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EDWIN J. SALTZMAN
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is February 17, 2015. This oral history session is being conducted with Ed Saltzman in Palmdale, California, as part of the NACA [National Advisory Committee for Aeronautics] Oral History Project sponsored by the NASA Headquarters History Office. The interviewer is Sandra Johnson, assisted by Rebecca Wright. I want to thank you again for coming and driving all that way to come meet with us today; we really appreciate it.

I want to talk about when you first came to NACA, but also a little bit about your background and what brought you to this area and what brought you to the NACA in 1951?

SALTZMAN: Well, I don't want to be too laborious about what brought us here, so you give me some kind of signal if I am too [long winded]. My background is as a farm kid from Iowa. All of my ancestors were farmers. The ancestors for three of my grandparents were Amish-Mennonites, and the fourth grandparent was of Scottish descent, who had, of course, [somewhat] different lifestyles from my other grandparents. I was raised in the Mennonite traditions, which were not as severe as the average person might think; they were quite progressive in their farming methods, [and we had most modern conveniences after World War II].

I went to country schools, one-room country schoolhouses, and I loved the farm. I had an uncle on my mother's side, who, in the 1930s, was not a full-blown barnstormer but he did fly biplanes, kind of on the fringes of barnstorming. He only did it for his own pleasure. I mention that because that impressed me a great deal when I was [probably] four to six years old. I didn't

know it was going to [relate to] my career eventually, because I thought I would be a farmer.

In spite of my cultural background, I enlisted in the Army Air Corps upon graduating from high school [spring of 1944], but I was just among the younger ones [to be in service at that time and was not sent] overseas. Consequently, I only served for close to a year and a half, and after the atomic bomb dropped, things suddenly accelerated in terms of prospects of the war ending. The Army Air Corps offered all of us, that were within those [training] classes at that time, the option of staying in the service and completing our training, which was tempting, or going home immediately—well, by immediately I mean within a month, maybe—subject to recall. I had a sweetheart at home, and all the [anticipated] farming activities too, so even though I was tempted, in a way, to stay in, I chose to go home, taking the risk that I would not be recalled, and it turns out I was not.

Then my dad insisted that I go to college, and actually I didn't want to, but I came from a culture where you did what your dad told you to even if you were 19 years old. So I started college, majored in physics at Iowa Wesleyan College [Mount Pleasant, Iowa]; it's a parochial school, just a small one. I went to that college because it was close. No profound thoughts went into choosing a college at all, I'll just go to the closest one [to my sweetheart and friends]. I did determine I wanted to have plenty of math courses. We got married before I was out of college; got married so soon, our second child was born in July following graduation [in 1950].

Dad didn't really need me at home, he had modern equipment and was able to handle his farm without help, so I looked for a job in the southeastern part of the state of Iowa, so we would be close not only to my relatives but to my wife's relatives, too. That turned out to be the Iowa Ordnance Plant [now the Iowa Army Ammunition Plant]. By then they were gearing up for production of ordnance for the Korean War, and with my [physics] background I was assigned

quality control responsibilities for some of the ordnance being produced there.

I'll skip talking about whether the job was interesting or not, but suffice it to say some of the materials we worked with were very toxic, and this was before much thought was given to that, as it would be today. I became jaundiced and weak, for a vigorous young man, and tired, and I knew I was in bad shape. So I went to the company doctor, that is, the company that was contracted to produce the ordnance, and he could see, if he chose to, that I was jaundiced. My eyes were yellow and my skin was yellow. I told him I was frightened about this and explained my symptoms that I was aware of, and he gave me a cursory examination and said I was okay. I was quite frightened about that, so I went to a doctor of my own choosing. He said, "Get out of there."

I went to the post office—I don't know what kind of thinking I used to make that decision, but that's just what I did—and looked on the bulletin board at the post office. They had several locations that looked like jobs I would be interested in, because I was very much interested, as I took my physics courses, in experimental work. For the NACA there were five locations where the NACA was hiring for people with technical degrees: chemistry, physics, aeronautical engineering, mechanical engineering, mathematics. I figured even though I came from this nondescript little school, on paper, at least, it looked like I was qualified. So, I took enough forms that they had available there home with me, five, plus I took another one home that represented an Army research center in St. Paul, Minnesota, so I took home six. My wife—I'm just going to refer to her as Lois from here on—Lois and I stayed up till beyond 2:00 in the morning filling those out. We got them in the mail the next day.

Within two weeks I heard from all six; all six offered jobs. I laid all six out in front of Lois on the table and I said, "I'm taking you away from your mom. You pick the place." She

picked Muroc [NACA High-Speed Flight Research Station, formerly NACA Muroc Flight Test Unit, California], and it was the best fit possible for me. I'm emotional because I lost her recently.

It was a perfect fit for my weaknesses and my strengths, and that's how I got there. The NACA culture was well preserved at the Muroc facility. It was well steeped in the mentoring tradition, and I was well mentored; in fact, I was mentored, in part, by Jake [Hubert M.] Drake, whom I regard as a genius. You've already interviewed him, or somebody did, and I think I told you on the phone how highly I regarded him. Then I had other mentors, and even though the procedures and the thinking with physics training and aeronautical training, they're different, I was rather quick to catch on, [thanks to Drake and other mentors, primarily Ronald [J.] Knapp, and later, [A.] Scott Crossfield].

