PROFILES OF SWE PIONEERS

ORAL HISTORY PROJECT

Barbara Johnson Interview

May 3, 2003

San Pedro, California

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Barbara Crawford Johnson

Barbara "Bobbie" Crawford Johnson was a woman pioneer in the defining years of the U.S. missile and space program. She was the first woman graduate in general engineering from the University of Illinois in 1946. She worked for 36 years at Rockwell International Space Division, making significant contributions to four of the nation's most prominent systems and technology ventures, including the Navaho missile, the Hound Dog air-to-ground guided missile, the Apollo Lunar Landing Program, and the Space Shuttle Program. A Fellow of the Society of Women Engineers and received the SWE Achievement Award in 1974. She was also a Fellow of the Institute for the Advancement of Engineering, and an Associate Fellow of the American Institute of Aeronautics and Astronautics. Johnson passed away in 2005.

In her 2003 Profiles of SWE Pioneers Oral History Project interview, Johnson discussed her early life and education at the University of Illinois; her career working at North American Aviation and its successors on projects such as the Navaho Program, study contracts, the Apollo proposal, and the Space Shuttle program; and her involvement in SWE.

- July 2016

INTERVIEW WITH BARBARA (BOBBI) JOHNSON, MAY 3, 2003

LAUREN KATA: It's Saturday, May 3rd, and this is an interview with Barbara "Bobbi" Johnson, of the Society of Women Engineers, for the Society of Women Engineers Oral History Project. We are in San Pedro, California. The interviewer is Lauren Kata.

Bobbi, can you begin by talking about your early childhood and where you're from?

BARBARA (BOBBI) JOHNSON: I'm from a small town in southern Illinois. I grew up -- well, at least from the fourth grade -- in a town called Sandoval. And I'm the last of a big family. My family, we were very close-knit, very close. We were very education-oriented. My father was superintendent of schools. My mother was a teacher before she married my father, and then she taught off and on part-time, substituting, primarily, in the local schools.

LK: What were your parents' names?

BJ: My mother's name was Nell; they called her Nellie. My father's name was Clarence, but he hated the name, and they called him C.E., or just Crawford. My mother called him Crawford.

My mother, her maiden name was Fitzgibbons, so we're very Irish and probably a little Scotch background. And we never had any money, but we didn't know it.

We played a lot of games. I know I learned to play bridge when I was in the fourth grade, because my mother needed a substitute once in a while. And she taught my sister -- who was right next to me, a year older -- and I how to play bridge. On Sunday we usually had a big dinner, you know, like fried chicken, typically. And whoever lost at bridge, the last two had to do the dishes. So we were very competitive. The whole family was competitive.

After high school we all just assumed we would go to college. I mean, we didn't ask whether we would or wouldn't, it was just assumed. My oldest brother went to the Naval Academy, graduated. And my next brother and my three sisters went to James Millikin University, which is in Decatur, Illinois. I went to the University of Illinois.

When I graduated from high school, at the time my two sisters were still in school, so my dad had me take all kinds of scholarship tests and so forth. But finally, the only one I accepted and could afford was the one that was in state, at the state university, at the University of Illinois.

My dad had been looking for the problem of too many of us in school at once, so he had taken my two middle sisters and pushed them up a grade, which he could do since he was the superintendent of schools.

LK: All right.

BJ: But there was pressure for me to finish college, which I finished in two and a half years I believe, because my dad needed to save some money for retirement when he was seventy -- I mean, sixty-five – but it turned out he didn't have to retire until he was seventy. But at any rate, I graduated from high school in '43. The war - Pearl Harbor - occurred in '41. And of course, all of this -- prior to all that was Depression times.

I was probably a tomboy, I guess you'd call it, and from the time I was a little kid, I had jobs. I picked berries and sold them to the neighbors, and I delivered papers. I was the first papergirl the St. Louis Post Dispatch ever had.

LK: Oh, wow.

BJ: I remember my dad taking me to a big party in St. Louis, a paperboys' party that the St. Louis Post Dispatch was having, and there were about 200, and I was the only girl. So I got all the attention, which I liked.

LK: What did your dad say about it?

BJ: He thought that was great. And later, I think I had decided -- I noticed boys, so I thought, well, maybe delivering papers wasn't very girl-like. So I got a job packing nuts and candy -- the man up the street, in his garage he had a business where he'd buy 1,500 pound boxes of various kinds of nuts and

candies. And they'd pack them in small packages, cellophane bags, and put a label on it, and stamp it on a card. And he had racks he put in bars, different bars, around the whole area. He covered quite a big territory.

LK: Did he have an office?

BJ: Where we worked was in his garage. He had an office set up. So I did that for a long time. And in fact, I hired a girl -- in fact, I hired one of my sisters when she was home from school, for the summer. And she wasn't very good. But these were all kinds of nuts: Cashews, redskins, Spanish, Brazil nuts -- everything you see in bars today. It's automatically packaged. And then I did babysitting.

Then when I went to college, I worked as a waitress in the student union building. I counted bugs in the biology department, checked hats in the student union. I worked in a bar for about three days. I remember that's the most money in one day because of tips. But then they found out I wasn't twenty-one. I had a fake driver's license -- well, it wasn't fake, it was some other person's driver's license. But anyway, that didn't last long.

LK: How old were you when you started at University of Illinois?

BJ: When I got out of high school, I guess I was seventeen. When I got out of college, I was twenty. In college, I took

engineering. I really wanted to take aeronautical, but at that time they didn't have an aeronautic program. They had it when I -- about a year later.

I had started to kind of fly in high school. When I was in grade school, Amelia Earhart -- I had my hair cut like her, Amelia Earhart. I thought that was great. I remember buying a cap kind of like she wore. At any rate, in high school, what I did was fly the farm people around -- some of them had some airplanes. And they had kind of a dirt runway in Centralia that -- or near Centralia, between Sandoval and Centralia. They had these airplanes, and I used to go and kind of watch them, and then I'd get a ride. Pretty soon I'd be getting to fly. And then later I could taxi.

LK: Wow.

BJ: And little by little, I could fly.

But then when I got in college, I would go to these student dances at Chanute Field -- they'd invite the coeds -- and try to get acquainted with some of the officers that had airplanes at the University of Illinois Airport. And I dated a fellow; his name was Stan Sevilla. He had a plane. And I flew -- I learned to fly his plane. I had a few small accidents.

LK: How?

BJ: Landing in a -- I ran out of gas once.

LK: Ooh.

BJ: I had to land in an orchard. I sort of set it down on a tree. It was in the summer. And actually, it didn't do too much damage. But a farmer came out, and his son, and they -- I went down a ladder. And then they took a -- from the street -- they were working on the street, and they took a crane thing they had and pushed -- pulled the airplane up and put it -- set it down on the runway.

LK: Oh, my gosh.

BJ: But it was damaged, but I think the insurance took care of it.

Then when I got a job -- I had three job offers in college.

LK: While you were in--

BJ: Well, when I graduated. I took general engineering with a civil option -- reinforced concrete was kind of my favorite. I don't know why. But I had three job offers. One was to stay at the university and teach and do graduate work, and one was with a bridge company in the east. I think it was Pittsburgh, or Pennsylvania somewhere. And then one was with North American Aviation in California. I had not been west of Missouri, and I didn't think I could ever afford to go to California, but they were willing to pay my way. So that's the job I took. I didn't really ask whether I was qualified. But my dad told me it didn't

matter, I would learn after I got on the job, which I did.

LK: Can you step back a little bit? You mentioned you were interested in aviation.

BJ: Uh-huh.

LK: Why did you decide to major in engineering? I mean, how did you come to learn about what engineering was before you entered the University of Illinois?

BJ: Well, I liked math and physics -- I mean, I liked math and science. I didn't take chemistry in high school -- but physics. I liked that. And I took Latin, but I didn't care much for that. I didn't care too much for the history courses. Mostly what I liked had to do with the teachers, the affinity I had with them.

When I was in eighth grade, our high school burned. It burned over Christmas.

LK: Wow.

BJ: My dad was instrumental in getting the WPA to build a new high school. So in the meantime we went to high school in some old buildings down in the downtown area. Because there was no hotel in the town, the chief engineer stayed at our house, he roomed at our house. He taught me how to read blueprints and do a little surveying, and I learned a little of the lingo. And he was just a real impressive guy to me.

LK: Was that the first time you'd ever met an engineer?

BJ: No. My oldest brother graduated as a double-E [electrical engineer] from the Naval Academy. Then when my sisters would come home from college, they would usually, in French, when we would be having dinner, ask for the bread or whatever. And that would just really irritate me to no end. So we had a rule they had to speak English at the dinner table. So I didn't want to take a foreign language. I think all in all, I took engineering because of what I didn't want to do, maybe, than what I did. But I'm really glad I took it. I mean, I've been very happy.

LK: What was it like taking engineering courses, or being at the University of Illinois during that time period?

BJ: Well, when I went, the war was on.

LK: Yeah.

BJ: And in the college of engineering, we had five civilians, I guess myself and four 4-Fs, probably, medical.

LK: Wow, yes.

BJ: So we went with the Navy students, the B-12 program. And we used their schedule, which wasn't the same as civilian. Then when the war -- in fact, I used to have to go to the Navy, the commander there, to get some of my textbooks. He used to kid me about how he should put a Navy suit on me, and that sort of

thing.

LK: Were you the only female?

BJ: Yeah. I was the only -- well, I was the only girl in general engineering at all.

LK: Wow.

BJ: Well, in fact, at that time, there weren't any in any of the engineering. Some of my professors had never had a girl, especially the lab people. One of them came to class with a -- he had a leather bow tie, black, and he wore that every time we had a class, he had that tie on, no matter what else he wore, he had a tie on, a black leather bow tie.

