed how Dean said, "Oh, another engineer and I."

WRIGHT: That was you.

CREWS: I was the other engineer. [Laughs] But I really had to work hard to get the responsibility. Everybody wanted to hold my hand. Now, I know that sounds, "Well, isn't that

nice?” But it isn’t when you’re really trying to prove yourself. I guess it’s the cliché that you really do have to work harder in order to be accepted. And it was new. I didn’t blame them; I really didn’t. They just didn’t know how to handle me.

So the zero-G [gravity] flights came up, and I was working on the Apollo landmarks. The idea was [that] you could navigate on orbit with stars. If something happened [to] the computer, you could get some data; you could get some fixes on it. For example, if you needed to fire the retro to return or if something was failed, you could use it as a backup. Well, the other thing was, “Well, let’s have some Earth landmarks that we know the latitude, longitude, etc.” You could use those, also. So I had the crew taking pictures of all sorts of things all over the world that would make a good point [to sight on]. You had to have something very good.

So while we were doing all these landmarks, one of the things to evaluate was the book that the crew was going to use to identify it, and I needed to go on the zero-G to see how they could use that. Let me tell you how hard it was to get approval to go on the zero-G plane. It was like, “Well, we just don’t know.” First of all, just the traveling. A woman traveling? Oh, my goodness. So there was that, and then it was just very, very difficult.

I finally got to go, but they made me wear a man’s size-eight boots, because that was regulation. I said, “If I had to jump out, they would come off.”

“That doesn’t matter. It’s regulation boots.”

So when we got there, a couple of the astronauts tended to get motion sick; whether I should say this or not, I shall. But anyway, they begged and pleaded, “Please give me your stuff to evaluate, because that keeps me busy.” If you stayed busy, you tend[ed] not to [get sick]. So I did give [it to] them, got to play the whole time, which was wonderful. I enjoyed the heck out of it. So after that things got a little easier [the traveling, etc.]

WRIGHT: Do you know if you were one of the first women to be in the zero-G?

CREWS: I think a couple of nurses had been used as an experiment sometime before that. I looked that up, and that was my only—yes, women have been. But then, of course, I'm not sure this is true, but it was a little hint that, "Yeah, but they didn't do very well." Hey, you know? So that was one of the things I had to overcome.

Then traveling was something else. "Oh, we don't think you should travel." I'll tell you, that was still happening thirty years later. We were doing another test when I was in Life Sciences. I needed to go to Guadalupe, the Island of Guadalupe, and they said, "Oh, well, you better not go there. It's not safe for women."

I said, "I'll bet you half the population is women. What do you think?"

Things like that, so you just had to—you know. [Laughs]

WRIGHT: You had to work through that system, huh?

CREWS: I did go. I did go. See, that was one of the things about me. I'm not a sweet, little, retiring person, because I would never have survived at least the first ten, fifteen years. It's much better now, I think, but I still think there's a long ways to go.

WRIGHT: Before you came to the Manned Spacecraft Center [Houston, Texas] [MSC], you worked a little while at Patrick Air Force Base [Florida].

CREWS: I was a mathematician, yes, as a junior mathematician.

WRIGHT: Was that a correct title, or was that just a title to get you in the door.

CREWS: Well, I didn't have my degree, and so they did hire—the truth—my dad was Inspector General of Patrick Air Force Base. When I wanted to come home for the summer, he said, "If you want to fly [home]," and, of course, I had a Siamese cat and a cockatiel and everything. "If you want to fly, you'll have to get a summer job." Jeanne had never worked before. "If you don't want to fly, and you don't want to work, then you can take the bus, and you don't have to work this summer."

My dad and mom never made me do anything [before], but this was something—okay, I said, "Fine. I'll work."

So he got me the job at the Tech [technical] lab over here on Patrick, and I really enjoyed it. I loved the work. At the time almost everything was classified. The nose cones, when they would separate—they have all these ballistic cameras [where] the shutters [are] timed, and so it was like solving a puzzle. You would get all these photographs and try to match the different angles of the photographs to the sequence, and so it was solving puzzles, which is my forte, anyway. It's always been. So I enjoyed that. But I did that for a year, and then I went and finished my degree.

WRIGHT: At least it was some exposure to that.

CREWS: Yes, to the workplace. But there wasn't really any—well, this is what's funny. I had no real prejudice or anything against me as a woman mathematician, because my boss was a woman mathematician, but also my dad was Inspector General of Patrick. [Laughs] I didn't know this till—well, some things happened, but, they tried to get information from me, of course. There's always something, isn't there? But this probably you don't want to use, and we'll take that out. But anyway, it was a very interesting job, and I enjoyed it.

It was nice making my own money; nobody telling me how to spend it. That was a wonderful feeling. I knew from then on that would always be true. [Laughs] No matter what, I would always have a say on how things got spent. I'm hoping most women these days, when they raise their children, the daughters are raised in that respect, too, like, "You know, you can do anything you want to."

Well, I don't want to get on that too much, because I feel very strongly about it, but in my last years of my career, I spent a lot of time talking to children over at Space Center Houston [Houston, Texas]. I used to give a lot of talks about hypervelocity impact to the kids, because I could talk to kids. I just don't like talking to adults. I would talk to kids. [Laughs]

WRIGHT: They listen better.

CREWS: Yes. Okay, well, now you've got to help me. I don't know where I am.

WRIGHT: Well, tell us about when you said that you interviewed at MSC, so you packed up your stuff and moved to Houston by yourself and began a new career.

CREWS: Yes, [I interviewed at KSC for the job at MSC—that way the MSC group could learn about me without having me travel to Houston prior to their decision], got an apartment and started down there. Right, yes. That was exciting. I enjoyed it. Well, I was an Air Force brat. I was used to moving, so I was always ready to move. “When is it time to move?” you know. So always something different. But I loved it. I was used to walking into schools, “Here I am. I’m new.” [Laughs]

So I just walked in, and then they went, “Oh, yeah. What are we going to do with her?” [Laughs] You could just see it, like “Oh, my.”

WRIGHT: When you started there, you mentioned some of those first projects that you had worked, like for Warren North, with Dean Grimm. Tell us about, you know, here space was new, and the nation was caught up in the space race, and you were beginning your whole new life in that, and then you’ve got these very unique projects. Share with us about some of those and about what you did. We have talked to people who were in the middle of them, and so they completely understand it, but then there’s those of us that didn’t watch those very unique ways that you tested some of the—

CREWS: You were too young. [Laughs]

WRIGHT: We were listening, but we weren’t involved in the testing of it, so explain that to us. For instance, when you were talking about the Agena.



CREWS: Okay. For docking, when two spacecraft dock, especially in space where you have all those degrees of freedom, it's very difficult to align everything and know exactly how far you are away. The range is very important, and it's difficult to tell. Now, mind you, I've only flown light airplanes. I'm not a test pilot or anything. But I got to fly the simulators as long as no reporters could see me get in or out. "Deke" [Donald K.] Slayton said, "You will not be photographed getting in and out. We don't want them to think there's a woman astronaut."

So I did a lot of the simulator flying and everything, and I loved it. I was very good at it, because—I'm getting off the subject, but it is something I just thought about. They had this moving-base simulator with the lunar module, the LM, where it was docking. It was in a big building over—I forget what it was called. It was right next to where my lab ended up being years later. But anyway, it was a moving base. It hung from the ceiling, and it actually moved. You had to get in there, and you hang on straps, and when you pitched the LM over, you were hanging. Now, I've always been a gymnast and very agile. Well, I was the only one that could hang in there for hours and fly for how much fuel it took. So I got lots of time in that one, that was why I got to fly some of those [simulators] that other people didn't, because it's very uncomfortable.