I should add, Jake Drake gave me a tour the very first day. I was so impressed. The hangar was full of white-painted, hot-looking airplanes. I just fell in love right away. I was assigned to the [Bell] X-1 number 2, which was still there. First day of work was July 2, 1951, and that was essentially four years, approximately, following the X-1 number 1 breaking the sound barrier. Anyway, the performance data, or lift and drag data, for the X-1 number 2 wasn't close to being [worked up and] published; they had gathered some data, but they needed to gather more data, so I was assigned to that. There again, that was a perfect fit for me right off the bat. It was simple enough that I didn't feel intimidated at all. I knew I was going to like it, and I did. Matter of fact, this'll sound rather dull, but that's what I worked on for 51 years, actually to February of 2003 when I retired.

There again, it was a perfect fit for my strengths and my weaknesses, and it introduced me to a long line of high-performance aircraft that was a real privilege to work on. I also got to

meet some of the giants that were remnant from the old NACA as I later transitioned into NASA. Perhaps that's a good place to pause and allow you to digest this and think about what you might want to ask next.

JOHNSON: Well, there was quite a transition for you and your wife, too, coming from Iowa, from a small farming community, to the desert, and the climate being different. Where did you live when you first came? Did you come first and find a place to live, or did you move at the same time?

SALTZMAN: I'll make another long-winded story out of that. We both realized that it was going to be emotional for both of us to leave, in my case, my father and stepmother and in her case her mom and her sister, but I was so excited about going to work, I kind of put aside the family thoughts for myself, but I realized it was really tough for her. But she was brave about it, so we left with the two little children [without any housing arranged for us upon arrival]. Let's see, Annie was two and a half and Dave was less than a year; I think he was 11 months when we took off. The car we had, I don't know if you've ever seen one like this, it was an English Ford called an Anglia, a little four-cylinder flat-head engine that was intended for driving in England instead of our highways, but it was what I could afford at the time.

So we started out with most of what we owned stashed on top of that little English Ford—we had a rack on top—including a potty chair on top. It was strange, to say the least. The trunk lid, instead of being hinged at the top and being raised up like an American car, was hinged at the bottom and flopped down, suspended by a couple of rather sturdy straps, which meant there was a horizontal surface where I could add some more junk. We were quite a sight,

but that's what we drove. I don't think we ever got above 55 miles an hour, and sometimes it was 45, [or even less on hills].

But we made it, we arrived at Mojave [California] on Sunday, July 1, 1951, and we found a place that Sunday afternoon at White's Motel in Mojave. That White's Motel no longer exists; there is still a motel that is called White's, but it's a different one. It was full of ants and sand, and I just felt horrible leaving the next morning to report for my first day of work and leaving Lois and the two children there, but there was no other choice, so I took off to go to work at Edwards [Air Force Base], at the old South Base facility. [The NACA place of work was a tenant within the Edwards property.] On the way, it was a very windy morning, and I'm going east from Mojave and climbing a hill that the locals call Nine Mile Hill. With the weak little engine on that Anglia, even with a tailwind, my velocity kept slowing down because we were climbing up a hill—in a modern car you hardly notice that it's a hill—and a tumbleweed passed me. That made me think immediately of Lois back in the motel, with the wind blowing, the sand, and the ants. That was my introduction to the first day of work.

As I said earlier, Jake Drake gave me a wonderful tour, and I felt good [about the place and the people] the very first day. I felt good the second day and the third day, because it was all so interesting and fascinating, but when I'd go to work, Lois would be quite sad because—you can understand—she was trapped there with those two kids. She didn't have a car, I had the car. So it was always a [bitter-sweet] reunion when I'd get home. Well, the next day at work, I mentioned to a fellow that was going to be [an office-mate] that my wife was just torn up about this, and I didn't blame her, of course, but I said, "I wasn't prepared for how difficult it was going to be for my wife."

He said, "Well, you know, that's very common. Most of us in this office have not been

here that long either, and almost universally that's the way it is. But," he said, "once you have been here a while, you get established in a neighborhood for your home, you've made a trip to the beach, you've gone up into the mountains, you become acquainted with all of the interesting things there are in the desert. You get to where you really like it, and your wife will too."

I was a naïve guy, and I went home and told my wife that. I was very deliberate and slow in how I said it, and she had tears coming down from her eyes. She said, "Let's hurry up and leave before we get like that."

She was still, for some time, very homesick and despondent about that, and I finally told her, "Honey, let's stick it out for a year, and if this has really taken a toll on you at the end of the year, I'll take you back to Iowa and I'll go back to Iowa and get a job." She didn't really say anything; she was just kind of quiet about it. But I could tell over the coming months that things were getting better. She became acquainted with other wives. By the way, almost everybody was married and had kids; after all, we were GIs, most of us, so there was a commonality there, where she quickly became acquainted with other wives and mothers, some with more kids than we had.

As the end of the year approached, I started kind of quizzing her, or brought up that subject, and she was still kind of quiet, noncommittal. And as we got closer to the end of the year, she said, "Ed, I know you love your work and I can understand why." She said, "I'm never going to take you away from it." And we were there ever since [for 51 years].

JOHNSON: That was quite a sacrifice for her, to do that for you. That was very sweet.

SALTZMAN: Well, that's why I get so emotional about it. I owe her everything. I'm sorry that I

teared up.

JOHNSON: No, that's okay. I'm sure she wanted to see you happy, so that's quite a nice thing.

SALTZMAN: She ended up liking it, too. It took her longer because she didn't have the challenge of the work like I did, [but she had the more important challenge at home with our growing family]. She ended up agreeing that we came to the right place.

JOHNSON: Where did you end up living?