I had to take pattern and foundry, and then machine shop. And in the pattern and foundry building, there were no ladies' facilities. So we rigged up this scheme where I would use the professor's. And there was just a light bulb above the door, and when I was going to be in there, I'd turn the light on, and then when I'd leave I'd turn it off.

LK: So everybody knew that you were in there?

BJ: Pretty soon the light bulb went from a white light to a red light.

LK: Oh, no! (Laughs)

BJ: And at any rate--

LK: Oh, that's funny.

BJ: It stayed a red light, in fact. Then in the machine shop, the same thing happened. And there the professors had a towel that was just so dirty I didn't even want to use it to dry my hands, so I sent it home in my laundry to my mother, and she threw it away it was so dirty. So they sent another one, and she wondered what I had done with that towel. And the professor was -- he mentioned the clean towel to me. He didn't say how it happened, but he just mentioned that, "We have a clean towel today." So that went on. My mother did the towels that semester.

LK: Oh, that's funny.

BJ: Some of my other profs like -- I remember taking a double-E class. And I had a slide rule in a -- you know, the old slide rule cases.

LK: Yes.

BJ: I had one little tiny thin lipstick and a comb, and a little ruler. And so I had to take all these out first. And I didn't realize he was standing behind me. Finally I got to the slide rule, and I heard this voice say, "My God, a slide rule." (Laughter) I jumped.

But actually -- well, in double-E lab, I refused to just take data. You know, I was going to wire the machines up and everything else.

LK: Right, you weren't just the secretary.

BJ: I remember all the circuit breakers blowing a couple times. But actually, I had fun in college. The only thing I regretted was on finals the B-12s had -- well, they had access to all the old exams. They had files from the fraternities and things, I think. And of course, we didn't have any in the places where I lived. I thought that was a little bit unfair.

LK: For sure.

BJ: But it was fine.

LK: You lived in the women's dormitory?

BJ: Yeah, most of the time.

LK: Did any of your peers wonder what it was like to be in the college of engineering while you were there?

BJ: Yeah. We used to -- well, actually, I did -- some of the courses -- I had to take an accounting course, which I hated. The girl across the hall from me took calculus, which she hated. So I used to do her calculus homework, and she did my accounting homework. So things like that worked out great.

LK: (Laughs) Yes.

BJ: But I really worked. I took twenty hours most of the time.

LK: Wow.

BJ: I was working also, so I didn't really have a whole lot of time in college. And then I was out -- in fact, ten days after

I graduated, I was out here. I had to find a place to live. I stayed at the Biltmore Hotel until I found a place. The company paid for that.

LK: Wow. That must have been exciting.

BJ: But as far as engineering goes, my parents encouraged me. And oh, when I graduated from -- as you walk across the stage to get your diploma, everyone stood up when I got mine, which I thought was nice.

LK: Sure.

BJ: They were so surprised, I guess, the audience. (Laughter)

BJ: But it was fun.

LK: That must have been thrilling.

BJ: My sisters all took, more or less, teaching, one's a librarian.

LK: What did they think about you being an engineer?

BJ: Oh, they liked it. They thought it was fine. But somehow it didn't seem to be unusual. I mean, they didn't think of it as unusual.

LK: Do you think that was because your brother was already an engineer?

BJ: No, I think it was just because of my family attitude about education -- girls can do anything they want, you know, that

sort of thing. We were encouraged to do what we wanted. And my dad always thought it didn't matter what you took, don't worry about getting a job, which we knew we all had to work. And it worked out fine for all of us.

LK: During high school or even at the university, did you ever have a specific professor or teacher that guided you?

BJ: Well, in grade school, I liked math. I was in a lot of the extra-curricular activities. And my dad would teach -- he would teach anything for anybody, any subject, if you could get six kids enrolled -- any subject. So I would drum up kids to enroll in like -- I took spherical trig. And I remember taking advanced algebra. It seems like there were a couple other math courses. Solid geometry, I took.

LK: So you would just get together a group of friends and go to your dad and say you want this course?

BJ: Six. If six of us would enroll.

LK: Wow.

BJ: Mostly the ones that went along with that later were in like the B-12 and the B-5 program.

LK: Oh, yeah.

BJ: One girl. She and I were really good friends. She liked math, too, and she was in it. She had enrolled. She was a year ahead of me.

LK: What was her name?

BJ: Her name was Judy Worley. Later it was Judy Kassimeyer. She went to Purdue, and I went to Illinois. We both played -- I played a French horn and she played a saxophone. And we would periodically leave them at home and get to go home and pick up our instruments. It was just sort of a joke to get out of school.

LK: Yes.

BJ: But I really didn't get interested in the academic world, so to speak, until I was about maybe a junior in college, then I became more interested. A lot of it was kind of boring to me, for some reason. I tried to skip eighth period any time I could in high school. I don't know, I just -- I was a cheerleader, and I think I -- well, I played in the band. That's about it.

LK: So you were involved in extra-curricular activities.

BJ: Uh-huh, pretty much.

LK: Were you involved in any engineering extra-curricular?

BJ: In high school?

LK: In college, in the university?

BJ: I got honors -- an honorary award in the Civil Engineering Society.

LK: So there was an active chapter during the war at the University of Illinois?

BJ: Yeah. I can't think of the name of it now.

LK: The American Society of Civil Engineers?

BJ: Yeah, that was it.

LK: The ASCE.

BJ: There was a student chapter, and I received an award in that. And later -- well, that was after I graduated, though. I can't think of any engineering -- I was a senator. I ran for senate at the University of Illinois and was elected. I ran on the GI party, Greek Independent Party.

(Laughter)

BJ: As a matter of fact, I got more votes than the person running for president. But the whole college of engineering got out and voted for the first time.

LK: Wow.

BJ: So that's why I won.

LK: Yeah.

BJ: I had a good rapport with the students and the professors both, in college. I didn't feel repressed or anything.

LK: So your first job was with North American Aviation--

BJ: Right.

LK: -- the company that you stayed with--

BJ: Right.

LK: -- for your entire career.

BJ: I think that the company really -- the whole thing sort of revolved around me. I was at North American Aviation. I was Rockwell/North American, then Rockwell International, and then Boeing. And I never left, and they all came to me, I think. You know? I was never bored. In fact, I had fun.

LK: What was your first assignment? You said you felt like you weren't qualified, and so your dad said, well, they'll tell you what to do when you get out to North American.

BJ: Yeah. Well, I had no idea why they put me where they did, but I was in the aerophysics lab. They had an engineering department and an aerophysics lab. And the aerophysics lab was kind of a prestigious group. Almost everyone had a Ph.D. And there was some German scientists from Peenemuende -- I think they were from Peenemuende. And there were some English aero (?) people -- I think a couple of the English companies -- one was -- I think they worked on recovery systems or something. At any rate, this was after the war, and they were probably -- they had an abundance of talented people and no jobs. Anyway, there were some of those people, and then some just straight scientists, Ph.D.s in physics and mathematics. A man named Dr. Boulay was the head of it.

And they put me in -- well, I guess it was an aerodynamics group. Having taken general engineering with a civil option, I

really didn't even know what a mach number was. And the first job I had was, they had a bunch of columns of numbers, and they said "multiply column five by column seven, and divide by column two," you know, things like that. That was the instruction. I had no idea what they were. I was doing this with a slide rule. I don't think we had Fridens or anything then. And I couldn't believe this.

So I went to the person that I was assigned to, and he was a German scientist, which I had trouble understanding. And he didn't want to have anything to do with any personnel. He just wanted to do his research. So he just told me to be -- just look busy – so I played Battleship with a guy that was in the same boat I was. We were both assigned to this man, and we played Battleship for about two weeks.

Finally -- and in between, I was multiplying and dividing these columns and so forth. Until finally, on a Friday, I went to the supervisor of the whole thing and told him -- he was a Ph.D. in math. I told him that I was an engineer, I was proficient at the slide rule and I knew how to use it very well, but I needed no more improvement, and I wanted a real engineering assignment.

And he had his feet on the desk. I remember he took them off and he just started laughing like crazy, and then he walked out of the room. And I thought, "Oh, my God, I've been fired." And I

was thinking of, oh, how much in debt I was already. Anyway, he came back with the manager, I guess, of the department. And he said to me, "I understand you want a real engineering job." And I said, "That's right. I thought that's what I was hired for." And I said, "I am a real engineer." He said, "We've got one for you, one that's really challenging," you know, that kind of thing.

And on Monday, they started me on a -- it was supersonic inlet design, like for a ramjet. And that led to bigger and better things from then on. In fact, that led into the Navaho program.

BJ: On the Navaho -- we used Talman's method, or something, it's characteristics, just basically solving differential equations. You're plotting it like a graph, where you would follow the pressure lines and so forth. So then I kind of got into aerodynamics.

In the meantime I was borrowing my boss' car to take graduate courses at UCLA in aeronautics. You'd have to understand my boss, about his car. It had a plant growing in it. He hadn't looked in it, the backside, for years.

And then after that, I went into -- we got some study contracts, I guess, in supersonic flight and ramjets. And then we got the Navaho contract, which was a boost cruise missile. I got into the boost rocket stuff, and flight mechanics, basically. And

I calculated probably the first boost trajectory that anybody in the country had calculated by hand.

LK: Wow.

BJ: Every two seconds I would calculate a point, a path.

LK: Do you want to take a break?

BJ: Yeah.

(INTERRUPTION IN RECORDING)

LK: Okay, we're back. You were talking about working on the Navaho program. Can you talk a little bit about what that project was and what its importance was?

BJ: The Navaho was a missile program. It was sort of three phases. And the ultimate -- the final phase was a 3.25 mach number ramjet cruise missile boosted by a rocket booster. The first phase was a turbo jet version, mostly working out the landing characteristics, and some of the low-speed aerodynamics. The part I worked on was the second phase, which was the 2.75 mach number cruise missile, which we tested -- I can't remember whether we had -- I know we had one or two tests that were very successful.