So I was flying those, and then I think from there it developed where Dean and—Dean had been working with Buzz Aldrin on the rendezvous procedures, and in doing this—I was working in the crew area, as you know. This was Warren North's area. Came up to how are we going to have our attitude indicators and what kind of docking aids are we going to use?

So there were no real simulators that we could do it from anything more than like fifty feet or maybe eighty feet; I don't remember how far the simulators. So that was why we developed these out on the back road of JSC—at the time, MSC. We got these big trucks and a

crane to hold the actual, full-scale models, and the crew would sit up in a mock-up like a Gemini, and so that they could use the different—we had about ten different things, so that’s why I’m muttering here.

I can’t remember what all we tried. We tried ten different sighting devices, and we had a cross where it would be up on the vehicle you were docking with, and you would have some kind of cross etched on the window of, say, either the Gemini or later the Apollo service module. So as the truck would drive closer, then we’d have them say how they could tell the range, try to estimate the range, and all sorts of little ways of doing it with little indicators and fiducial marks and things like that.

So without drawing it, as any good engineer, it’s hard to explain without a pencil in my hand. But it was really a very interesting test, and I think we had almost every astronaut. At the time I think there were only two groups, the first seven and then that first group, with John [W.] Young and that group. Maybe there was a third group just selected after I got there. But anyway, almost all of them went out there, and we ran them through.

It was wonderful. I had all their little comments and stuff, and then we had a flood in Houston where I lived out near Galveston [Texas], and it just messed them all up. I know. It was neat, because they all had funny little remarks and stuff, so it was too bad. That would have been nice to have given to NASA.

But anyhow, so that was where I got the title “Moon Maiden,” because one of the things I did when we were trying to—because people would say, “Well, we can’t go out there and do this if we have a full Moon,” and blah, blah, blah. So I got all the data for the next three months of the Moon cycles and plotted it. I just love solving puzzles, and I came up with a very clever little thing where you could just move something and find out what the Moon would be on that night.

So especially Wally [Walter M.] Schirra coming down, “Hey, Moon Maiden.” So it was those days when you did things like that. I don’t think that goes on much anymore, but there was things like that. [Laughs]

Okay, so that’s enough on that one. What was the other—oh, the Apollo landmark. I think that was one of the first ones, the lighting, that I worked with Dean as a major project that we had. I think shortly after that then I got the Apollo landmarks; that was my own study after that. That took a year or two. That was pretty impressive, because I got to look at every part of the world pictures. I had to get an extra clearance and everything to look at them, because when you’re up there in orbit, you don’t care what country it is. If you need to get home, you’re going to use that landmark. So that was an interesting project.

WRIGHT: Was that, you said, the first one that you really worked on, too, that you were in charge?

CREWS: I think that was more the first that was totally mine. I did most of the setup work on the lighting, but Dean, of course, was involved, too, because he was senior to me. He was the senior engineer to me, but I think he was a [GS-]13 and I was like a 7. I got my promotions just like that, but I worked. I bet I worked sixteen hours a day. But then that’s what I wanted to do. It was my life. That’s all I cared about. I couldn’t date.

Oh, and the stories going on around about me. You know, it’s so funny. “She can drink anybody under the table.” I don’t even drink; never have. I still don’t. Never do. But that was humor. That was some of the stuff I can’t put in the book, but it would have been funny. Some of the stories I can’t tell you; I wish I could, because they were humorous.

Let's see. What else did I do after that? I guess then one of the later things—there were a lot of projects in there. Actually, I have to tell you what I think Dean—as Dean got promoted up, he tended to send me in on projects when they weren't working. Yes, so I guess that was—at least I'm the “other engineer” he talked—but, well, when we get through I'll tell you why.

Then Skylab. When Skylab started, there was so many experiments scheduled for Skylab. I don't know if you have heard from a lot of people you've interviewed, but astronauts and principal investigators [PIs] is probably oil and water, or even worse, because a principal investigator sees nothing but his experiment, and he sees a klutz astronaut that's going to break it. [Laughs] Or not do it right, or something.

So they decided, in their wisdom, “Let's put Jeanne in there. Maybe the PI won't kill her, and maybe the astronauts won't kill her,” because before that I had a job, in some cases, of trying to get a bunch of astronauts to agree on anything. Those are funny stories, too. It's a wonder I'm still alive, actually, because they wouldn't agree on anything; the controller, the Navy, Air Force, Army. [Laughs]

WRIGHT: Everything but, huh?

CREWS: Yes, I think having a woman in there really helped them, actually. I don't think they could have gotten it done very readily at first with a man, because the reason it worked is they didn't want to kill me. They were still trying to patronize me, and yet they still wanted to fight, but I had a little leverage there.

I remember when they were getting ready for their—remember when Ed [Edward H.] White used the gun, EVA [extravehicular activity] gun? They had put in a floor, air-bearing

floor, where he could train on it, and so they were training a couple of the astronauts on it. It was being kept very, very hush. No one was supposed to know that we were going to do the EVA on that. Some of the crew members wouldn't train. I only heard this after the fact. Jeanne was asked to go in there and do some of it, so I did, and I did okay. So they used that by saying, "Well, a girl can do it."

So [hits hand with fist]. But anyway, I learned later why that was done. It's funny now. I wouldn't have liked it at the time, but it's funny now.

WRIGHT: It gave you an opportunity to do things that other people couldn't do.

CREWS: Oh yes. Sure, sure, I got to do them. And the funny thing is with men, and no offense men, if you're reading this, but once you show you can do it, it's almost like, "Oh, well, sure." But just doing it that first time when they're—it's more like they're half protecting you, and they're half protecting themselves, because of their ego. But in the end, most of them will come around; they accept if you just show them.

It's the same with anything, I mean, any group. If you have a bunch of nurses, and a man comes in and wants to be a nurse, I'm sure it's the same. I'm sure it's the same. It's just frustrating. It's frustrating when it doesn't go away after a while.

But anyway, that was probably the job that I did on the Skylab. That took quite a few years, and it was extremely extensive. You know what, I hardly remember the details on any of those experiments. There were so many, and I had about six or seven subcontractors working for me at the time, because it was too extensive, from Martin Marietta [Corporation] up in Denver [Colorado]; they were supporting. We'd go all over the country to support these.

But I will tell a funny story about the rotating litter chair. This is one of the—if you've never heard it from anybody—have you interviewed Walt [R. Walter] Cunningham yet?

WRIGHT: He was done, but it was done more of a PAO [Public Affairs Office] style interview.

CREWS: Oh, well, he may not have remembered this, but this was too funny, and Joe [Joseph P.] Kerwin had a little part in it. The PI for the rotating litter chair—I cannot remember his name, but he was a very large, big man. The chair was designed so that you put the crewmen in it, and you rotate it, and you want to see how sick they can get. [Laughs] Well, the astronauts, of course, they're trying not to get sick. So we were having a big meeting, and I can't remember; it was either in Maryland or Boston [Massachusetts], some big auditorium.

There was tension; you could cut it with a knife, because this PI and particularly Walt Cunningham had been at each other's throat about malaise-3, I think, but anyway, they wanted to bring them right to the brink of it. So before it started, there was a piano sitting down in front, and all of a sudden Joe Kerwin goes walking down and starts playing the piano. It was great, because it relieved [the tension], because it was just like this [indicates tension].