SALTZMAN: We lived in that motel for a week, and it turned out that out on the Air Force base they were opening up new homes, never been lived in; they called them Wherry homes. I think there was a senator previous to that [Senator Kenneth Wherry of Nebraska], a United States senator, that sponsored a bill that would permit these kind of homes to be built as an incentive for officers and enlisted men that were technicians and so forth to stay in the service and become well trained and [to feel] more or less permanent. Well, the NACA arranged with the Air Force for a few of those homes to be reserved for NACA people, and we were able to take advantage of that.

We lived on the base for a year. An opportunity opened up in Lancaster [California] for new homes being sold there, and I heard about it, went in one Friday evening and bought a home, just like that, so then we lived in Lancaster for 10 years. It was an awful dull drive between Lancaster and what became Dryden [Flight Research Center]. Then being a farm kid, I wanted to live out in the desert. There was a little desert community that no one would want to

live in, except a farm kid, north of Edwards Air Force Base, across the highway, which is now Highway 58, from the base called North Edwards.

I bought a home out there that was a wreck. The owner of it didn't even live around here anymore, he lived in Oklahoma. I offered him $10,000 for it over the phone, he accepted, mailed me the paperwork, and we bought that home for $10,000, all done over the phone and through the mail. There weren't any real estate people involved. In fact, we became good friends later on when he traveled to California and I got to meet him.

I spent a number of years fixing up the house for Lois, because it was such a mess, and we raised the kids there. It was out in the desert, they could ride their bicycles and run in the desert till they were worn out. I loved it for them. The boys loved it; I'm not sure about the girls. We [eventually] had three boys and three girls. [We lived there for over 40 years, until retiring to Bakersfield, California, in 2003.]

JOHNSON: Before you came to work for the NACA, and when you walked into that post office just looking for a job, did you know anything about what the NACA was doing?

SALTZMAN: No.

JOHNSON: You just applied, and you didn't really care?

SALTZMAN: I became informed by reading some of the details on the notices. It said research, it said experimental work, aircraft, so I had a clue, and I already had an interest in aviation—I mentioned my uncle [who flew]—and I was in the Army Air Corps, which didn't make me very

well informed, but it did stimulate my interest a little more. [Also, I took flying lessons in college, on the G.I. Bill, long enough to solo.] The main thing that drew me, whether it was aviation or not, was the experimental work. I had asked my physics prof, when I was going to this little parochial school, I said, "I really want to do experimental work. What are my chances of making a living at it?"

And he said, "Well, not very good, because you'd have to get your master's degree, at least, and preferably your Ph.D. to get experimental work." Well, I believed him, but it turned out I got experimental work of the very best kind with just a bachelor's [degree. It was as if I was being led by my hand – essential doors just kept opening before me!]

JOHNSON: Were you aware of the work with the X-1 that was being done before you actually came here and then started working on it?

SALTZMAN: No. I had a beautiful thing just dumped in my lap.

JOHNSON: It's amazing.

SALTZMAN: Amazing, absolutely. And all through my career it's actually kind of been that way. I'm one lucky guy. [Actually I should say, "One blessed guy."]

JOHNSON: Since you were in physics, what was your title when you started? Was it research engineer? Did you have an engineering title?

SALTZMAN: I'm embarrassed to say, because it sounded so—it sounded like something that was made up to be impressive. And it wasn't just my title, all of the other persons that came in at that time, in response to those application forms, had the same title. You'll agree it sounded kind of hokey: Aeronautical Research Scientist. We weren't scientists, but that's the title, Aeronautical Research Scientist. We snickered when we saw that. We knew we weren't scientists. However, the nature of the NACA was that you became acquainted with scientists and [on occasion] were mentored by some of them. That was [a wonderful thing].

For example, one of the primary aeronautical geniuses of those decades was Dr. Richard [T.] Whitcomb at Langley Research Center [Hampton, Virginia]. I was privileged to work on all three of his inventions, and I copied, mimicked, I'm not sure what the right term is—I tried to think like [he thought]. I didn't have the intellectual tools that he had, but I studied how he thought, and it was a great benefit to me.

JOHNSON: I was going to ask you about other mentors and people that you worked with that you felt like you learned from.

SALTZMAN: [Dr. Whitcomb would have been an example of a scientist that was an "unknowing" mentor. I so very much appreciate the mentoring provided by Hubert Drake (mostly by example), Donald Bellman, Ronald Knapp, Harold Walker, and Scott Crossfield. And there were others whose intellect and work habits influenced me. Back to] Whitcomb, he was unaware that I was observing and trying to understand his way of thinking, but it really stuck. His secret to all three of his inventions was to try to visualize in his mind where an air molecule would want to go as it encountered the [proximity of] certain faces, certain slopes, certain

surfaces on an aerodynamic vehicle, [taking account of compressibility effects and shock waves, if present.] I knew that, and so I adopted that way of thinking too, and it just greased the skids, it made things a lot easier.

JOHNSON: So it changed your perspective to start thinking more in that way.

SALTZMAN: Oh yeah, it's a powerful tool.

JOHNSON: You mentioned that when you first started, you started working on the X-1 number 2. What were you doing with that? Was it the L/D [lift to drag ratio] studies?

SALTZMAN: Yes, with accelerometers and a few other instruments you would be able to resolve the forces acting on the airplane and end up with the lift and the drag and convert it into the various metrics that are of interest for [analyzing and] publishing lift/drag work. That resulted in my first publication.

JOHNSON: As far as publishing for NACA, I know they were very well respected, the technical reports and the papers that were published by the NACA.

SALTZMAN: That's true.