I was kind of what you would call the project aerodynamist for the thing. I did the boost trajectory to start, but then I evolved into sort of handling the whole thing, the aerodynamic performance of the thing.

LK: How many people were working on that at North American?

BJ: Oh, a lot of people. It was a big program. It evolved from the aerophysics lab. I have no idea how many were working.

LK: Hundreds?

BJ: Yeah, in that vicinity. We had a contract with the Air Force, but we had allowable conditions. We had to boost the trajectory to certain attitude, velocity and altitude conditions, and then there was probably a couple seconds or so that the ramjet would light. We had flight conditions for the ignition of the ramjet we had to meet, and I calculated those. And probably at this time I had people kind of working with me, helping me.

It was kind of a three-dimensional envelope. And then the ramjet would climb to cruise phase, we called it, from these conditions, at the boost altitude, and climb to cruise, and then if this reached 2.75 -- it was a nuclear bomb delivery system.

LK: Wow.

BJ: So I remember the Air Force people -- I didn't realize this at the time, but the engineers around were calling it Bobbi's box, Bobbi's box. That's the allowable ignition that the booster had to get the ramjet in. These were -- this is a flight envelope, altitude, velocity and attitude, kind of a thing. But I didn't know they called it that.

Well, anyway, [one day] these Air Force people were there.

And a colonel said to the chief engineer of the program, said, "Are you instrumented to know whether the booster -- boost conditions are within Bobbie's box?" And everybody (Laughs) -- he didn't know that this was the person, Bobbi.

(Laughter)

BJ: And he thought that was, you know, like just a proper word for the thing.

LK: Oh, how funny.

BJ: (Laughs) And anyways, everyone--

LK: Not knowing that Bobbie was a woman, right?

BJ: Everyone looked kind of funny, and they looked at me. I finally realized what was going on. And I said -- there was sort of a silence there, and I said, "I'm Bobbi."

(Laughter)

BJ: And this (Laughs) colonel was so embarrassed. But then, everyone was laughing by then, so he was laughing too.

(Laughter)

BJ: Then it kind of got explained how it became known as Bobbi's box.

LK: Wow.

BJ: But that was funny.

LK: That's very funny.

BJ: There were a few funny things like that. At any rate,

the program got cancelled. But it had made major technology advances, especially in structures and materials, I believe, and maybe others -- I just don't remember now -- that were later very effective in the space program. It was cancelled because the -- there was kind of a breakthrough in the atomic bomb, where for the same yield, you could use a lot less weight. See, this was a heavyweight payload we were carrying -- we would be carrying. But it went through the test phase, anyway.

After that I was in -- I worked a lot of phase A and B studies, which we would get. And this was before women traveled, and sometimes to report on one of these studies, I'd have to explain to some person, some other person that was allowed to travel, male, you know, what to do and what to say, and so forth and so on. It was like teaching them, you know. And that got kind of old. But it really was short lived. [We also] had a Hound Dog contract --

LK: Uh-huh.

BJ: -- this was a study contract, we got the hardware to build it. So we were, whatever, phase A, B, and C, I guess. And I was a project engineer honchoing all the performance of all the different configurations we had on the Hound Dog. At one time we had two or three propulsion systems from different companies, different aerodynamic shapes, I don't know, just a whole bunch of

things. This is so many years ago, I can't remember.

LK: Sure, sure.

BJ: There were maybe fifteen or twenty different combinations of configurations. And we finally honed in on the one. After that I didn't want to go on the program. We got the contract, and in the meantime I had gotten kind of tired of it. And so I worked on an Air Force study, for a -- we called it Bolo. It was a terrain clearance vehicle. It was a missile that would follow the terrain, so you couldn't -- if you were in a war situation, you couldn't spot it. You couldn't catch it on the radar, and so forth.

So at the same time of this Bolo contract, we were to report to Wright-Pat [Wright Patterson] Air Force how the study was going. It was at the same time the company was sending people to Wright-Pat to write the work statement for the Hound Dog, which is the Gam-77, I guess they called it. So they were sending maybe forty people, thirty, I don't know – so as a result, there were a lot of TAs -- travel authorizations going through. And so for the three of us on this Bolo, the three of us were going to go report on a study we had done -- they just put my name in as B. C. Johnson, and it went through, like with all these other TAs, B. C. Johnson.

We were all staying basically at the same hotel. But we'd

check the elevator -- there were three of us. And Gary would be -- he would go up in the elevator, and Burt would stay down below to see if it was clear for me to go up or down, you know, to avoid seeing the program manager, Dale Meyers, to avoid seeing him, because of me traveling.

So at any rate, at noon one day, one of the [Air Force] officers heard that I had been involved in the performance of the Hound Dog, the Gam-77. And so they asked me to sort of brief them on the performance. They wanted to find out about it.

LK: Did they know that B. C. Johnson was a woman?

BJ: Well, no. They didn't have any idea of that. There was kind of a barrier about women traveling. You know, they didn't know anything about that.

LK: Oh, okay.

BJ: So I did. And there were about thirty or forty officers who came in. And I went, just using the blackboard, and drew all of these configurations, and why we did this and that. They really appreciated it, but -- and I thought everything went smooth. And one of the colonels -- or maybe he was a one-star general, I don't know -- was taking Dale to the airport and really thanked him for the briefing, that they really appreciated the briefing they got. And he didn't know anything about it.

So then the Monday when I got to work -- this was on a

Friday, and when I got to work on Monday, there was a -- my director called me to go with him to the chief engineer's office. So we went there. And the chief engineer gave me a form that had come through that women traveling for the company must be -- their travel authorization must be signed by the president or the senior vice president of the division. So that broke the ice.

LK: Wow.

BJ: And then I had more travel than I wanted after that.

LK: What was it like working on that project during the time period that you were working on it, I mean, the beginning of the Cold War?

BJ: Well, I don't know.

LK: I mean, do you have any thoughts about that, or do you remember, did it impact your group at all?

BJ: You know, I really didn't notice much difference, other than when the Sputnik went up.

LK: Yeah.

BJ: When the first Sputnik went up, the chief engineer called me in with my director and said to me, "Learn all there is to learn about re-entry."

LK: Wow.

BJ: That was my assignment. So I started studying anything that had been done that I knew of. Langley had done quite a bit.

LK: Yeah.

BJ: And well, the Russians, of course, I didn't have anything on them. But there had been some other studies made that I got a hold of. I don't know, that was -- I went to Langley, in fact, to talk to a couple of the fellows that had written papers.

LK: Yeah.

BJ: And the Mercury was starting. I can't remember what year Mercury and Gemini were, but that was what--

LK: That's okay. Do you remember how you felt about those advances?

BJ: I thought it was great.

LK: Yeah.

BJ: I thought every time the Russians did something great, I thought it was even greater, because we would have to do it, or get to do it. And I thought, well, -- I worked on the Apollo proposal.

LK: Right. Do you want to talk about that?

BJ: I had worked on a lot of studies, but we did not have the phase A or B studies that I believe McDonnell and maybe Martin had. I'm not sure of the companies, whether it was McDonnell -- it seemed like it was McDonnell and Martin. I may be wrong on that.

LK: Okay.

BJ: But there were study contracts going on--

LK: They had those contracts.

BJ: -- phase A and B, we didn't have that. We had the X-15 program, which was at the Los Angeles division, not where I was, in the space division. Or it was called -- it wasn't called space division, it was -- whatever we called it – I'd have to look that up.

LK: That's okay.

BJ: Systems -- something Systems, I don't know. But in fact, from this group of people, which was an extension of the aerophysics lab, Rocketdyne was formed and Autonetics, the space division. I mean, it was great. I mean, this was formed from the Navaho.

LK: And then soon after that--

BJ: I can't remember. Space -- it was something and Information Systems.

LK: Okay.

BJ: I can't remember. But at any rate, when I was working -- this is some time later -- when I was working on the Apollo contract, the proposal, I honchoed the trajectories, the aero-heating, and I forget what else. But we worked around the clock, night and day.

LK: Wow.

BJ: Nobody thought we'd get it, I don't think. I'm sure we didn't get it because of technical reasons. I think it had to do with the X-15, and Harrison Storms and a few other things -- past performance with the Air Force.

LK: At this point, the Apollo proposal was to the Air Force, it wasn't to NASA, correct?

BJ: No, it was to NASA.

LK: It was to NASA?

BJ: Yeah.

LK: Okay.

BJ: NASA--

LK: Do you remember how you all felt when NASA was officially announced?

BJ: Well, I thought it was a good idea, I really did. In fact, I liked the idea of separating the military from space at that point. I liked the idea of developmental research, experimental research.

LK: Yes.

BJ: In fact, the whole concept of going to the moon, and landing people and bringing them back just blew my mind. That was the greatest. I couldn't get over it. In fact, it was -- you know, I worked night and day on this, just making everything come together, helping to make it come together. But anyway, we worked

on the [Apollo] proposal, and we were sort of astonished when we got it.

We went to Langley to work out the work statement. And there were about thirty of us, probably, thirty-five, maybe. And we got as far as Cleveland, I think -- or Columbus, I don't know. Anyway, because of the weather problems, we ended up at the -- what's the -- near Langley there's a -- it's a Ford -- no, Rockefeller -- no. It's a big park. It's where we went for the work statement. Rockefeller? No.

LK: It was in Virginia?

BJ: Yeah.

LK: Hmm.

BJ: It's like early American, like you lived in England.

LK: Williamsburg?

BJ: Williamsburg.

LK: Colonial Williamsburg.

BJ: Yeah, that's where we went.

LK: So you stayed in a resort in Colonial Williamsburg?

BJ: That's where we were working on the work statement.

LK: For the Apollo?

BJ: Uh-huh.

LK: Wow.

BJ: But I forget where we landed, we needed to, probably in

Columbus, because of weather.

LK: Okay.