Then later as it got going, I remember Walt and the PI, they almost were swinging. But I had to, after that work with Walt to try to get them—see, I would talk to the PI, and then I'd go back and talk, and try not to get killed from either side. [Laughs] But that was one of the worst experiments. That was really bad. The others were more scientific; well, that was scientific, I suppose, but the others were astronomical, where you were looking at all sorts of different instruments and things. If each one came up, I might remember a little bit, but I was a very busy person.

WRIGHT: Did you have to become very knowledgeable about each one of those experiments?

CREWS: Well, sort of, because no one could become [extremely knowledgeable] in all of them, and they were all for different crews for different missions on the Skylab. We sort of broke it into different ones. I would take so many and cover them, and then each guy that worked for me would cover so many. Then we'd sit down and go over the changes and requests and what the crew didn't like. We'd have to review all the hardware.

I remember—I won't even say his name—but one of the astronauts was a huge man, and even if he tried, he couldn't be gentle. The PI would say, "Do not let him near my—."

"Oh, what's this? Oops!" [Laughs]

So it was an interesting time. It really was.

WRIGHT: When you say you had guys that worked for you, were you then moved into a supervisory role to do this, or one of the leads?

CREWS: Well, you're a contractor monitor. I was reading someone's the other day; I forget whose it was. I don't remember, but they were saying the difficulty of NASA contract monitors was being a contractor. I think it was Burt [Burton G. Cour-Palais], maybe. And then becoming a contractor and doing that. You know, it can have its problems. I had quite a few people. When I developed the lab few years later, I had lots of contractors working for me.

WRIGHT: This being still in the sixties and early seventies, did you have issues with contractors not wanting to have you as their monitor since you were female?

CREWS: At first, absolutely. One of my favorites was Harvey Brandt; Harvey now lives down south of here. He worked for Martin Marietta, and he's a character. He was from New York. He'd never seen a tree except the few that grow along [the streets], so I always teased him. But he had worked for lots of the big companies, and he was a very, very good engineer. So he walked in and looked at me like, "Hmm." But within six months he was calling me "boss," and that was such a compliment. Talk about a compliment.

The reason is, if you got somebody smarter than you on a subject, you let them do it. Anyway, that's my whole philosophy. Call it whatever it is. Why should I relearn something I don't need to? Anyway, that's progress, and so I was very proud of that. I'm proud of the day he called me "boss." That meant an awful lot, because I knew exactly what it meant.

WRIGHT: You knew so many of the astronauts and flight control people as all of you were moving along through these years. Tell us about some of those memorable times that of course, the first Moon landing or even Apollo 8, when they made the decision to go around the Moon. Or Ed White; you trained with the same instruments that you saw these astronauts go out and use.

CREWS: I'm trying to think of any of the—hmm. I worked with them every day.



WRIGHT: Where were you during those time periods? For instance, for Apollo 11 were you working the mission?

CREWS: Apollo 11, no. I had done all my work. Shall we just say the head Flight Controller and the head doctor at the time were—women were not allowed out on the floor in Mission Control [Mission Operations Control Room, MOCR]. I spent many times on the Skylab experiments in the back rooms, and then if I'd walk in the elevator, there would be comments by the two people I referred to, like, "Well, it's certainly good we keep women out of the Mission Control," I mean, things like that.

That changed about ten years later, I think, but they did keep women out of it for a very long time. The thing was, it's a distraction. Okay, now where was I? [Laughs]

WRIGHT: So, you were working in the back room. How about Skylab? It was the first time they went on twenty-four-hour—on a continuous basis.

CREWS: Yes. I was in the back rooms whenever there would be a problem with an experiment or something. What I would do, I lived right across the street from JSC; I always lived in an apartment very close, because I was always over there at any hour. They would just call you at a minute's notice or something, and sometimes we had to monitor the temperature when that shield broke away. I think Burt talked about all that. Had to monitor the temperature, and he helped like that, but I could not go out on the floor, so it was always in the background.

Mostly the work I did was preparing for the flight. The crew items would be like we talked about having the way to sight on the window, how you did that; procedures for how you

tracked landmarks, because I did, I set up a bunch of simulations up at Boeing [Airplane Company]. I did the lunar landmarks, too.

They put a big model of the Moon, and then you had a TV camera, and you were flying the LM. This was one of the first early simulations, which later they got very sophisticated. Now they're extreme. You can hardly tell the difference, that you're not going to the Moon. But that was one of the very early ones where the TV camera would scan along the craters and things like that. I did that.

WRIGHT: You set those up as well?

CREWS: Yes, I coordinated the requirements from the crew's point of view to the contractor developing that, and would go and help fly it originally. Then you schedule some of the crewmen to come up and make sure, and get their input to make sure it was implemented, the changes; things like that.

WRIGHT: Did you fly the simulators as well?

CREWS: Yes, I got to fly them.

WRIGHT: And try those procedures out?

CREWS: Yes, I was never very good with the LM landing, because I wasn't a pilot, and I didn't have much practice on that one, because everybody wanted to fly it, and I didn't have that

priority. [Laughs] If [Alan B.] Shepard or somebody came and said, “I’d like to fly it,” well, I had to get out. So, yes, but I enjoyed it. It was lots of fun.

WRIGHT: Did you get feedback from the crew about what worked well and what didn’t? Did it come back to you?

CREWS: Oh yes. On the things I was working with, that’s what you would actually do. You’d go and work something out and get it set up, and then you’d try to schedule different crewmen to come in and evaluate it, and you’d take their evaluations, and there is where the problem was. You’d have five astronauts flying it, and they’d have five different opinions, and then you would try to stay alive resolving that. [Laughs]

WRIGHT: Because I’m sure they were all correct in their thoughts, right?

CREWS: Oh, oh, and they were all for sure they were right. No, that was fascinating. I didn’t know how much—and I hate to use the word *fun*, but I might as well. At the time it was work, and I used to go home stressed. No one ever saw me cry, but then if they’d have come home with me, there might have been a couple times. But I mean, it was fascinating, and actually, looking back it was fun.

But *challenging* is the word. That was so challenging, because I will tell you, in those days a GS-7, which I was, and a GS-15—at the time I think that’s the highest we had—and all of the astronauts, it didn’t matter. You sat around a round table, and anybody had ideas, you just

said them. Nobody was “sir” or “ma’am.” It was just a bunch of engineers and scientists trying to work, and that was wonderful. It’s not true anymore. It was wonderful. It really was.

What is it? After twenty-five years everything becomes a bureaucracy, and that’s sad. This was when it was just a baby, and I cannot tell anybody how wonderful it was, just fascinating. I miss that part very much. So anyway, but that was the early years. I haven’t thought about them much, but it’s kind of fun to remember some of this stuff. I’m sure I’m not remembering the best parts. I probably will after you’re gone. [Laughs]

WRIGHT: Well, we’ll just fill in those blanks when we do that. The seventies was a changing time for NASA.

CREWS: Yes, they were shutting down that division, and so I don’t remember how it happened. It was very weird. Dean Grimm went and hired over in Engineering. He went and took a job over there. I was really happy where I was, but Dean said something that made me go over there. I probably would have been better staying where I had been, but he informed me that he didn’t think that I would do well if I stayed. So anyway, I went over there, and that was probably the least effective part of my career. There was nothing really where my expertise or my interests.