JOHNSON: How were you introduced to that process? Did you work with other people as they were publishing first? Or did they drop you into it and say, "You're going to do this work and

we want you to publish it"?

SALTZMAN: They did drop it onto me, but what I did, I cheated. I dug up some previously published reports and studied how they presented the data, how they analyzed it, how they explained it, and I copied them. Copied the ideas, you know, I didn't copy the words. So again, the skids were greased. I'm basically lazy, and I just do it as easily as I can.

JOHNSON: Then I imagine you worked with editors and the people actually doing the production of the paper?

SALTZMAN: Yes, and they had excellent editors, just excellent. I admired them even when they changed my words. I came to respect them a great deal, and I also came to enjoy writing myself, and that also greased the skids. [Three excellent editors really cleaned up my proposed writings. They were Helen Foley for the NACA period, and later Lita Holleman, and still later, Yvonne Kellog. There were also other excellent editors that helped me for shorter periods.]

JOHNSON: How long did it take you to do that first paper?

SALTZMAN: Well, I arrived in the summer of '51, and the first publication was in 1953. Of course the assembling of the data takes the longest, and then when you get it assembled, then it's a matter of [analyzing the results and then] fitting into the procedure that they have, and there's always a backlog of other publications that are ahead of you, and you wait your turn. The '51 to '53 thing would not be excessively long at all, it was probably fairly normal.

Another thing that greases the skids is enjoying the writing. If you don't, then it becomes laborious, and a lot of the guys [did not enjoy the writing duties]. Iowa Wesleyan is a liberal arts school, it's not an engineering school, and I think coming from a liberal arts school was another thing that helped me. By the way, it was the oldest four-year school west of the Mississippi [River]; it's been around [since 1842]. It had been in business a fair amount before the Civil War.

JOHNSON: I imagine that liberal arts background did help you with writing. You probably did that a lot in school, too.

SALTZMAN: Yes, and strangely enough, I enjoyed the writing in the school, too. I had no clue that was going to help me [in an engineering job], but it did.

JOHNSON: That's interesting. In doing the technical papers, were there support personnel? I know that computers, of course, helped reduce data and do that sort of thing, but as far as doing the papers, were there graphics people doing the charts?

SALTZMAN: Yes. Matter of fact—I suspect you've heard of Roxanah [B.] Yancey. She was the head computer. She did a lot of the graphics herself. When you see some of the graphics in those early reports, including my first report, she did it. She was quite particular [and improved all of the reports she worked on]. She was a great lady. [Later on under the NASA umbrella, we also had the very best support, very talented and committed workers that employed the latest hi-tech stuff.]

JOHNSON: Did you work a lot with the computers and that group of people that did that work?

SALTZMAN: I made sure [that we] became good friends.

JOHNSON: It always helps, doesn't it?

SALTZMAN: Greases the skids.

JOHNSON: That's right.

SALTZMAN: That sounds self-serving, but everybody benefits when you approach it that way.

JOHNSON: When you first came, you were on the South Base, on that side, and the working conditions on the South Base were different than it was in 1954, when they built the new facility on the Main Base. Can you just talk a little bit about that South Base and where you were in the setup, where you were located and where you worked, and just a little bit about that area?

SALTZMAN: Well, you would already be aware of the metal building that was located to the east of the hangar, they always called it the Butler building, because a Butler building is a metal building [that was prefabricated mostly for farm and industrial use]. I was put in an office with three other guys, I believe it was. We each worked on a different airplane [but we did interact and supported each other]. There weren't that many offices in that building. Offices that would

be a parallel [of comparable purpose] to the office I was in would probably number no more than six, something like that. That small building even contained [the offices of] the chief, Walt [Walter C.] Williams, and De [E.] Beeler, his assistant.

Walt Williams had the only office that you could consider a conference room. Any other offices of division heads—they didn't even call them division heads, but what would be the equivalent of a division head [today] would simply be that their offices would have been a little bigger than other offices, and have a table that was quite modest in size, not much bigger than a family dining-room table in a family home. [So, it was only the division heads and Williams who had small tables for conference-type meetings – just a hand full of such facilities]. And I noted when I retired, in 2003—well, I noticed it a little before that—I went to the phone book and looked at all of the conference rooms in the phone book in 2003. There were over 20, and you had to make reservations to use one. That very well represents the decline in—this is an old man talking—but it truly represents a decline in [decisiveness] and efficiency in management. That sounds very biased, but it's so obvious.

JOHNSON: I think you mentioned the culture, the NACA culture, and it was very much that you just did the work that needed to be done and people would just meet and talk, and it was more informal. As you said, you didn't have to make reservations to have a conference. You mentioned that you had the other gentlemen in the office with you and you were all working on different airplanes. Did you talk to each other much? If you had an issue or a problem, did you just talk to each other and help solve each other's issues?

SALTZMAN: Yes, sure. It was extremely informal. No one was looked on as a competitor.

Never. Not in my experience. We were just tickled pink to be there. [A lot of our conversations, about work or otherwise, occurred when we opened our lunch pails and ate the sandwiches that our wives had prepared.]

JOHNSON: Felt privileged to be there?

SALTZMAN: A great privilege. It was just so much fun that you didn't think about getting home quick or taking a long lunch. Jake Drake and a couple of the other guys that were at the same level he was, I don't even know if they ate lunch. They mainly just thought [and discussed their latest ideas]. Guys like myself were maybe eight years younger, something like that, we admired those guys so much. All we thought of was being [innovative and forward thinking] like them. That's how strong the NACA culture was, in my sight.