BJ: So they rented -- a guy named John Pop -- I think he was the program manager, he chartered a Greyhound bus. We all got on the bus, and we were on the bus all night. Guys had on suits and stuff. And I was sitting next to my boss, and he was going over what he thought the work statement should be. We had a light on; I think it was 2:00 o'clock in the morning. And I looked at him, and I said, "You know, Earl, this light is the only light on this bus, and all that snoring you hear, these people are sleeping, don't you think before the 8:00 o'clock meeting you should get some sleep? In fact, I know I should." He finally turned that thing off.

But anyway, we got off, I remember, about 4:00 or 5:00 in the morning. We got to [Virginia], and we're filing off the bus. These guys were coming off, and they had a beard by this time, you know, they hadn't shaved. And their ties were all askew, and well, we just looked terrible. I got off sort of about two-thirds of the way, after about two-thirds of them were off. And there were some guys, young guys, that looked like they'd been up all night doing whatever, and probably drinking, were standing around, and they said -- one of them said, "Boy, do you see what I see?" And the other one said, "Yeah, I bet she's having a good time."

And another one said, "Hubba, hubba."

(Laughter)

LK: And here you were up until 2:30 going over technical work statements.

(Laughter)

BJ: But we got there. They were trying to give out the keys to the rooms, and somebody said -- I think it was Charlie Felt -- "Oh, just throw the damn things down," because they -- we were short of rooms, and some people had to room together. So, "Throw the damn things down." But then they said, "Well, what about Bobbi?" So they had to find my room. But anyway, we were about an hour late -- the 8:00 o'clock they changed to 9:00 so we could at least freshen up a little.

LK: Yeah.

BJ: But that was Williamsburg.

LK: Wow.

BJ: It was fun.

LK: Was it difficult at all to be the only woman working on this, or did it even matter?

BJ: It didn't seem to matter.

LK: Yeah.

BJ: But by this time people knew who I was.

LK: Sure.

BJ: And you know, I had already proven myself, so to speak. Years before that, my brother taught me the best lesson there was. He said, "Bob, if you ever want to do anything you don't want anyone to know, don't ever go so far away you can't see the flagpole." (Laughs) It just meant that no one will know you -- no one will know what you're doing.

LK: Yeah.

BJ: "No connections" is what he meant. And that was a good thing to remember. There was always some worry that -- I think men sending women on trips would worry that women might act the way they sometimes can't. You know?

LK: Yeah.

BJ: Anyway, what my brother told me was very good advice, and I followed it. So there was no problem.

(INTERRUPTION IN RECORDING – end of tape one)

LK: This is tape two for our interview with Barbara Johnson on May 3rd, 2003. At the end of tape one, you were talking about your work on the Apollo proposal. Obviously, that was successful. Could you talk a little bit more about working on the Apollo program, and how that led to your work on the space shuttle?

BJ: Well, after we got the Apollo contract, I had been working -- well, I had been working without title. You might say I had been honchoing a bunch of people around, which I love to do

anyway, but without title. And I thought I should have a title.

So in the meantime, Autonetics had a job they wanted me to take, it was a supervisory job that had the title. And so I just, in passing, mentioned to my boss I'd probably go transfer over there, even though I really wanted to work on the Apollo. He said, "Well, why would you do that? We're making you a supervisor here." So I stayed.

So as a supervisor, my idea of getting ahead, I guess, without worrying about a title was just to take on a little more each time, roles and missions, so that I could expand them very easily into the gray areas--

LK: Sure.

BJ: -- and just take more and more of the gray areas. I thought it was good for me, and it was also good for the people that worked for me. It expanded their disciplines and capabilities, and it was more exciting. Then I always had people that could take my place. I mean, I made sure of that, because at a moment's notice I might want to do something else. So I never got bored. And on the Apollo program, it was especially that way.

We started out -- we were in the re-entry, they called it. We changed it to entry -- we reasoned that we had never exited, so we're entering, we're not re-entering. It was just sort of a fun

thing to do. We did the performance and all the design trajectories, spelled out some of the systems requirements and the environment, and so forth, that they were going to be in.

And little by little we expanded entry from the de-orbit, so that got us into the boost -- into the rocket part of the -- booster part of the mission. So we had the de-orbit burned, and then the attitude changed for the entry, and so forth.

Goddard had the guidance, and so we -- I think it was Goddard, in Cambridge? That's Goddard, isn't it? Yeah. And so little by little, we got involved with the guidance -- the backup guidance, the entry monitor system. And the entry monitor system was -- to the company, anyway, it seemed kind of outrageous, because it was a plotter, an XY plot. It's a graphical display. And they were all used to needles, fly to, fly from, all these engages, you know. But this was wild, you know, in their minds. And it was very negative at first.

We developed -- it was a display of load factor acceleration -- load factor, and inertial velocity. And then it had limit lines. There would be a display of what the primary guidance was doing as it came into the earth's atmosphere. And there would be limit lines to identify whether it was working properly.

LK: Okay.

BJ: And we had an initiation of entry, which was triggered

by .05G -- gravitation, that's around 400,000 feet. And then we had an indicator where the lift vector was, lift vector up or down. There were range-to-go lines on it, so it was like an energy, potential kinetic energy.

LK: Wow.

BJ: So if the guidance was working properly, it would stay within this boundary -- these boundary lines, limit lines, and if it wasn't, they could take over and manually fly it -- not accurately, but grossly. They would come within sort of a gross area of where the splashdown or the ship would be, using these range-to-go lines.

LK: Wow.

BJ: Anyway, that was the concept.

LK: And it was, like, a radical concept at that time?

BJ: It was, at the time. We continued to really sell it. In fact, there were three of us that were involved, two fellows and myself. And one in particular was the real creator of it. And he and I -- I would try to keep it sold. But we got the astronauts -- we got it in the simulator, and we got the astronauts into it, and they liked it.

LK: I was going to ask you if you interacted with the astronauts while you were planning the design.

BJ: Yeah. They liked it because it was something they could

see and they could take over if they had to.

LK: What was the name of your co-worker that you said was really the--

BJ: Art Frank, and Elvin Knotts. He had the primary guidance, so -- that Goddard had, but we had to simulate it. And we used it in our trajectories, we used the primary guidance. So we had the thing programmed. And Elvin was our interface with the primary guidance -- he worked in my group. In fact, we published -- it's one of these papers, one of our publications.

LK: Oh, okay, right.

BJ: And at any rate, after NASA liked it, the astronauts liked it. They liked it, and they gave the contract for the hardware to Autonetics. Autonetics was one of our divisions. And every time we'd have a flight, one of the astronauts would look at me and say, "Is the EMS going to work, Bobbie?"

(Laughter)

BJ: Because the first time it was an earth orbit thing, and it didn't matter so much. But the accelerometer didn't work quite properly. So I would go through this business of what Autonetics had done, and blah, blah, blah, you know. Anyway, it did work fine throughout the lunar missions. And now they have graphical displays everywhere, but I think this might have been the first one. I don't really know for sure, but I think it might have

been.

LK: Did you have any sense of -- did your group feel any sense of pressure? I mean, especially with the astronauts coming to you to get some reassurance that it was going to work, do you remember feeling any kind of pressure?

BJ: Well, in a way, yeah. That's why I would go over to Autonetics, and I would talk to the person that was really into the nitty-gritty of it. And in fact, one time I took him with me.

But with NASA, they had a group called Flight Techniques, which was headed by Bill Tindall. And that group was really in great detail "how you fly the mission" and "what about failures."

One of the other things that we did, in my group -- well, for earth orbit missions -- -- and this was maybe something I did, I don't remember -- but instead of flying circular orbits, or as near to circular as you can, we initiated flying more of an elliptical orbit, because we rigged up a scheme whereby if we couldn't de-orbit with the surface propulsion, we would separate and we would de-orbit with the command module reaction control jets. And we could do this at apogee, which would require the least amount of propellant to de-orbit us. Even though we wouldn't land particularly where we wanted, it would get us

captured by the earth's atmosphere, so we wouldn't stray in orbit, which you wouldn't like to see.

LK: No.

BJ: Because in the headlines of the paper every day it would have, "There are so many more days or hours left of oxygen," you know, things like that. We wouldn't like that.

LK: No, no.

BJ: But anyway, that was kind of an innovation, I guess.

LK: Sure.

BJ: We went through all these "what if" exercises in these flight techniques meetings, and for failures, double failures and things like that. We had FOFOFS -- Fail Operationally, Fail Safe -- I guess that was it, Fail Operation, Fail Operation and Fail Safe. If two failures, you'd still continue. With one failure, you could still continue. And then another, and then you have to fail-safe.

Then later -- I had quite a large entry trajectory group by then. I mean, we kept kind of grabbing off a little more, aborts during the boost phases, the abort phase parts. Then they had an Air Force version of the Apollo kind of thing. That was a separate organization, and that merged. And when that merged, they made me a manager, so I acquired both groups. I had to marry the group that was doing the same kind of duplicate -- kind of

marry them.

LK: Was that complicated?

BJ: A little bit, a little sticky -- who I made the supervisors and things like that. But it worked out. No one quit.

LK: Well, that's good.

BJ: Yeah. And the counterpart to me that was manager over there, he was an Air Force officer at one time. I forget what his background was, but I put him on my staff. And he liked to do, oh, administrative kind of organization -- head counts stuff, and just scheduling.

LK: Coordinating.

BJ: And I didn't care much for that, so I liked that. He liked kind of detailed planning stuff. Anyway, we worked -- we became really good friends. And the gal that saved all this stuff for me, she was also on my staff.

LK: What were their names?

BJ: Margaret Chase was her name. And George Taylor was his name. That was so long ago. You know, I'm talking, what, forty years ago, or something?

LK: Can you believe that it was that long ago?

BJ: Yeah, I do, in a way. (Laughs)

Anyway, as a manager, as time went one, if they didn't know

where to put some group, they'd put it in my group. I had group procedures for how to operate, set them up, and in case of failures, what to do, for the equipment that we built that the crew interfaced with.