I did try to redesign the backseat of the B-57. Al [Albert H. Crews, Jr.] was flying it at the time, and I knew that the backseaters were having trouble with the controls and everything, because it had just kind of grown. Nobody had ever taken it and laid out a design for it. So I did that, sort of sold the idea on my own and tried to get that going and worked on that.

Then a job became available over in Space and Life Sciences, and I wanted to do research. See, half of me had always been a scientist. I probably would have liked to have been a marine biologist, because I loved to scuba dive; all sorts of things, and animals. But I wanted to be an astronaut, so that drove me to the engineering. So this was an opportunity, I thought, to go over there and maybe could do some research. There were a lot of geologists and things like that.

So I got over there. Of course, dumb me. What they wanted, they needed an engineer to help their scientists. Well, at the time I was a senior engineer with experience, and that angered me. So once again the battle raged with the scientists. [Laughs] “No, I’m going to do my own thing.”

So they had a—in those days they called them an RTOP [Research and Technology Operating Plan]. I think Burt had submitted—I didn’t know Burt at the time—had submitted something to say, “We need to build a little hypervelocity launcher to take a look at new materials.” Nobody there wanted to do it in the division, so that was assigned to me, which I knew nothing about it; wasn’t interested in it until I got the thing built, and took a look at the first impact that I saw.

I put that together with my crew experience, and there was my life’s calling. That was it. There’s no question about it. In fact, I should show you some, if you want to cut that off a second.

WRIGHT: Sure.

[Tape recorder turned off.]

CREWS: —orbital velocity made this. Look at the back blown off of that. I'm going to show her, too. You cut the crater in half so you [can] see [the damage]. And this, see this piece of nylon here? [shows a nylon slug-cylinder] It did this [one like it]. That's at orbital speeds. Isn't that amazing? It's a piece of nylon did that, see? So when you hear about orbital debris, this is why. I hadn't paid any attention to it, and so these little light gas guns they were talking about, Burt had done this in the past for Apollo, but I still didn't know Burt.

So I had a corner of a geologist's lab given to me to do this, because he didn't have a gun that shot this high [of] a velocity. So I built this little teeny gun; that was the engineering part. Then when I shot it the first time and saw what it did, I thought, "Oh, my goodness, I've got to get involved with this." These guns are very, very simple. It does nothing—they're called light gas guns, not because they don't weigh much, but [because] they use hydrogen gas. That's the fastest propellant, because when you compress hydrogen, when it expands, you get the most work from it, or energy.

That's what you do. You just drive a piston down and compress the hydrogen, and it launches these. The art, though, is making sure the little ball gets down and hits the target without a bunch of other junk [hitting the target], and that's a real art. But anyway, so that way I got interested in the little gun, and I started testing things, just different materials, to see how they would withstand impacts. It wasn't good. We have aluminum on almost all the spacecraft, and there wasn't much shielding, so there became my calling. [Laughs]

So Joan of Arc. But I decided that really someone needed to do that, because Don [Donald J.] Kessler, who was telling everybody—and he and Burt had worked together—that the

debris is getting worse. Nobody was telling the engineers, “Hey, your spacecraft are not being designed right.” So that’s not a popular thing, either, so I started doing that.

Then Burt came over one day—I don’t remember why, to look at the gun or something—and we met. I didn’t hear from him again, and then all of a sudden he was brought over to the division just to archive. They just wanted him to go sit down and write the history.

Do you know he passed away recently, about a year now. But anyway, he’s just a very nice man, a gentle person. Thank goodness, I wasn’t. Between the two of us, with his experience from the past—when he did come over, I went in and told him that I had heard the Division Chief speak about him like, “Well, he’s not going to do anything.”

I went and I said, “Here, I’m Jeanne,” and we shook hands. I said, “We are going to go fix this problem. Between your experience and your expertise in this stuff, and my determination and knowledge with the crew, we’re going to do it.”

So that became a pact, and I guess it was twenty-some years we worked on this stuff. We fought because we were so different—we were trying to develop shielding, lightweight shielding. For a while I called him “Mr. Aluminum” and I was “Miss Nonmetallic,” because I was looking at all these fabrics and knew—because I had no restrictions, because I didn’t know enough about what had been done for anybody to say to me, “You can’t do it.” In fact, I never did know what the words “You can’t do it” means in my whole life.

So I would go on with all these wild things, and he’d say, “You can’t do that,” which was wonderful. If I could ever recommend to people who want to do research, get someone who’s got all the knowledge, very, very smart with everything that’s been done, and somebody who knows nothing about it, but is interested. That’s the most wonderful team you can ever have. So

he would keep me within bounds, and I would make him grow. Together we came up with really a fascinating shield.

The way they stopped this particle in the past, it's called the Whipple shield. So what you would do, if this was the back, the wall of the spacecraft, you'd put a thin sheet—by “thin,” I mean a certain—about like this here [demonstrates]. When the ball hit it, that would break it up into pieces, but you would get pieces of the aluminum, and it would go back. You just design it so it can stop a certain particle at a certain speed. You can't stop everything. So that was the Whipple shield, just one bumper and one wall.

So what we started looking at was making it thinner and thinner, but making the same thickness essentially, but thinner pieces, more of them. What we were doing was repeatedly shocking it, and that was wonderful, because that was actually vaporizing more of it. The more you shocked it, the more—not only that, I found a piece of ceramic fabric that someone wanted to see if they would use it to protect a nuclear satellite, because it was good for radiation protection, and would it do okay to protect it. So I tested it; it was wonderful.

Burt goes, “No.” It was a ceramic fabric, so right away here we go. I don't know how many times he'd slam the door on my office. I'd slam the door on his. But we really, we ended up—it got classified, it was so good. [Laughs]

So we used to travel all over, and poor Burt, he wasn't “Mr. Athletic,” and we'd have to carry this aluminum box, and it was classified, and fight with everybody at airports to get it through, because they couldn't open it. They wanted to open it. “No, you can't open it.”

He'd be huffing and puffing, trying to catch airplanes and stuff, but he loved it, because I read what he said. In the middle of the night we'd have to go and knock, knock, knock. “We



need to lock [up] this.” [Laughs] Someplace, I forget where we were, but it was really hard to find. He mentioned where it was. But anyway, so we had a lot of really good times.

WRIGHT: Did you handcuff it to yourself?

CREWS: Oh yes, yes, on the suitcase. Well, we couldn't leave it. He ended up starting to call it “Baby,” because you couldn't leave it. If we had to go to the restroom, one would have to keep it and the other one went to the restroom. But that was sort of fun, I guess. It wasn't fun at the time, but things like this are fun when you look back. It couldn't get real well known at NASA, because you couldn't. It was classified.

But DoD [Department of Defense] knew about it, so we started doing well with DoD, and meanwhile the lab [laboratory], I was building it more and more. I got [NASA] Ames [Research Center, Moffett Field, California] to give me one of their older guns that they had, so that way we could shoot these larger particles here. The lab was growing. See, no one funded that lab. I was the battler. Burt, he wasn't up to battling people. He was just so smart and just a sweetheart, so it was up to me to do the battling, and that was where I got a reputation for being a real pain.

But I did get that lab built, and I did get some shielding developed, and I got a bunch of wonderful people working on that. Eric [L.] Christiansen is the one who now—I hope someday you'll interview him. He is NASA's knowledge of the shielding and the model that they used for the debris. He just doesn't beat his own drum. He is the one. He is the brain, and he's not a fighter, either.