JOHNSON: You mentioned that it took until 1953, and you were working on the X-1 all during that time, until that paper came out that you were working on. What did you move to next? Was it the [North American] X-15? Or what did they call it at first, the Project 1226?

SALTZMAN: Yes, [the earliest work we did on that project was known as Project 1226. However,] there were quite a few things I did before we got the X-15. The very next thing I did was the only work I ever did outside of lift and drag and performance. It was on the [Northrop] X-4 [Bantam], and they asked me to do a stability and control [analysis] on it, which resulted in my second publication. I didn't know stability and control. Scott Crossfield, whom you've heard of, was the pilot. He [said he] was a farm kid, too, by the way. He knew I was going to do

some stability and control work, and he knew that I didn't know anything about the subject.

I want to contradict some myths about Scott Crossfield. He was generally considered to be a little on the dashing, cocky side, and some might even have thought of him as being arrogant. I saw a softer side in him. He mentored me in stability and control, and it worked out well. I've always honored him for that. He didn't have to. He could have said, [based on his position], "The guy you've assigned to this doesn't know the subject. You gotta get somebody else." He didn't do that. [Instead he was patient and mentored me effectively enough that I did a credible job. I'm very grateful for his understanding and thoughtfulness.]

JOHNSON: During that time, also the Korean War was happening. Did that affect the research that was doing here as far as, did you have security clearances and those kind of things? Were you working on anything that had to have a clearance?

SALTZMAN: Well, [most of] our publications through that period of time were confidential.

JOHNSON: Were they?

SALTZMAN: Yes, yes. From the X-4, I went on to—does the term Century Series fighters [aircraft] mean anything to you?

JOHNSON: I have heard that term before, but go ahead and explain that.

SALTZMAN: The reason they called them Century Series is that there was a series of fighter

pursuit-type aircraft, by now jet-propelled instead of propeller, that were being proposed, and then prototypes built and tested, and then the Air Force or the Navy would, based on results, decide which one to buy. Among them was the 102, [Convair] F-102 [Delta Dagger]. It was a delta-wing airplane. I worked on that between the X-4 and Project 1226, that you referred to. That's when I was first introduced to Whitcomb, because, you see, the area rule was first applied on a Navy plane, which I did not work on, and also the 102, which I did work on. I think I had about five publications on the 102, I believe, and it was a great privilege to be involved with the area rule, which is, of course, [Whitcomb's] first major invention that I'm aware of.

JOHNSON: And you met him. Did he come out here?

SALTZMAN: He'd come out once in a while, yes. A chain-smoking, intense person. Extremely intense. Sometimes there could be all kinds of conversations going around him and he was so intense and concentrated in his thinking that he could filter it all out. Amazing man. [He was the epitome of innovation.]

JOHNSON: And it was an interesting time in the country, in trying to get ahead. You mentioned Scott Crossfield, and of course the other pilots. He was helping you with stability and control, but how closely did you normally work with those test pilots?

SALTZMAN: Not as close as the other specialists. For example, the specialists that were controls people or stability people or handling qualities people. All of those things involve the pilot closely, [because of flight safety issues] and what I measured, by and large, was something that

the pilot wasn't really thinking about that much, unless they needed predictions for how high they might be able to go or what the range might be, something like that, then I might be involved. But not involved nearly as much as those that had to do with pilot safety. The job itself, that I did, didn't place me close to pilots, except in the one case about Crossfield, where it was his decision, but socially we had some good friends [among the pilots] anyway simply because they had a bunch of kids and we had a bunch of kids, and we'd get together for stuff. The [John B. "Jack"] McKays were good friends of ours, Jack and Shirley, and their kids were the same age [as ours. Also Stan [Stanley P.] Butchart became a friend, as we were in the same car pool for quite some time.].

Many years later, there were certain projects where I was necessarily closer to pilots, even though it was performance work on the winglets [wingtip devices] to some extent, and [also I worked with pilot] Tom [Thomas C.] McMurtry on the Supercritical Wing. [Years later, after Milt [Milton O.] Thompson retired from piloting and assumed other duties, we became good friends at work, though not in a social sense.]

JOHNSON: You mentioned social gatherings during those early years at NACA. Were there a lot of those types of opportunities that might have been organized by the Center itself that you and your wife and the kids participated in?

SALTZMAN: Yes, that was one of the very desirable things, especially, about the NACA. Walt Williams was very keen, and wise, to try to have an atmosphere that felt like family, and he insisted on that. It was very beneficial. They were good about—well, they had a special activities committee. I think all of the laboratories and stations had activities committees, and

they were very good about arranging a lot of parties [and picnics], and some of [the parties had] very good bands. I can recall—both of you are so young, maybe this name wouldn't mean anything to you. Have you ever heard of Les Brown and His Band of Renown? We had them. We had Tex Beneke, [who took over the Glen Miller band,] and then other bands that were equally [competent] but not as impressive, in terms of the name. They would also arrange bus trips down to the Music Center down below or to the Ahmanson Theater. Very good about that. It was especially beneficial for our children, because anything we could take our kids to, we did. Some of my kids still talk about being introduced to the Music Center.

JOHNSON: So it did make it more of a family atmosphere, where everybody got to benefit from you working there.

In 1957, of course, when Sputnik [Russian Satellite] flew, things started to change in the thinking of the United States, especially. Do you remember that time period, or have any recollections to share about if people were talking about it on site and what the thinking was, or if you had any idea what direction things were going to go to?