And they also had a psychologist -- psychiatrist -- psychologist, I guess he was -- for the crew -- in the crew procedures. Most of them did the flight testing before the astronauts, where they do these zero Gs, and some of this underwater testing.

LK: Right.

BJ: And then I had a flight test group -- flight test requirements. I had on-orbit consumables -- well, all the consumables: Consumable managements, batteries, oxygen, you know, like just the management of the consumables. And what else did we have? We had the ascent orbit and descent trajectory stuff, orbital mechanics. And then when we put experiments in the service module bay which we called the J-Missions, we had the experimental requirements and we interfaced with the -- they called them "principal scientists," or something.

And then what else did we have? I'm sure -- I'd have to look on one of those org. charts.

LK: Yeah, that's okay. I mean, that's a lot.

BJ: Yeah. It was a big group. It was maybe 150.

LK: Wow.

BJ: A big group.

LK: And what was the atmosphere like? I mean, there had to be a lot of adrenaline.

BJ: Yeah, there was. And you know, we were aggressive. We were very active. And we interfaced with the NASA very well. Sometimes we didn't think things were going quite right with a company, we would sometimes suggest to the NASA people that they suggest to Rockwell, or whatever...you know. And it worked. It worked. We had a good reputation.

LK: Did it sometimes get complicated that the progress or the work on the US Space Program was coordinated by NASA, but with different subcontracts? I mean, what was that like, from your perspective, working for a contractor?

BJ: Well, we were a prime contractor, along with Grumman, I guess -- or TRW, too, I think. And this is -- I think -- well, Grumman, for sure. Boeing, I believe, was the integration at the pad, maybe.

LK: Okay.

BJ: But we had the integration contract for the flight, which really, we were integrating at the stack. In the beginning, I would rather work for the company where I'm helping spell out the systems performance requirements and taking the whole point of

the contract, the purpose, the objective, and saying how we'd meet this objective, say in through the flight, and whether we get so much payload to orbit, and this kind of thing. So I'd rather work for the company during that stage, during the design and development -- preliminary design and development.

But after -- in the operations stage, I believe I would have rather worked for the government, if they're going to be the flight operators, because they have the final say, in that sense. It was pretty hard for them to have much say during the design and development, because they weren't into the details that we were as engineers.

LK: Right, right.

BJ: Where, in the operations phase, they have all this support from us. Before I left the company -- I went out on medical -- and I was still the manager of the program -- this was the Shuttle by then -- I was appointed a special assignment as the program manager for a support contract with NASA, where we would had like a subsidiary, at NASA, which I have some of the -- I think some of the logos and stuff we made. We set up like a separate company.

LK: Oh, that's right.

BJ: This was in the proposal. A separate company, and it had a different pay scale and the whole thing. And we moved. We

kept certain key people. We moved to Houston from Downey. We took the excess engineers that were doing this now at Houston and hired them. I mean, this is how we were going to get the manpower. And I had, I remember, the people from financial and different organizations I hadn't interfaced with much, they were just spoon-feeding me. You know, they were teaching me everything they could think of. I mean, I was pretty naive in this field. It was a real education to get into that.

So I remember being briefed about -- we had this dynamic pay scale, and so forth and so on, (Laughs) which was obviously reduced pay over what it is at Downey. But they didn't -- and I would have a list of things they had to bite the bullet on, so to speak. And one was to form a subsidiary, which was the big one. And we had already, in this proposal, had the president named, and so forth and so on. But they couldn't quite -- they weren't quite ready for that yet.

But then about a year later, they made the proposal and won it. So then we had a support contract with--

LK: Wow.

BJ: -- on the Shuttle -- with the Shuttle.

LK: Yeah.

BJ: And so it worked out. So at a couple retirement parties, they were kidding me about not wanting to go to Houston -

- I had a -- not wanting to go to Houston because of the reduced pay scale. But the people from Downey weren't going to lose their money.

LK: Do you feel that managing came naturally to you?

BJ: Pretty much, I think. I think I was kind of that way all through my life. And I think I had the respect of both the people above me and the people -- my peers, as well as the people assigned to me. Well, that party, I think, was a good example.

LK: The party of--

BJ: Where they had -- in 1997 or something, we had -- a bunch of us got together, like a reunion, almost.

LK: Wow.

BJ: They found out where people were through e-mailing and telephone, and so forth. And we got -- what did they call it? Systems -- B. C. -- Bobbie Johnson Systems Engineering, or something or other.

LK: That must have been quite a reunion.

BJ: Yeah, there was a flier I had that showed it, yeah.

LK: Yes, we have that – you gave us a copy.

BJ: And it was fun.

LK: That was everyone that you worked with?

BJ: The people they could find.

LK: From the different space programs?

BJ: No, just the Apollo.

LK: Just the Apollo?

BJ: Well, the Apollo and Shuttle; manned space, yeah.

LK: Can you talk a little bit about the development of the Shuttle and your involvement -- I mean, the evolution of that, from your perspective?

BJ: Well, the early part, we had a study contract. And I was still on the Apollo program. And then after we got the -- probably phase C, -- I knew I was going on the Shuttle program. And I had gotten with this organization, and we had cut the pie, so to speak, on which part we'd each have -- I'd have the trajectories. It's pretty much what I had on the Apollo, but primarily the trajectory groups, and the consumable -- mission -- the mission stuff.

So I had sent a lot of my people over there, over on the Shuttle. But the person at NASA -- I can't remember his name -- wouldn't release me from the Apollo. He had just taken over the flight operations. The chief engineer that we had went on the Shuttle -- and his project engineer took his place. Between the two of them, they wouldn't release me.

LK: What was your preference?

BJ: To go on the Shuttle. But this was at the very tail end of the Apollo. So I didn't really get into the details of how we

evolved the Shuttle, exactly. I got in on some of the changes. I was there long enough for the tests that Crippen and John made on the piggyback ride and the drop, and then, I guess, the first flight. I think I was in the hospital on the first flight. I had lung surgery.

And then just when I was going to go back -- it took a long time to get over lung surgery. It's a very -- with some complications, it was pretty difficult.

LK: This happened, you said, for the first Shuttle flight?

BJ: No, it happened -- I was there on the first Shuttle flight. It was right at that time. But then when I was going to go back to work, I had an emergency appendectomy.

LK: Oh, my gosh.

BJ: And then after that I had another surgery, two years--

LK: Wow.

BJ: Then I never went back. I retired by the telephone. So then I went to Hawaii, and went surfing. And then everyone was playing golf. Then we came back and we took six golf lessons. (Laughter)

BJ: That's it.

LK: Wow.

BJ: But the Shuttle -- I worked with -- I need to think of the name -- he was a command module pilot on Apollo 8. He's a

good friend of mine. Fred Haise. He was an astronaut. But on the Shuttle he was -- I forget his title. I should find that letter. He and I coordinated -- I for Rockwell and him for NASA -- the requirements of the mission. It was about a three-day affair. I had people that were there with me, and he had people. He wrote me a very nice letter, sent it to the company and me, on how well we worked together.

LK: Oh, that's nice.

BJ: Because frequently you have big arguments and so forth, and this went very smoothly.

LK: Wait. I'm sorry. Frequently you would have arguments with the astronauts?

BJ: No, -- on the requirements for the system.

LK: Right, right. I can imagine it was hard to come to agreements about it.

BJ: But this worked out very well, and he really appreciated it. So I have something on that flight, the first flight. In fact, when I was in the hospital, I believe that Crippen and Young both wrote me. As a group, we interfaced a lot with the astronauts, the early ones. On Skylab -- see, when -- this was not the Apollo -- but command service module. Because see, we did the Russian thing and the Skylab, the Russian docking that Anita mentioned last night -- or --

LK: Bonnie Dunbar?

BJ: -- Bonnie had mentioned last night [at the SWE-Los Angeles Section 50th Anniversary banquet]. And that was pretty interesting.

LK: That must have been thrilling.

BJ: We were in a meeting one time with the Russians. And this was in Houston. And we were talking about docking -- they had a two-gas fourteen PSI system, and we had a one-gas 5 PSI.

LK: This was docking the--

BJ: The command module. And so when you went from one to the other, you had to do some pre-breathing and all this sort of thing. You did this in this docking module. And you had to have a special garment. And we were talking about this, and these Russian astronauts were there.

LK: This was during the Apollo?

BJ: No. Well, this was the command service module. It was after the Apollo.

LK: After, okay.

BJ: But we were still using the command service module. It was these programs that I couldn't get released from. After the Apollo, we had the J-mission.

LK: Okay. Now I'm coordinating it all in my head.

BJ: Yeah, we had the J-mission, which was, we'd put

experiments in the bay of the service module. And then we had the Skylab and the command service module docked with the Skylab. Skylab was the booster stage. And then we had the docking with the Russians, those three programs. They were all command service module, which we used on the Apollo.

LK: Wow. So you were talking about the Russian astronauts.

BJ: They were hearing this, and their interpreter wasn't as good as ours, apparently. He -- it came across to them that they had to -- these garments you had to put on, it came out [through the interpreter] "wet suits." (Laughs) And they were sort of smiling and looking at each other funny. I had someone come and show them a picture, and then they started laughing.

(Laughter)

BJ: But you know, at these meetings, these Russians -- it's like, we had paper, and we just ran a bunch of copies off. Like if you were giving a briefing, we used briefing charts and geographs, and if you wanted copies you just ran them off. They didn't have much paper, and they pretty well read their technical speeches.

LK: Wow.

BJ: They were amazed at the amount of paper we had.

LK: Amazed at bureaucracy? (Laughs)

BJ: I guess they don't have many trees or something.

LK: Well, yeah, really.