But sometimes I want to head back just to go back, because they're designing the new spacecraft; same mistake they made with the old ones. When the Shuttle was being designed, or the Space Station; let me use that one. That's even worse, because it's up there for a long time. It needs shielding.

They had 300 pounds of total meteoroid shielding on the Space Station—when they took the contract out to have it built, 300 pounds. No way. That thing is going to sit up there and it's already had some little dings, but, anyway, our calling became to go and fight for that. What they should have done when they designed it, if you combine meteoroid, radiation, and thermal [shielding] at the beginning, you will save so much money, you will save so much weight. It's just beyond—I want to stand up and scream it, but you can't get those three disciplines together. They all want their own thing.

It's just like the ceramic fabric, this [3M] Nextel that we used. It's used to line furnaces. It's used behind the tiles on the Shuttle as a heat protection. It could be used as a thermal protection. It's great against meteoroids, because it's ceramic material, which is very good at breaking up particles. Radiation, it's quite good at. Why don't they do it?

I guess if I leave anything else with this discussion here, if somebody will just read that before they continue designing, because they're going to end up doing what they did before. They're going to do the thermal. Then they're going to do the radiation; worry about it. And then they're going to slap on the shielding for the orbital debris and meteoroids, and that's foolish. So, there. [Laughs] I don't know what else to say about it.

Then I have another thing. I'll probably forget it, so I'm going to throw it in here. The asteroid impacting the Earth. NASA is [not] giving—like we always do, we need to show politically we're paying attention, but we're not giving it near the attention we should. I tried

with [Daniel S.] Goldin, to tell him. His comment to me, “We’ll let the Air Force handle it. They’ll nuke it.” You don’t nuke it, because then you have all the pieces coming [at] you. You don’t do that.

They’ve been looking at it a little better, but the budget is so low. And [an impact could] wipe out the planet. That would wipe out all—you know. So that’s another one that people really need to do something about, and we can. We can. One of the things I was wanting to do before I retired was have a workshop once every two years with everybody in the world. I don’t care if we like them, or if they don’t like us, because this is everybody’s business. Just have a workshop where you take all these people [scientists, engineers and politicians], lock them up in a hotel, and pretend that, “Okay, we’ve got ten years. One is going to hit us. What are we going to do?”

When you’re through, come out with a really nice plan, and then it will be updated. When the technology improves, update it. But I know they’re not doing that, but they should. They should. So I’ll be on record when we’re all gone. [Laughter] Lots of good it’s going to do, but anyway, that’s very, very strong I feel on that.

Okay, the lab. Is there anything? That was my most important thing I did.

WRIGHT: Talk to us about these fabrics. Did manufacturers approach you, or how did you find out there were new types of—

CREWS: It was just the people who—I forget who it was; it was Boeing. They were designing a nuclear satellite, some kind of reactor, and they had to have a good thermal shield around it. It wasn’t [for shielding] from orbital debris or meteoroid shielding. So they sent me some fabrics

that they thought, “Well, will any of these be okay that they won’t get totally wiped out by being hit by small particles?” So with the gun we tested them.

Oh, and I may throw in here, if you’re the researcher, you’ve got to have your gun right there. I’ll get to that. Don’t let me not talk about [NASA] White Sands [Test Facility, White Sands, New Mexico]. This is so important.

It’s like if you had someone researching something and not giving them their computer, that they had to write up what they wanted someone to run on the computer. It doesn’t work. You have to have it right there. If you want to develop a shield, you have to be able to change something immediately and do another test. No one has that capability right now at NASA. It was taken away when they closed the [JSC] lab and sent the guns to White Sands.

Anyway, okay, what were we talking about before that?

WRIGHT: About the fabric.

CREWS: The fabrics. So people would send me things all the time so say, “Would you please take a look at this? Will this withstand a couple of years’ worth of this?” Whenever I could test it, I would, because I was not being funded by JSC, per se. I would get grants or I would sell tests to the DoD or to Sandia [National Laboratories, Albuquerque, New Mexico] or to somebody, whoever I could. That’s how I supported it, because I wasn’t in the mainstream.

In fact, no one really wanted to hear about shielding, so I became to the Space Station people—and I loved them, don’t get me wrong; they really helped me in the long run. But they would call me “the cultist.” [Laughs] I’d stand up there. In fact, this piece right here, when [Richard H.] Kohrs—Kohrs was head of the Space Station [Freedom]. It was before they hadn’t

done anything to put any more shielding on, so I walked up there, and I had fifteen minutes to talk. It was the ninth floor conference room. Everybody was there, and so Kohrs was sitting there, and he was very—I don't know if you all have interviewed him. I really like him now, but at the time he loved to intimidate. He would just sit there and glare at you, and he didn't say a word. So I took this, and I said, "You know what? I don't know what else to tell you but this."

[Handed him an example of the impact of a nylon pellet on metal shielding at orbital velocity.]

[Laughs]

He didn't want to take it from me, because he liked not to acknowledge people, but he took it and sat it down. Then I just briefly said, "This is what a piece of nylon can do." I said, "Just imagine what a couple pieces of aluminum or whatever up there." I said, "Just imagine." That was essentially my presentation.

I never did like to drown everybody in facts, because if you can't get their attention with a two-by-four, then why bother? Because that's Eric, he likes the technical. He's wonderful. But you've got to get their attention first, because if their eyes glaze over, they go to sleep. So that was what I used.

In later years I even gave Kohrs one of these, because he ended up being a good guy. He just didn't want to have to acknowledge, because why? It was going to take more money. They didn't have the weight, the money. I understand; you had to fight for your part of it.

So that was really what I did. The thing that I did, even more than building the lab, was go and make them realize, or win the battle against everybody else that wanted the money and the weight. That this is something they had to do. Now it's pretty well protected; it really is. I mean, the [International] Space Station, they've protected it pretty well, and that makes me feel good. So, let's see. That was fun, that one. That was good.

But it was a battle the whole time to keep funded, to keep the lab going, because—and I'll just go ahead and say it. George [W. S.] Abbey didn't think there was any problem with orbital debris. "They haven't been hit yet. Well, why do you think we'll ever get hit?"

Well, come on, it's a probabilistic thing, and the Russians felt that way at first, too. The *Mir* [Space Station] had been up there, and it was still there. But, you just can't play—the expression—Russian roulette with it. It's there, and we're going to get hit. Let's just hope we've done our job. We can only protect up to something about one centimeter. But the probability goes—and when it gets really big, you can track it, so then you can move the vehicle if you have the time, or orient it.

So that's the thing that Eric is so good at. He had developed this bumper program that uses all this together. It puts the environment that they've been measuring for debris, puts the vehicle with its design, its orientation, all of that together, and it comes out with a "Here's your number [for] your probability of impact during this mission." He's very, very good at that. He will definitely give you the technical facts.

I like the big picture, and I really enjoyed trying to get people convinced of things, and I was so proud of it when they would realize it. None of them ever liked to say, actually, "Well, Jeanne, you know what? You're right. Here's your money." It was like on the side somewhere. They would call me and, "How much do you need?" [Laughs] So that was good.

WRIGHT: Did you have to write formal grant proposals?

CREWS: Well, I did that to stay alive 'till I got them to listen. Once they listened, then I got a budget; had to fight for it every year just like everybody does. But no, then they started paying attention.

WRIGHT: Was anybody else in NASA doing the work that you were doing?