SALTZMAN: Of course, even for the general public there was a lot of, I don't know if it's too strong to say concern or not, but initially surprise, perhaps, that the Soviet Union could seemingly creep up on us like that. That was quite impressive, of course, to us, and there was a lot of scrambling around within the organization, which, of course, soon became NASA. Even before we became NASA there began, even at our [facility], which I think was still called a Station, they started bringing in [well-known scientists] to give us lectures, very formal lectures. Some of them were some of the scientists from Germany that were brought over [after World

War II].

Still being young at that time, I recall I was quite thrilled to be lectured to by some of those guys. I think the other guys were equally excited to feel like you were getting the inside best estimates of what the future might hold. Then they would fashion their lectures to be helpful in terms of how do we go about being a contributor in some way, and we were kind of thrashing around [trying to determine] how we were going to contribute. We were almost like teenage kids anticipating the future there, I think.

I recall in my office one summer, for example—this may sound pretentious—I had a summer aide come in. He was a pretty bright young guy, probably not more than two years younger than myself. He was all gung-ho to do something spacey, and so we put him to work designing, on paper, a satellite that you could live in. I still have the paperwork at home. Naturally, that was never used, but the process of him going through that, which is almost like an assignment that you'd get in a college course, to try to design a satellite that would stay up there, be able to maintain a temperature that you could live in, not too hot, not too cold, and that would rotate sufficiently to provide some G forces so you wouldn't be weightless all the time; it was thrilling for him and [of great interest to all of us who kept up with his efforts].

I think that was kind of representative of some of the, I would call it thrashing around trying to find ourselves, until management could give you some purpose. Management could come in and say, "Okay, now it's reasonable for you to start doing something that really will contribute."

That actually started with the X-1. When I talk to anybody that's interested in hearing this, I tell them this. The X-1 was the impetus that got all of this started. [The X-1] definitely determined that there would be an X-15. Jake Drake and his fellow engineer, a fellow named

Bob Carman, [L.] Robert Carman, [soon proposed] the first rocket-powered vehicle that would perform like an X-15. I have drawings of it, maybe you've seen those drawings. Richard [P.] Hallion's book contains a drawing of that. Anyway, that was pointing to the X-15. Jake Drake and Carman submitted it to [NACA] Headquarters [Washington, DC], and Headquarters said, "Well, this is too futuristic." And within about two years, the pressure was on to build something like the X-15, which started out as 1226.

By the way, I was privileged to use a 20-inch slide rule to [do performance] calculations on Project 1226. I thought I was in heaven. It was such a privilege. By 1959, of course, we had the X-15. Before that, however, Jake had wisely foreseen it. It had to be carrying aboard itself a system for reaction controls, because you were going to fly outside of the sensible atmosphere, and he and a couple of the guys that were working really close with him designed the Iron Cross.

The Iron Cross was a [motion] device wherein a pilot could practice using reaction controls, and it was on this crude iron thing out in the hangar where the pilots found out how to develop a subtle technique for using reaction controls and not letting it get out of control. They developed a technique that they called the "bang-bang" technique, "bang-bang" meaning you fired the little miniature rockets in pulses instead of just turning it on [and holding it there for a time. They found that very short pulses were the most effective.]

[This promising technique was eventually] used on the X-15, after [first] trying it out on an F-104, and it was very successful. This is what makes me feel good—I didn't have anything to do with this, by the way, I'm just reporting—it makes me feel good that that Iron Cross and the techniques developed from it have provided [the background] guidance to all of the reaction control work that's ever been done since, on the [Space] Shuttle, on Mercury, Gemini, Apollo, on all of the satellites up there right now, including Hubble [Space Telescope], which require

precise aiming. It started with the Iron Cross. Jake Drake [and his team] deserve credit for that.

JOHNSON: So it was like a simulator that they could sit in, and then do that?

SALTZMAN: Yes. And of course they did that also in conjunction with the applications, I guess you would say, that were associated with a computer that accompanied [the Iron Cross, where] they would see the results of what they were doing on a screen. A friend of mine named Dick [Richard E.] Day was involved with that; another protégé of Jake Drake. Jake Drake had [many] protégés who owe their success to him.

JOHNSON: During that time period, the transition to NASA was beginning. Did you notice any changes in your day-to-day activities once that transition started?

SALTZMAN: It was a very slow thing. There were enough people of the NACA tradition, their training and their habits continued because that's just the way they were; they were of the NACA mold, old-school, I guess you'd say. I'm so thankful that we had management that retained that, and then those of us of the engineering level wanted to retain it, and so it worked well, but very gradually over the years the NASA influence grew.

I'll give you an example. Walt Williams eventually, you already know, went to Langley, then to Houston [Texas, Manned Spacecraft Center, now Johnson Space Center]. [Headquarters chose him] to do that. I admired him a lot. Then we got Paul [F.] Bikle, and Paul Bikle, even though he did not have the NACA experience or background, or anything like that, he was naturally that way. He was a natural. It was as if Paul Bikle was still of NACA type of thinking

and type of managing. [Perhaps it was partly a generational type of thinking – and also perhaps World War II experiences may have been imprinted on many leaders.]

Well, at Headquarters, NASA type of thinking was growing and they needed to keep [the outlying facilities in line with the top-brass way of thinking.] See, I'm biased, but if I was, so was Bikle. It seemed as though Headquarters wanted to have a firm hand on the tiller, so to speak. That's a natural thing, if you aren't thinking like the NACA type folks. I suppose many large corporations would be thinking something like NASA began thinking. In order to have the control and confidence that would go with being able to control wisely, they wanted to have a lot of meetings [at Headquarters]. Bless his heart, Paul Bikle wouldn't [always] go. Once in a while, if reason convinced him, if the [purpose] for the meeting was substantial enough that he thought it was really worthwhile, he would go. Often he would [in effect] simply tell them, "I have better things to do." That would be an example of how the NACA way [and the NASA way sometimes intersected], but you can tell I'm biased.