BJ: And then the other thing, one of them had a Porsche. I think, piece by piece, every time we came here, he'd get another part, and he'd put it together. And I think he--

LK: You mean the car?

BJ: Yeah. It needed parts. You know, it was probably old.

LK: Wow.

BJ: And he'd find -- he'd get them from here. The guys would go find them for him.

LK: That must have been interesting, the interacting -- you know, working with the Cosmonauts.

BJ: Well, I didn't do too much of it, but a little bit.

I think the Lunar Landing was the *coup de grace* for me. It was great.

LK: Can you expand on that a little bit?

BJ: Well, it's just the fact that we could go to a strange body and come back alive. It didn't matter what we brought back, rocks were fine. But it was just kind of an expansion of what people can do.

LK: Sure.

BJ: You know, it's like you wouldn't dream you could do that, and we did it.

LK: How do you feel about that today, lunar exploration?

BJ: Well, my idea of -- see, Apollo, we had the team, which was very important. Like on Apollo 8, we didn't have to call anybody back to work. They heard it on the radio. They heard something, a problem. They just went back to work. I went back to work, and I didn't come home for forty or more hours, you know.

LK: Yeah.

BJ: And when you have the teams in place, and we had the equipment, and we should have, I thought, gone ahead and mapped the moon for future explorers. And we didn't do that. I think that was a mistake, because we should use the moon for a large platform for deep space, which is what we should be using the space station for, for space probes. But the moon, we could have had a base, a big base, and then used it as a launch facility. And you save -- you don't have to worry about all this atmosphere we have to go through when we boost things now from the earth. But people became -- they thought we were spending all this money on the moon, you know, which we didn't spend any on the moon, it was all spent here. But that's when the politicians got in the act, and it became unpopular. So we had big layoffs.

I'll tell you one thing, I was always trying to get more charge numbers to keep the people with contractual coverage so I wouldn't have to lay people off. There was one year the company -- there was sort of a threat that the engineers were going to

unionize. And the company didn't want them to. The head of the engineering department called all the managers in, and directors, and wanted us to talk to the people, and tell them what "a people oriented company," they had. And I did that. I had several little talks with them, with my whole group, and how there wasn't really any advantage to unionizing. How it would be less flexible in a few things, and how this was a people-oriented company. And I believed it.

Traditionally -- and this is part of the perks when you hire in, you're told that we always got a week's vacation at Christmas, a week off at Christmas with pay. Anyway, about three, four weeks before that one year -- that same year, several months after I'd said it was a people-oriented company, I got this thing on a Friday that said you have to have a blanket layoff of some percent. I don't remember the number. And I went home on Friday. And I had everybody covered, contractually at the time. Plus, we were going to get the J-missions, and I would have more coverage after Christmas, which they were coming in after Christmas.

I was so disturbed. I didn't sleep the whole weekend. So Monday I went to work. And I called my supervisors in and I showed them this letter I had gotten -- directive. And I said, "Now, if anyone would like to take a vacation now, take a one-week vacation," they'd get two weeks -- you know, the week you get

paid, and then a week's vacation -- to go ahead. And I said to myself, "Don't break anybody's arm over it, and don't discuss this with" -- it's just -- if it's an option with them -- kind of encourage them to take it. So that would take care of this percentage stuff I had... So I had this big flood of people request a vacation. I'm just signing them all, signing all of them, and so then I don't have to lay anybody off.

LK: Because they're not there. (Laughs)

BJ: They're not there. And so the chief engineer -- I had two people in my office at the time, one was the project engineer and I forget the other one -- he came in my office. He was furious. He was even red in the face. And he says, "You get those guys back to work! You've made a mockery of the system!" (Laughs) And he left. But there wasn't anything I could do. I didn't even know where they were. So that passed. (Laughs)

LK: And so you didn't have to --

BJ: No, I didn't do anything. So believe me, everybody in engineering knew about this. The word got out, you know. And all these other managers came up to me and told me how popular I was. (Laughter)

BJ: But years later, several years later, one of the chief engineers that I had was telling another -- on his retirement, was telling another how he used to just go crazy when there'd be these

layoffs, and I'd come in wanting to hire. (Laughs) Anyway, he mentioned this. It's well known.

It was really bad for the company to do that.

LK: Yeah. That must have been difficult.

BJ: Especially after saying, "people-oriented." But that -- I'll never forget that.

LK: That's very funny.

BJ: I used it -- one time we had an Air Force -- oh, I know. We were working on this study I did, I was working on with others. It was like a kite. It came from a fellow at Langley, the idea of -- Rogallo his name was -- of using a Rogallo kite to recover a spent booster. The whole concept didn't really work out. But we were -- I went to Air Force, and the president of the division was going over, along with two or three other of us. And I was going to be one of the briefers.

I walked in, and some Air Force officer said, "Oh, you're the lady that's going to bring the coffee." And I said, "No, no, I'm not that one." And he said, "Oh, you're here for the dictation." I said, "No, Captain." I kept calling him Captain. I knew he wasn't a captain, but I did that anyway. And so then I was introduced, and this captain was a colonel. But anyway, afterwards he came over and apologized to me. And then of course I had to apologize because he wasn't a captain, he was a colonel.

LK: Wow, that's interesting.

BJ: But it worked out fine.

LK: Did that happen often to you?

BJ: Not really very often.

LK: Everybody pretty much knew you.

BJ: Once in a while, once in a while.

LK: Let's shift gears a little bit. How did your family react to your evolving role in the US Space Program?

BJ: Oh, they liked it.

LK: It was exciting, wasn't it?

BJ: Yeah, they were very happy. They were proud of me. Every time we had an Apollo flight they would interview my mother -- the Centralia Sentinel. And I would always cringe, because there was a fellow that lived in Ashley, which is a small town near Sandoval, and his family probably got the Centralia Sentinel -- his parents. And they would send it to him, "Do you know this girl?" His name was Jim Johnson. And he'd come and bring it over to me. And the things, you know, your mothers will say. (Laughter)

BJ: But, no, they were very happy, very proud. When I gave a couple talks at the University of Illinois, they were there -- at least -- my dad had died by then, but my mother was there. And all my brothers and sisters were happy.

LK: You were talking about how during all this time, it was long hours.

BJ: Yeah, especially on the Apollo.

LK: How were you able to balance family life with that career lifestyle?

BJ: Well, at first -- we were both engineers.

LK: You're talking about you and your husband?

BJ: Yeah. He worked at LA division, and I worked at Downey, at the space division. But when Eric was small, we had a housekeeper.

LK: Eric is your son?

BJ: Uh-huh. Well, all the way through school. She also was a cook. And then we had a house cleaner, but she was a child-sitter, or whatever you call it. And she was very good. She was like his grandmother. In fact, maybe better, maybe even sort of like his mother in some ways.

He started ice-skating, and we'd go to that, go to watch him. And he got to be a pretty good ice skater. He was a West Coast champion in his class.

LK: Wow.

BJ: But as the Apollo program went on -- oh, when he was in the first grade he was in Art Linkletter's, *Kids Say the Darndest Things*.

LK: Oh, wow.

BJ: He was one of the kids. And I forget what they asked him. But he said his mother was an engineer. And then he quickly said, "Oh, not that kind." I think he was thinking of the railroad engineer, you know? But anyway, he would say, "Oh" -- for the weekend maybe, he'd say, "Oh, Mom's going to the moon again," I'd hear him say.

(Laughter)

BJ: See, he grew up with this. In the meantime, I was working more and more and traveling more and more, and we just didn't communicate. We didn't really argue or anything, we just didn't communicate. So finally after twenty or twenty-one years, we got divorced. Eric was in -- just about finished with college. It was still a shock to him.

LK: Sure, absolutely.

BJ: And then later -- I was single for quite a long time. Hal and I have been married over twenty years. My sister died, and she had been married to Hal for thirty-five years. And then he started coming out here on business. Of course, I'd known him forever. And then we just kind of got together, and we got married. My first husband got [re] married before I was again. So [Hal's] children, I'm their aunt, and he's Eric's uncle. His kids' kids, you know, the grandkids, call me "Aunt Grandma."

LK: (Laughs) Aunt Grandma. How neat.

BJ: And it works out fine.

LK: How interesting.

BJ: And my brother was still living at the time, one of them, and he thought that was great. My sisters had both died, and my other brother. They -- pretty much cancer.

LK: That must have been difficult.

BJ: It was. So in a way, I didn't really manage too well, but to some extent, it was okay in the early years. Just the later years, we just went our separate ways more or less. So I guess I didn't manage. I really did what I wanted to do, I think.

LK: Well, I mean, it's not success or failure, it's just how you perceive--

BJ: Yeah, evolved.

LK: -- and how you choose to handle it.

BJ: And SWE --

LK: Yes. How did you get involved with SWE?

BJ: Well, I knew about SWE all the time.

LK: How did you hear about SWE?

BJ: Well, I knew about it from the beginning.

LK: Really?

BJ: Pretty much. I knew when they were forming out here. But I didn't -- I was real -- I was just working too hard, and I

really didn't have time. I was going to graduate school and everything.

LK: Were you involved in any other professional organizations?

BJ: Well, I was involved in the AIAA. And I was later in the IAE, and mostly the AIAA. And I got -- in '74, I guess it was, I received the [SWE] Achievement Award. But I hadn't been a member of SWE.

LK: How did you feel when you received that award?

BJ: Oh, I couldn't believe it. The University of Illinois, I think, was the one that sponsored me. But the first year it was great. My mother came down. She flew down to Houston -- or to Dallas. And I think Le Earl Bryant and -- there were a bunch of them there – Naomi [McAfee]. And who's the girl that was at GE?

LK: Nancy Fitzroy?

BJ: Yeah, Nancy. But anyway, Le Earl and some others met me, and so it was kind of a festive thing. We had a party and everything. My mother enjoyed it. And then I started going to the local SWE, I guess. The next year I went to -- where was it?