CREWS: Eric, but his hands are so tied on developing new shields. See, we have three or four patents on new shields, and we were doing great, and he's brilliant. But he now has got to go to get his testing, which is the only way you know if it works, at White Sands. At White Sands every test costs two to three times more, because they have a different group making the sabot [phonetic] a different one with the gunpowder, a different one doing [the test sample]—whereas we had one guy that did everything right there. If you have an idea, you can't wait a month for it to be done and sent back.

The reason George—well, there's a couple of reasons, but the ones I'll talk about that George did [to] my lab the way he did, took all the guns and sent them to White Sands. It cost a half a million dollars [to move it]! We were *the* lab for NASA, and so, of course, he had friends at White Sands, the Senator at the time. They needed something to keep White Sands open. White Sands was getting close to being closed.

So one of the reasons for sending the guns there was that. He sent other things up there, too. But there were other, different, more personal reasons, but anyway, he took the guns away, which it took me twenty years to build the lab. It was known all over the world. Everybody in the business, that was *the* lab, at JSC. It was Building 261 right next to the astronaut gym.

Actually, though, what I did, before he did all that, I sent a gun up to Rice [University, Houston, Texas], so Rice has a little gun that shoots this size, and they've been still using it. We call them "gunners." That's not a very professional name, but Jay [Laughman], the gunner, who's wonderful, and if he doesn't keep shooting, he'll lose his expertise—he goes up there occasionally and does tests at Rice. I think Southwest Research [Institute, San Antonio, Texas] has one of the guns.

See, I had parts, so I made sure that the expertise stayed, because Southwest Research did a lot of work for us with the shaped-charge [testing]. We did all sorts. We were the ones that actually developed—Burt and Jeanne, and then Burt, Jeanne, and Eric, and then Jeanne and Eric—developed all the shielding expertise. See, the geologists, with their guns they're doing different things. They're studying how things [planets, asteroids, etc.] break up and stuff like that. But we were doing the engineering part.

Of course, it made us unpopular in the Space and Life Sciences, because they were all scientists. But it's okay; they let me do my thing. So there's a gun there, but I also had one put up in the lab just before I retired. But it's sitting there in mothballs. Nobody will let them shoot it.

If Eric could just have that little gun. The big gun's gone, the big one that shot this. That was a wonderful gun I got from Ames. It's up at White Sands now. But if they would just let him use the little gun, he could be developing more and more shields, and no telling how great he could do. He could be combining the thermal, the radiation, and that; but he cannot afford to do it with the budget they give him by testing at White Sands.

I don't know who to tell this to. Nobody listens. John [W.] Young listens. John's been one of the supporters.



WRIGHT: Talk about the patents that you developed.

CREWS: The first one was classified for a while, because that was the multishock. The multishock shield is what everybody is now using. In fact, joy, joy, joy, I was watching the science station the other night, and they're talking about Deep Impact, the spacecraft going up to the asteroid. And there's Joel Williamson, who used to work at [NASA] Marshall [Space Flight Center, Huntsville, Alabama], who couldn't stand the multishock shield; it just wasn't good, because they had all sorts of shields.

The announcer says, "And here's Joel Williamson." He's at the University of Colorado [Boulder, Colorado] now. And with a little gun, and he said, "He invented this innovative shield."

And Joel says, "And here's a copper multishock," and I'm going [makes noise].

I sent him an e-mail, and I said, "If you have a patent on this, we have a problem."

He said, "Well, no, Jeanne, I know you invented it, but they just said that."

I said, "Well, you owe me an apology at least." Anyway, I had done that in '82.

Anyway, so the multishock shield is the one I told you about. Rather than use one bumper out in front, used a bunch of little thin ones, and you can do so many things with so many—that was copper I used; I used aluminum ones; the Nextel fabric, which was really a breakthrough, because then you could have also at your shields that could conform. Metal is wonderful, but it has its limitations on how you can use it. The Nextel is even good for putting it behind—we had to jury-rig one. We couldn't use the full multishock to fix something that had already been built.

That's what I'm trying to say. You have to go back, and you don't do it as well as you could. So we sandwiched it, and it still does work well. Not as well as if you could have had it standing out like that [gestures], because it ended up weighing more.

But that was the first patent was the multishock with Burt. He was very proud of that, and he was proudest of the *National Geographic* picture, but he would not come over to have his picture taken at the lab with me. He wouldn't do it till I threatened to kill him. I know we're not supposed to say that these days, but anyway, I really had to just about strangle the man, and so he finally agreed, because the guy took all day (the *National Geographic*). He must have taken 300 pictures.

So anyway, Burt, after that he wouldn't tell me for a while. I think he said it in his interview, too. Every time I had ever talked to him on the phone, he said, "Jeanne, forget all the awards we got and all the commendations." He said, "My grandkids only understood I did something good when I was in *National Geographic*." I thought that was so cute, because he really liked that. So that was the multishock.

After that I think that's when Burt left, so the other things were more derivative of that, though. I know that George Abbey didn't see fit to renew the patent on the multishock. You have to pay like I think it's a thousand a year or something, and it's the basis of all the new shielding. So be that as it may; well, that's NASA. You know, they get the royalties.

That was the most important one to me, and then Eric and I worked on a couple. I think the latest one—oh, the one I told you about that they fixed. I can't remember what we called it. What did we call it? It's the one I put Marshall on it, because Goldin wanted me to show that we're working together. If the patent guy overhears me say this, I'm dead, because I had to say,

“Oh yes, they were involved.” [Laughs] “Oh yes.” Well, anyway, and that’s Joel’s, the one that I saw on the Science channel.

So anyway, that one, and what did we call that? I’m sorry; I can’t remember.

WRIGHT: That’s okay.

CREWS: As I say, it was a jury-rig, but it was different. Well, it’s on the Space Station now, and then the one that Eric and I just did before I left is the flexible shield, which is really great, because that way you put a foam in behind the ceramic, and you can carry it up and deploy it wherever you need it. So that can be used. I don’t know that anyone is using it yet, but that was a good one.

The reason that one was such a problem is Boeing came to the lab, a couple of people, and they saw it, and went and patented it. Yes, we fought that for many years. But we knew what we were talking about, so we could take everything they didn’t know to put on it, and we did. [Laughs] Eric and I got the rest of it. Yes, that was a couple of bad things, but that felt like me fighting Goliath.

WRIGHT: No kidding.

CREWS: Of course, I sort of did that my whole career, but, you know, I enjoyed that. I’d go home frustrated, and as I said, just of anger, but no, I enjoy a good fight. I guess that’s the only reason I did survive, because a lot of people wanted to kill me. [Laughs]

WRIGHT: I can imagine. [Laughs]

CREWS: But I think most of it in the end, I think there was mutual respect, I think, at the end. At least, I know the people that would call me the cultist, it was Bob [Robert E.] Bobola and [Clarke] Covington and all of them, they would come over to the lab and have a private meeting and look at all the stuff we'd done. So they really did appreciate it. It was just one more problem they didn't need. There were so many problems other than those. I wouldn't want to be a manager of one of those programs. I know; I used to have to go say, "Well, this one you've got to listen to." [Laughs]

WRIGHT: Lots of details.

CREWS: Yes.

WRIGHT: Were you involved in any way with after [Space Shuttle] *Challenger* [STS 51-L accident], looking at anything or any part of that?

CREWS: No. No.

WRIGHT: I was just curious.