JOHNSON: I've read that there was more autonomy for the Flight Center here during those early years, and Langley didn't have that luxury because they were so close to Headquarters, and you all were so far away, and Walt Williams was of the management style that he kept you all working on projects and doing things in more autonomy at the Center.

SALTZMAN: [Yes, both Williams, and later Bikle, tended to think], "We know what we're doing, and you judge us by our results."

JOHNSON: During that time, as you called it, people were thrashing about trying to figure out

what to do, was there a lot of people that left to go to some of the other Centers because they wanted to work more in the space realm?

SALTZMAN: It's hard for me to be very certain about the timing of all this, when things happened. We did lose some engineers to industry, primarily because industry was paying more money. We had some very solid engineers that did leave, mostly to industry, but then, when Johnson Space Center was established, naturally it's going to grow, it has to be staffed, and we lost a few to Johnson as well as industry. Some of them came back later. I'm uncertain what percentage came back, but a substantial number did. For myself, I was having so much fun and liked where I lived, that I never even discussed [the possibility of leaving] with my wife.

JOHNSON: And I think the perception was that this area, the work that was being done here was more aircraft, and the other Centers were doing more space, but the work you were doing on the X-15 and the work that was being done on the Lifting Bodies and the Paresev [Paraglider Research Vehicle] and all the different things, they were space-related, because it was reentry and different things that were being studied. I think that people didn't realize that all of that was so space-related too, during that time period.

SALTZMAN: Yes, our Lifting Body work, I guess, began about 1960, '61 or '62. Something like that, I guess. Maybe '61. Of course [R.] Dale Reed, whom you're probably well acquainted with, deserves all kinds of credit for getting us into it [that early]. Now, Langley and Ames [Research Center, Moffett Field, California] both proposed [reentry] configurations, and Dale picked up on that right away. You're already aware, I think, of how he started building a [small

scale] model of the Ames model, [i.e., the M2].

JOHNSON: That was the plywood one?

SALTZMAN: [Well, after demonstrating the small model, the plywood M2-F1 was approved.] It was the Ames [shape]. The Langley one was the HL-10, and he did not build that one. There again, that's the beauty of Paul Bikle's mindset, in that he supported Dale in that and more or less just went ahead with it whether Headquarters [wanted] it or not, and made it work. And of course the pilots loved that too, it gave them something new that no one had ever flown before. Milt Thompson was quick [to support the Lifting Body and—]what did you call it, the Rogallo wing?

JOHNSON: The flying wing? The Paresev?

SALTZMAN: Yes, [the Paresev] and also the Lifting Body.

JOHNSON: Did you work on the Lifting Body project?

SALTZMAN: By then I was supervising engineers [in our branch] that did, so I kept abreast of it, yes. [Outside of our branch I mentored Vic [Victor W.] Horton and Dick [Richard E.] Klein on their M2-F1 lift and drag work.]

JOHNSON: So you moved on into supervisory positions.

SALTZMAN: Sort of. I always denied that I was a supervisor, and it was frustrating to my supervisors, but I kept close to [the Lifting Body data throughout]. And in later publications that I produced, particularly right before I retired, I used all [the subsonic Lifting Body data]. From all of the Lifting Bodies and the X-15 and the Shuttle, it turns out that they combine into a unified package of [all horizontal landing] entry vehicles, and consequently I was reintroduced to all of the Lifting Body work and interpreted [those results, the X-15 data and the Shuttle data as a unified generic family because they all have large blunt base surfaces].

JOHNSON: Was it in the early ’70s, I was reading about your work on the bow waves on trucks and how that came about. Do you want to talk about that for a minute? Because that’s so different, but how that’s related to airplanes and aerodynamics and that sort of thing. If you want to just talk about how that idea came to you and what brought that about.

SALTZMAN: Sure. Have you been exposed to [Christian] Gelzer’s work?

JOHNSON: Yes, the book [*Fairing Well: From Shoebox to Bat Truck and Beyond – Aerodynamic Truck Research at NASA Dryden Flight Research Center*]. I was looking through that.

SALTZMAN: You already know quite a bit, then, how I [was moved to investigate the aerodynamics of trucks because of how their bow wave pressure pushed me, on my bicycle, when they passed by]. That was [during] the so-called oil crisis of, what was it, ’72 or ’73? Oh, man, that was enjoyable. Talk about low-hanging fruit. That was it. My friend Vic Horton and

I, whom would be better known by his work on the Blackbirds and also as an engineer aboard the Shuttle Carrier [Aircraft], that's where he earned his bread and butter. He and I were very good friends, and he let me borrow his pickup to do the first experimental work that I thought would justify going into the [Center] Director's office and saying, "Hey, we have an idea."

So we did a base drag experiment on his pickup [and camper combination]. I think we showed that when we drove his pickup down the highway at 65 miles an hour, it was taking [about 14] horsepower to have the back end of his truck [with camper] chopped off so [bluntly]. Since trucks and buses and motorhomes [also have blunt bases], that means a very high percentage of people and stuff carriers on the road have that same problem, and that means that an awful lot of horsepower, [hence fuel,] is being used every day because of the way they're shaped. So we used the data from his pickup[-camper] truck to put together a little two- or three-page pitch on why we thought we ought to be investing [effort and time] into how we could make a contribution on highway vehicle [efficiency].