LK: You went to the convention in Pittsburgh?

BJ: Yeah, in Pittsburgh, yeah. I got there because the headquarters of Rockwell was at Pittsburgh, and they wanted me to come in early. I think they wanted to meet me or something.

LK: At this point, North American had been--

BJ: It was Rockwell.

LK: -- Rockwell.

BJ: So I got in early, meaning early for the convention, but late at night. And the hotel was refurbishing part of it, and it wasn't ready yet, so they gave me a room without air conditioning.

LK: Oh, yikes.

BJ: And this was the end of June, so it was hotter than blazes. And it was late, and I was tired. I laid the dress I was going to wear to the banquet on the other bed that was in the room.

LK: The Achievement Award Banquet, the SWE banquet?

BJ: Yeah. I was going to be leaving to an air-conditioned room in about a day; they were going to have a room ready for me. So I opened the window just -- there wasn't really much of a breeze, but I opened it. I started out with some -- probably a gown on, and I took that off. And then I had just a sheet over me for a while, and I took that off.

And so here about 4:00 o'clock in the morning, just dawn, just getting dawn, I heard something. It seemed like there was something around. And I looked down, and there's a pigeon on my bed, just right there, just kind of looking around. And I'm like, God, and my dress is over there. And I have no idea what it's

going to do. I mean, I'm terrified. And with my toes -- and I have short toes -- I'm trying to grab this sheet, you know, just ooze it up a little, to get it so I could kind of -- I didn't want to excite the pigeon -- so I could kind of take this sheet and help the pigeon find the window, you know?

LK: Yeah.

BJ: I mean, this is -- anyway, this took a while. Fortunately, the pigeon just kind of acted bored, just kind of looking around, a big thing. Anyway, I finally did get the sheet where I could reach down with my fingers and really gently pull it up. And then I kind of pulled it up like that, and I gradually got out of bed. And I'm walking around the room just with this sheet, kind of helping -- and the pigeon is kind of flitting along. He'd flutter a little, and go to another table, or bed or something, you know. But I'm getting him closer to the window. And finally I got him close enough that he -- I just shoved him out, and shoved the window down. (Sighs)

Well, I'm telling these gals – and men -- some of them about it. And I mean, it was wild. Anyway, they were just hysterical. And I'm hysterical, but not the same way. They're laughing and everything. Well, it turned out it worked out all right. My dress was okay, and nothing was in my suitcase, which was wide open, I didn't find any problem. It worked out, but I almost had

a heart attack. (Laughs) I did.

LK: Oh, my gosh.

BJ: So Minta [Harness] gave me a pigeon. It's in the kitchen. I'll show it to you. In fact I'll go get it if you want to take a picture of it. I've got flowers in it right now. (Laughter)

LK: Oh, how funny.

BJ: But it was just a drastic change from Dallas, where I had all this attention and everything, to Pittsburgh, where there's nobody there, and I get this pigeon. Oh, I tell ya.

LK: Sounds crazy. Well why don't we stop.

(INTERRUPTION IN RECORDING)

LAUREN KATA: This is tape three for our interview with Barbara Johnson, May 3rd 2003. We ended tape two talking about SWE. But you have a couple of things maybe that you can show me and talk about, two frames...

BARBARA JOHNSON: Oh, these are Columbia -- the Shuttle. These are just presented to me. This is a flag from the -- that was flown on the first Columbia flight, STS-1.

LK: In 1981.

BJ: In 1981, April. And it's a recognition of contributions toward helping to make the mission a success. And it's signed by Chris Kraft and John Young and Bob Crippen. And then this is

another picture from -- I can -- this is Bob Crippen and John Young and their wives.

LK: Okay. I'm just going to zoom in on it a little bit.

BJ: And it says -- I can't remember. Oh, wait a minute. Oh, "Thanks for making our flight possible."

LK: Oh, wow.

BJ: And I was in the hospital. It says, "Get well soon." Then I was in the hospital. That's when I had lung surgery.

LK: Yeah. That must have felt good.

BJ: Uh-huh. I thought that was very nice.

LK: After receiving the SWE Achievement Award, why did you decide that you wanted to continue your work with SWE and come back to LA and join as a member? I mean, you get membership as an award recipient, but...

BJ: I guess I had met so many nice gals at the first -- at the one in Dallas, the convention in Dallas. And I knew Minta from when I was on a panel.

LK: Arminta Harness?

BJ: Arminta Harness. I knew her from a panel at the University of Illinois on career development. She was there as a military and I was there as an engineer, aerospace -- or just as an engineer, maybe. And I also met her at a convention that the Senior Girl Scouts had at a park here in LA. It was Will Rogers

Park. She was still in the military. So I had run into her a couple of times.

And I gave a talk on -- I took Jules Verne -- the art department did a really clever job for me, how we're going to fly the Apollo. This is well before the Apollo flew, but mainly Apollo to the moon, the Lunar Landing. But how we were going to fly the mission, the way Apollo -- we planned for the Apollo, and how Jules Verne went to the moon. And I would interchange these view graphs. And it was kind of fun. It was successful. They liked it.

LK: Did you work with the Girl Scouts often, or did you interact with them often?

BJ: No, I didn't. I've forgotten how I was invited. But when I was a little girl, I was a Girl Scout for a while, until I was asked not to belong. I wasn't ready for the Girl Scouts, because we were crocheting -- well, first of all, we went camping. I guess this is regressing.

LK: That's okay.

BJ: But we went camping. And myself and two other girls were supposed to cook the breakfast that morning. And so I got the idea that it would be fun to have the dinner we had planned for breakfast. And so we fried chicken and did all this stuff. We got up real early, and made mashed potatoes and everything.

And the gals loved it. But the Girl Scout leader did not approve. That was the first thing.

The second thing was for Mother's Day, we had to crochet the word "Mother" on a linen handkerchief, which cost fifty cents, I remember. And I didn't do a very good job. And I had used up all four corners of the handkerchief; they had big holes in them. And she told me to buy another handkerchief, and I refused. So then she said I wasn't ready for the Girl Scouts.

(Laughter)

LK: You went on to bigger and better things.

BJ: So on the night of the Scout meetings I would go to my friend's house. And then my mother happened to run into this teacher, and she mentioned this to her, and the teacher -- I mean, my mother didn't act like -- because I had been always saying it was a Scout night, you know. And so when I got home -- I said, "Well, I'm going to -- it's a Scout night tonight." And my mother says, "Oh, really? Well, I talked to Miss Stiles (phonetic)." And so then the whole story came out. But that was my association with the Girl Scouts.

(Laughter)

LK: That's funny.

BJ: So, the Senior Girl Scouts, I don't know how I got involved.

LK: But you had known -- that's how you had seen Minta.

BJ: Yeah.

LK: So you continued your involvement here in LA, through the LA Section?

BJ: Just with the LA Section, yeah. And it seems like I was the rep one year, what they call it?

LK: The section rep?

BJ: The section rep, one year. And then one year I was elected to the -- I think they called it -- I don't think they call it--

LK: Oh, the Executive Committee?

BJ: Yeah. Now it's called Board of Directors, I guess.

LK: I think so, yeah.

BJ: But it was the Executive Committee. But I did not -- I had to resign from that because of illness. So not too much have I gone to the local chapters in the last several years.

LK: Sure. You got involved with SWE kind of at an exciting time, during the height of the women's movement.

BJ: Yeah.

LK: What was that like here from the LA perspective?

BJ: I got involved a little bit, too, with the university chapters. I can't -- I guess helping -- I think I helped start the one at Illinois. But I don't think I stayed with it. That

was years ago.

But you know, in SWE, the reason they had to allow men had to do with universities would have contracts with the government. And if you had organizations that were discriminatory you could be -- your contract could get cancelled. It was kind of a thing like that.

LK: Oh, right.

BJ: So that's why clubs and things like that, if they were sponsored in any way by the government, they had to have both, they couldn't discriminate. And like the golf club at Augusta, that's a private owned.

LK: Right.

BJ: So they have no government contract. And all you have to do is give them a government contract, and that's how the women would get to play there, you know. (Laughs)

LK: Well, hopefully Title IX will stay. (Laughs)

BJ: But that's how men... anyway.

LK: That's an interesting explanation.

BJ: So I was saying to somebody, I said, "What man is going to join the Society of Women Engineers?" And I was amazed at the numbers. But I really hadn't thought the thing out, because fathers of girls that want to take engineering would be interested, and well, people whose wives are involved.

LK: Sure, and faculty, advisors and people like that.

BJ: Faculty people, yeah. So it's not unusual. At the time I thought it was kind of funny. But that's the way I think it happened.

LK: Do you remember any other activities during that time period, in the '70s here in LA that SWE was involved in?

BJ: About SWE?

LK: Uh-huh.

BJ: I'm sure there were. I can't remember whether it was SWE or just people in our division, women, but we had a kind of a Space Day or something, where we invited guests. I mean, people came from -- and I know I was one of the speakers for the women. It may have been just for space women, I don't know, secretaries and engineers and computer people. We had quite a few.

I hired every woman engineer I could find whether -- for my group or other groups. I helped -- I did a lot of recruiting for the company for engineers--

LK: Wow.

BJ: -- colleges. But I really hired for myself, I mean, I took the pick if I could.

LK: Did you have any female role models yourself, either in science and engineer or just in general?

BJ: No, I don't think so, unless Amelia Earhart flying would

come the closest. But my dad was probably -- and my mother were, probably as much as anybody. I know there's some very impressive women. And at this Upward Mobility Conference in Easton, Maryland, Dorothy Simon – was it Dorothy Simon?

LK: Uh-huh.

BJ: She was very impressive, I thought. I think she was Avco, maybe.

LK: These are women that you met through SWE?

BJ: Uh-huh.

LK: How is that, to meet women in other disciplines during that time?