CREWS: By then I was over in Space and Life Sciences. Now, on [Space Shuttle] *Columbia* [STS-107 accident], the guys that worked in my lab, Eric Christiansen and Justin [H.] Kerr—years before that when I first started my lab, I was sitting at my computer, and this person walked in. He's six-foot-three, I think, and I'm looking up, and he's got this green suit on with the shoulder pads, good-looking kid. He said, "Hi, I'm Justin Kerr, and I'm a co-op, and I want to work in your lab."

I said, "Do you know what you're talking about?" Because we were very unpopular.

He said, "Yep." So that was so cute. Yes, but he was excellent. I think Justin is going to be head of JSC one of these days. Anyway, but he's no longer working in hypervelocity, but he did for a long time. He was really good. But with Eric and Justin—and I think Justin just quit working in the hypervelocity about two years ago, so I don't know if you've talked to him at all or anything. Well, he's just getting married this month.

WRIGHT: A little busy.

CREWS: Yes. What they did, Justin did run the program over at San Antonio [Texas] at Southwest Research, where they launched the foam. Those are the people that we had always worked with over there. I don't know if you remember that. When they were showing that big hole, that was Justin that ran that program, so he was running that. That was an interesting one, but that wasn't at orbital velocity. That was at a lower velocity, but, still anything moving at those velocities can cause problems.

I wish I had thought about my ceramic fabric about hurricanes. That's what they're using it for now. They make hurricane drapes, where you would just drape it down. It will stop quite a

bit of stuff, yes. You put a little bit of Kevlar in there, which Kevlar is better for lower velocities, because it's strength, whereas Nextel is a ceramic, where it shocks; it shocks the other. They take those now, and you just unroll it as a thing. Then Eric and I could have had some money, but we didn't think about that. We were too busy thinking about space. [Laughs]

WRIGHT: About space. Important at the time.

CREWS: Right.

WRIGHT: Before you moved over to Life Sciences, because we had mentioned earlier about the seventies being such a change for the whole NASA culture, they announced that they were going to hire a new group of astronauts and include women and minorities. Did you think about applying?

CREWS: Yes, but at that time [it was my age]. Or Al is going to tell you about age; that's his biggest thing, yes. All the guys that worked for him were younger. [Laughs] Then when John [H.] Glenn [Jr.] flew. [Laughter]

WRIGHT: So that affected your decision?

CREWS: Right. I didn't. I applied earlier back when no women were. I guess it was a nun and myself that applied. Of course, we were laughed off of it.

WRIGHT: At least they remembered that you were there.... What can you tell us that you'd like to tell us about the changes for roles for women from the time that you went to work at MSC to the time you left JSC?

CREWS: Oh, they've changed. I was so proud when they selected the first women astronauts. I was so pleased. I knew that the time that they did that, they had been ordered to. Well, Dwayne would know the truth about this, but most of the stories that I told, that they had to pick some, and our certain most favorite person, George Abbey, kept not doing it until he had to. But I'm so glad he had to. [Laughs] And I think they were wonderful, every one of them, every one of them that I saw. I didn't know any of them real well. ...

WRIGHT: What about the other roles other than the astronauts? You were one of the first female engineers. Did you see more and more start to come in, or was it a slow coming?

CREWS: Yes, after the first five years, because I kept being told that, "Oh, there was a woman engineer, but they had her in tears the other day, and she quit."

I heard that about three different times, and nobody—I said, "If you hear that, tell me. Let me go talk to them." I'd say after about five years; I was probably one of the very few for five years, actual engineers. Now, there were some women. Here's another one I love, and I can't remember her name. She did the food for all those years.

WRIGHT: Oh, Rita [M.] Rapp.

CREWS: Rita. Rita. She wasn't really, I don't think, an engineer, but she became very knowledgeable in her field and did such a good job. So some of the women were then starting to do things like that, but there weren't very many, and there were no women managers. Of course, that was something I never wanted to be. Talk about a thankless job. [Laughs] So I didn't want to do that. I was close enough running the lab. I just didn't want to do that.

But I'm trying to think. I know that when I first got there, within the first year one of the secretaries came in to me. This you're not going to believe. She said, "Jeanne, did you know you're keeping a man with a family from a job?"

I just, you know, but I have to say I felt better years later. She was one of the first secretaries that used the upward mobility to become a what do you call it? In the different divisions they have—oh—

WRIGHT: Like the administrative—office—

CREWS: Yes, administrative assistant or whatever you call them, yes. So I was pleased to see that. I wanted to call her and say, "Do you remember—," but I didn't do that. I didn't do that, because people honestly felt that way when I started to work. They cared more about what I was wearing, my styles, my fashion, what I was wearing, than they did what I could do. The patronizing was the main—I'm serious. And if you were cute, they really didn't want you to have to do anything. [Laughter] You know, "Please let me do it. Please let me do it." That was really the way it was.

They meant well. There was only a few, and I can name who they were. Chris [Christopher C.] Kraft was one. I might as well just say it, because he was definitely one, and



Barry, the doctor. Those two tried to make my life unhappy, because they would sit in front of me on the shuttle that flew to Marshall and back and forth; they had a plane that would go. When you're on Skylab, we would go all the time. They would sit there and they'd try to talk about the astronauts' underwear, which didn't—you know, by then I had gotten really tough. But in those days, I mean, I had one of the guys in a meeting say "damn," and say, "Oh, excuse me, Jeanne."

I said, "Well, damn it, just say one for me." I never swore, but I started swearing, because you know why? It worked. [Laughs] They quit patronizing me. So it did work. It's terrible that you had to do that, but—I don't know if these are the things that you want to hear. This is more of a personal—I probably shouldn't be talking about it.

WRIGHT: Well, no, because it is part of the NASA culture that changed.

CREWS: It did. Oh yes, it did change.

WRIGHT: It is part of NASA history, but it did change.

CREWS: No, I watched it change, and it was good. Then, of course, when Carolyn [L. Huntoon] became [Center] Director—of course, that's a whole 'nother story. She should have still been Director, but somebody got her—George [Abbey]. Anyway, that was good for a while, but it didn't end up good, because she was being used, I'm sorry to say. But, you know, I think Carolyn was tough enough; she could have handled it. I didn't get along that well with Carolyn, but that was fine. We were free to argue and discuss.

So I'm trying to think what else got my attention. It was actually the nineties before the women started getting management positions, though, wasn't it? You guys know better than I. I didn't keep track of the time. I just knew it was evolving; it was changing. I don't remember, but it was not too long ago. It hasn't been that long. When they picked the women astronauts, I think that really helped.

WRIGHT: Made the biggest—okay.

CREWS: Yes, I think that really helped.

WRIGHT: Why did you decide to leave when you did?

CREWS: Well, I put a big black ribbon on my door the day George took my guns. See, I would have sat in there and not let them take them. They had to totally remove me. I couldn't have my lab anymore, because I was fighting it. I mean, it shouldn't have happened. It shouldn't have happened. So I put the big black ribbon on my door, kept it, and then tried to do a few other jobs. I don't know; they made me an Assistant to the Division Chief for this or that. It was just a "fill your time," and I'm not a good "fill your time."

I mean, I was still going and trying to get money. I mean, I was still the senior whatever title they gave me. I wasn't in there getting my hands dirty doing what I wanted to do. I loved doing my research, and I loved building the lab, because it ended up having like ten or eleven people, maybe twelve, maybe twenty—I don't remember—at one time.

It was the main place for all of NASA. NASA right now does not have anyplace that if there's an emergency up there, they can do the testing and have an engineer right there evaluating it. And they need to, especially on a window. They get an impact on a window, they better have somebody doing it, and the crew measuring it and telling them how big it is, and they better be testing it before they send them back in [re-enter].

Anyway, that's why I put that gun in there, against all odds. I had it actually sneaked in there. If my lab guys hadn't loved me so much, they would never have done it, because they were sticking their necks out. But it needs to be there, and the whole place was designed to shoot guns, the safety stuff we went through, you know. See, I'm getting all riled up now.

WRIGHT: What year did you leave?

CREWS: It was 2002, November 2002. The reason I did it was Al had retired, and I knew he wasn't real happy. I mean, you know, he wanted to fly. He wanted to fly, and I was still working, and because of the lab I had no real incentive to stay. I would have stayed there till I died if I'd still had the lab. I would have still been doing research.

But I decided I needed to come down and [build the new house]. We'd already bought the [old] house here [and had it torn down], and I decided, well, if I'm ever going to do it, I need to get it done, because I knew it was going to be bad. I just didn't know how bad. [Laughs] So I had designed the house, and I had changed it, the design, a few times. So that was why.

I hated leaving. I felt lost the first year. You don't know who you are. It's like, you know, I'm supposed to be Jeanne Lee Crews, the—excuse me—the bitch that runs the lab, the

witch. I don't know if I'm supposed to say it, but anyway, it's okay. It never bothered me. You always knew you did good when you left a meeting of 200 men, and you heard, "Bitch."

"Yes!" [Laughs]

WRIGHT: Made an impact, right?

CREWS: We're going to have to clean all this up. But you know, no, really, that's not a bad word. That's not a bad word. So that was always good. But, I mean, I really do miss it, even when I talk to Eric now, and I say, "Okay, what's going on?"

He says, "Jeanne, come back and fight." You know, I would love to do that. I wish I could, but there's no way I can do that. No, it's a safety area. It's a crew safety area. You have to stay up with it. Yes, I could do some consulting, but I don't think I would earn my pay. I could B.S. it. I'm just not going to do that. I'm not going to do that. Because a couple of people I know have asked me if I wanted to consult, but I'm not going to.

I could use the money to pay for this [new house]. [Laughter] But, you know, I may go be a greeter at Wal-Mart. "Hi, there," at Wal-Mart, but I'm not sure I'd be very good at that.

No, I'm feisty, always have been, but it really does take that if you're doing something new. You can't be nice. Like Burt, a sweetheart, just loved him, but he—we needed each other. We really did. He needed to keep me grounded, because, oh, I came up with—I was even going to shoot—you know the scrubbing pads you use to scrub pans, the green side? I thought that looked like a good shield, so I shot it. [Laughter] Oh, so he would keep me grounded, yes, so anyway. But I do miss it. I do miss it.

But I can't think—unless you have some questions.

WRIGHT: [unclear] think of anything.

CREWS: The two important things I left you with were the one, they need to incorporate those shields all together, and, you know, the thermal, the radiation, and the micrometeoroid and debris shields; and the second thing is the asteroid impact. NASA really needs to do that. See, they see the stuff on TV, the models on the computer. They need to see this. [Gestures] I mean, if that little piece can do that to a piece of aluminum, what is something the size of Texas going to do when it hits this planet? Anyway, to me that's very important.

I mean, going to Mars is extremely important. Going back to the Moon, why we ever stopped—don't get me started on that. That was one of the stupider mistakes. It wasn't NASA's fault. Being controlled by our government is very, very frustrating.

You can't carry your money till the next year. You can't invest it. I wish NASA could invest the money so they could use the interest to work on, but no. You can't build a house if one day you're told, "Here's your budget. You've got \$500,000. Go build this house." So you go buy all the materials, and they're sitting [there], and the next year, "No, well, we've decided you can only spend 300,000." So now what do you do? You're still supposed to build the house, but you can't. So that's the way they treat NASA.

But this asteroid thing, even if it isn't NASA that gets on it, NASA needs to be involved. They actually should start a new—to get rid of the bureaucracy; and I'd go back to work if they'd do that—start a new group that's nothing but planet security or planet safety or I don't know. They need to do that, because it's important enough. It needs the whole world's cooperation, too, because, you know, if you do know one's coming, what you've got to do is go

up there and slowly budge it out of the way. There's a bunch of different ways. You can use all sorts of things. But you need to do it. You can't wait till—you know, we're all gone if it does.

WRIGHT: No. I just have one other question real quick, and then I'll ask Sandra if she can think of anything. But when you were talking about the Department of Defense and saying how you were walking in with this information, and you were sitting with military men of many years in this capacity, did you have any issues convincing them of the relevance of your work?

CREWS: Well, you see, that was funny, because that was the Star Wars. Remember Star Wars? The Star Wars was something; that's why they wanted us to show them the shields. But, of course, they had their own people working on their own shields, so when we walked in, it wasn't so much with open arms. It was to look at the competition. We didn't know this. We were just told to go, because they'd classified it.

When they heard we had a shield that was doing what it did, they came down, and all of a sudden—we didn't know what happened. They walked in the lab, and they said, "This is classified." See, NASA didn't have much classified stuff. We didn't even have a say. We couldn't talk about our work. I mean, it was very frustrating. We thought, "Oh, good. They want to hear about our shields." So we'd walk in, and they're like this. [Gestures] [Laughs] So Burt and I go, "Oh, what in the world?" So I didn't like to present, just because I have to fight. I was doing all the fighting, so I'd make Burt get up there and give the technical, and Burt would put everybody to sleep, you know. So I remember this one—but he knew a lot of these scientists working for DoD.

Burt would give the presentation, and one of the guys that he'd known for, I don't know, years when he worked back on the lunar stuff, which I didn't know anything about, he came up to him. I know I'm probably going to get zapped out of here, but he said, "Well, Burt, you know, that was sure a *sh---*y presentation, but a fantastic shield." [Laughs] Burt never swore or any—he would always say that, because he thought that was so cute.

So I thought that was funny, too, because none of them would even ask questions. Well, see, they were paying all these contractors to develop shields for them, but they wanted—so I don't know that they ever utilized any of it, but we had to go everywhere. We must have gone on ten different trips, and they were, I told you, a pain, because we were carrying the samples. And the airport, oh, my gosh. You know, the alarms would go off. "Oh, it's metal. It's metal."

I'd say, "But here's a piece of paper."

"No, we've got to open it."

"No, you don't open it." [Laughs]

So most of the time I compromised, and I don't know that I ever told Security, because they would have had a hissy fit. I took out the back sheets from the shields. I said, "Just stand over there," and showed them that. I just didn't show them the whole thing. That way they could—it's common sense. They would never have figured anything out. We couldn't have gone anywhere. We were stuck, like in Atlanta. [Laughs]

WRIGHT: Amazing.

CREWS: Burt, he used to love to tell those stories. I mean, I loved the man. I'm so glad he had those experiences, because I think Burt was old when he was born. I don't know. Did you all interview him?

WRIGHT: Yes, we did.

CREWS: He's a sweetheart, but he was always like that. It wasn't just when he was older. He was always very, you know, quiet, except when he got mad at Jeanne. Then he'd get the adrenaline going. So I wish he was still here, because I would enjoy talking to him. But anyway—well, this is really taking me back. [Laughs]

WRIGHT: Well, we really appreciate it. We've enjoyed hearing and listening to everything you have to say.

[End of interview]