BJ: That's what I think is so good about it, it's so multi-disciplined. In fact, if their meetings weren't so far away for driving back and forth at night, I'd go. There's nobody in my area to drive with. I'm not worried about driving, it's just the trip by yourself, the fore and back.

LK: It's a long trip.

BJ: Yeah.

LK: Why do you think there's a need for a Society of Women Engineers? Or do you think there's a need for SWE?

BJ: Yeah, I think there's a need for -- some more than others have problems. Especially -- it depends on their work situation, too, and also their personality. They might be the

best there is and not -- and be maybe bashful or something, you know. You have to be competitive.

LK: Do you think that's true for men, too?

BJ: Yeah, I do. And you have to -- well, like me, my idea of a good job when I was young was one I didn't have to wait in line for. I'd have enough money, I wouldn't wait in line. You know? That seems like a worthwhile goal. And I think I would have been -- I think I had recognition of a higher office in the company than they had given me title for, you know? I mean, I really -- because like I would report to the chief engineer, the manager, other people were directors, you know, later. This is later. And I had just as many people working for me. And I think just about when I was leaving on medical leave, they were making a big change, because I would have gone to Houston as a director.

LK: You would have done that?

BJ: Yeah, I'm sure I would have. In fact, I had an apartment down there, a condo.

LK: Did you spend a lot of time traveling to Houston? I would imagine, yeah.

BJ: Oh, one year I was traveling somewhere every week, we figured. Houston, Boston or Cambridge or Washington. Mostly Houston.

LK: Did you enjoy traveling while you were working?

BJ: Well, not that often. But it's kind of -- it's really hard on you, a little bit. And you get -- late at night, I've gone late at night, going the wrong way on the wrong -- on the freeway, you know.

LK: Yeah, it's tiring.

BJ: Yes, very. (Laughs)

LK: What does it mean to be a woman first? I mean, you're a woman first, first woman.

BJ: Yeah.

LK: First paper girl. (Laughs)

BJ: Yeah.

LK: First female graduate of your engineering school.

BJ: You know, I didn't do it for that reason, but...

LK: Right. What does it mean to you, though?

BJ: Well, it really doesn't -- it really never impressed me so much, except it seemed like it impressed other people more. I mean, I didn't really think about it. But I think it probably -- if you're on the fence like whether you wanted to deliver papers or not, it might be a push for you if you were a woman knowing other women did that, other girls. Or the same as engineering, it's like it's not necessarily you're masculine if you take engineering. You know, it just sort of proves a point like that, that you can still be very feminine and take engineering. There

are plenty of very feminine engineers.

LK: Did you have to prove that at all in your career?

BJ: I don't remember that I did. I can't think of that. I never -- as a matter of fact, I knew about the glass ceiling and all this stuff, but to tell you the truth, I was always so gung ho about moving ahead and making a dent on like on the program, I didn't really differentiate much with being male or female. It was kind of a neuter thing. And people, when I worked with them, they treated me that way, pretty much. I didn't swear or anything like that, but some men do that, but most of them don't, you know. It's a matter of their vocabulary limitations.

LK: Yeah, yeah.

BJ: You know, I really -- I'm sure I would have been at a higher level in management as far as the name goes, and probably, I'm sure, some money too, but I didn't really worry about it, actually. I didn't. I just got so gung ho working on this stuff.

LK: Were you ever involved, other than SWE, in any other women's organizations?

BJ: I had given some talks to University Women of--

LK: American Association of University Women?

BJ: Yeah. And let's see -- I think that's pretty much it. Oh, a couple women's clubs. And then I did these things like career development, we had it at schools, and like the prison, I

mentioned.

LK: Can you talk about your trip to the prison?

BJ: At Terminal Island had a prison, a women's prison. They may have had a men's too. But they had a women's prison that they requested a professional woman. And I guess they requested, apparently aerospace, because I was the chief engineer, and I went down there. The first time -- the second time I went by myself.

So I gave a talk on -- it was kind of like career development, but I used the space program more as a background to develop the ideas I wanted to get across, because I knew these women weren't students. I mean, they weren't children. They were adults, and I didn't have any idea that they were actually students. But they were very impressive as a group, as far as the questions they asked. They were either -- they were always taking extension courses, the ones that I talked to, for either high school or college. And they were very interested in if you -- you know, jobs, a future.

And most of them were in prison for, I guess, murdering their husbands. But they had every reason that I heard was because they were abusing -- serious abuse to their children or to themselves.

LK: Yeah.

BJ: And they couldn't get away from the situation, even though they tried. And it was either kind of them or him, you

know. And so I don't know how long -- I don't think they have that prison there now. But I don't know how long they were to be there, but they were certainly striving for a better background in the event they did get out.

And I went another time and took a spacesuit with me and had a fellow try it on, and so forth. It was fun. And I was impressed with them. They asked good questions. I forget what year that was.

LK: Is that while you were working on the Shuttle?

BJ: No. I think it would have been earlier than that -- oh, I know it was quite a bit earlier.

LK: This is kind of a loaded question, but what do you think are your greatest technical contributions--

BJ: Are what?

LK: -- greatest contributions to the engineering profession?

BJ: The women in general, you mean?

LK: No, you personally. What would you consider to be your--

BJ: I don't know. (Laughs)

LK: As I said, it's kind of a loaded question.

BJ: I really -- I think I've been very effective in meeting like program objectives, and just through hard work and honesty, integrity. But I don't know, my contribution, when you say that,

I think of something personal. I think it would have to be the management style, to some extent. It was definitely progressive. And I always had people that could take my place. That was important to me. I had a very low attrition rate. Most of them were because they went back to school for a Ph.D., something like that. So it was probably management style. I don't know how I'd even quite describe it, but certainly integrity and competitiveness. And I think I was pretty objective. I treated everyone equal, whether personally they appealed to me that much or not, it didn't matter. I made sure of that. I can't really know, I guess.

LK: I think that's a good answer.

BJ: I'm just glad I was in the situation -- I was sort of lucky I was at the -- I was really lucky to get into the aerophysics lab, because I learned an awful lot in a short time from very good people, experts. And I almost went to Rand with some of them, the Rand Corporation.

LK: Really? When was this?

BJ: This was before the Downey move. We were going to move to Downey. And two of the people were going to Rand. And they wanted me -- one of them wanted me to come and work for him. And I really thought seriously about it. And I told that to my boss. And then I also had an old beat up kind of a Buick convertible,

and it needed new tires. And I said, "I can't drive to Downey, I don't have good enough tires." And anyway, these guys chipped in, that I worked with, they chipped in and bought me tires. They took my car one noon, and came back with new tires on it.

LK: Oh, that's funny.

BJ: So then they said, "Now you got to go to Downey." But I don't know, I really don't.

LK: Do you follow the space program today?

BJ: To some extent. Anything that's in the paper, that's all. And like after the Columbia, I called Frances Ferris, to see if she was working on the cause ... I called -- I talked to Shirley last night about it. There's a report coming out very soon, I guess. But you have to be -- I don't have any -- many contacts anymore.

LK: Yeah. I mean, how do you feel about it today? I mean, it must be overwhelming to think that you were working on it.

BJ: Well, I feel terrible about it, really. But right now I don't want to -- I wouldn't want to say anything without knowing--

LK: No, that's okay.

BJ: But it certainly was a shock. You know, it's like -- well, every problem we've had -- the problem we had on the tests on the ground when we lost three people, we -- that's with Gus Grissom, and that group -- it took me three weeks or more to get

back to just to normal sleeping.

We probably, I think the company -- they did materials testing. They probably did, in three months, what most research people would do in two years, where you combine different materials with each other under certain environmental conditions. And that was the problem where it was flammability of one material behaved differently than if it was combined -- by itself -- than when it was combined by another, things like that. And we changed the way the hatch opened, the direction, a lot of rewiring, a lot of things.

And these are kind of like "what if" things. So after that, every time we had a flight, we'd inspect the Shuttle for everything. We'd go through "what if" exercises. That's what we called them, what if this failed, or that, you know, what would we do? So the things that you hadn't thought about -- if you'd already thought about them, you know what you're going to do right there, so it could give you more time for the things you hadn't thought about. So I imagine there's a lot of what ifs going on right now on the Columbia. At least I would think so.

LK: Yeah.

BJ: I hope that it comes to a very positive conclusion and we can continue on.

LK: You believe in continuation of the space program?

BJ: Yeah. And I think we should be spending money on new technologies that will get us into deep space with man's exploration. It's called -- I think its growth, for growth. I think Mars would be in the picture. There's a moon of Mars that sends a signal down using an atomic clock, been doing this for forever. And I don't know how many years, but many, many, they've been tracking this, and the signal is the same time all the time. I think that's fascinating.

LK: That sounds fascinating.

BJ: It's just, I keep thinking there's another universe or galaxy that have -- there have got to be some that have life on them somewhere. We might not recognize it. But this Hubble Telescope has been amazing.

LK: How has it been since you retired to watch some of the advances that have come up?

BJ: Oh, it's been great. When you see the pictures of the Hubble, where these stars are still gases, and they're still millions of light years away, and by the time you see them, they're probably already formed, and we're seeing them as a gas, it's amazing. It sort of blows your mind when you think about it. That's why I like science fiction.

LK: Do you have any final thoughts about your career, or even the Society of Women Engineers?

BJ: Well, I'm sure if it hadn't been for the series of surgeries, I would -- well, I wouldn't still be working at seventy-seven, but maybe seventy.

(Laughter)

BJ: But I've been very happy playing golf and bridge and doing some traveling and reading. And I kind of work out a little bit to help my golf game. And it seems like every year I've lost a bet at Saint Paddy's Day, so I always have green hair for a while, but other than that...

LK: (Laughs) Well, we have the picture of the green hair.

BJ: Yes.

BJ: Is there any other thing that you have to?

LK: No, if that's your final thoughts.

BJ: Yes.

LK: Thank you very much.

END OF INTERVIEW