The thrust of our pitch was, it could be done so cheap that it's ridiculous. And they [agreed with] us. It was an easy sell. As I said earlier, it was low-hanging fruit, and we just picked it up and ran with it. I'm so thankful that every Director we had after that concurred [and provided support]. They would ask questions, they would say, "Are you sure a flight research center should be involved in this?" It was an easy sell, [because the data from Vic's pickup was convincing and the political environment was friendly]. So we never had a single Director, and I think I could name four or five Directors that concurred in succession, didn't have a single Director that turned us down. Consequently, we published 22 [documents related to] truck drag.

A Professor [Vincent U.] Muirhead from the University of Kansas was employed to do some wind tunnel work for us. Also had a professor from Cal Poly [California Polytechnic State

University, San Luis Obispo, California] to do one series of tests, and then Muirhead must have done six or seven. I talked to Muirhead recently, because I wanted to inform him of how wildly successful [his side-skirt experiment was in providing fuel savings for 18-wheeler tractor-trailer rigs for the nation]. I was sure he didn't know [about this and wanted him to be clued-in].

If you see these semi-trailers going down the highway with a panel underneath the truck—I'm talking about the trailers that look like a van, not a flatbed or a tanker, but the van type—underneath the bottom of the trailer, you'll see a [long] panel [on each side] between the tractor rear wheels and the trailer's wheels. That was proposed and published by Muirhead and myself as something that he, in his wind tunnel tests, did for us. We proposed that. It's been picked up—it took about 25 years, I think, for manufacturers to pick it up, [but it's being used now].

I have a pretty good idea of what percentage of trucks have [the side-skirts] because I took a survey last March, when my son and I were in Arizona and then we drove home. It was over 900 trucks that I spotted and kept tally of; 43 percent of the trucks had [side-skirts] last March. There ought to be more now, because a smart trucker will want to take advantage of it. But based on the 43 percent and fuel prices and how many trucks there are that would be candidates for it, and how many miles trucks drive each year and all that, those [side-skirts], manufactured by 8 or 10 or 12 different companies, some better, some worse—the savings per day in this country should be a little over $1 million, every day.

I was so anxious to tell Muirhead about [this]. Today he's happy and satisfied and content to get his retirement checks, and I'm happy and content to get my annuity checks. We're not getting any of that million dollars, but [we both feel rewarded] to know that the economy is benefiting $1 million a day. And it'll get bigger as more trucks utilize this. Of course, if the

price of fuel goes down, [the savings will be less].

[It was an honor to inform Professor Muirhead of the sweet success which came from his wind-tunnel model experiments. He is a 95 year old Pearl Harbor survivor, and 1941 graduate of the United States Naval Academy [Annapolis, Maryland], Navy fighter pilot, and later, instructor/Professor of aerodynamics at the University of Kansas. At the University he became a world renowned leader in the understanding of tornadoes, the simulation of tornadoes, and designing buildings to reduce damage. He also designed the world's largest shock-tube facility. We were fortunate to have him as a member of our team.]

JOHNSON: When you were coming up with the idea to work on the trucks, is that part of what you said, that you tried to emulate Richard Whitcomb, the way he thought about things, and you just thought about it differently and could see the way it would work.

SALTZMAN: Yes. You try to visualize where those molecules are going to go, and it's such a simple thing [and often quite helpful]. It sometimes prevents you from overlooking something.

JOHNSON: And during that time period in the '70s, too, when you were doing that work, there were other things happening, and there was talk about even closing the Center at some point when the X-15 was over with, and because of the way things were until other work came along. Then the Shuttle changed a lot of the focus, the public perception of what work was being done out here, and being a place for the Approach and Landing Tests [ALT] and then the landings. Do you want to talk about what you were doing during that time? Were you working on or overseeing any engineers working on the Shuttle work, anything with the Shuttle or the ALT

landings?

SALTZMAN: Here again, if you're doing lift and drag work, you're sort of on the periphery, in a way, but [eventually] I used the ALT lift and drag data in several publications [that I mentioned earlier, i.e., publications which demonstrated how all blunt-based reentry vehicles (for horizontal landing) belong to a generic family, and how the base flow characteristics obey unifying equations at subsonic speeds. The Shuttle data were a part of this, and it's interesting that the base flow characteristics of large trucks also belong to this generic family.

So, I believe it is clear that my work did not contribute to the Shuttle; however, I borrowed from the Shuttle by the use of its lift and drag data to formulate the unifying concept, mentioned earlier, which will be useful for reentry designers in the future. I feel fortunate to have tasted that small portion of Shuttle flight results. By the way, have I mentioned that earlier we worked on the XB-70?]

JOHNSON: You worked on the B-70?

SALTZMAN: Yes. And then, much later, the [Grumman] X-29.

JOHNSON: Did you work on LLRV [Lunar Landing Research Vehicle?

SALTZMAN: No. That was a very innovative thing, too, that came from the minds of Jake and Gene [J.] Matranga and Donald [R.] Bellman. Donald Bellman was my immediate supervisor. Great guy, great guy. He let [his team] do most anything we wanted to [as long as we completed

the assigned duties, he encouraged playful/thoughtful innovation!] As long as we didn't embarrass him, he turned us loose [to explore possibilities].

JOHNSON: Did you remember the first ALT landing, after it separated? That first time, were you out there watching that?

SALTZMAN: Yes.

JOHNSON: With everybody else? All the other thousands of people?

SALTZMAN: Of course. And by the way, our home in the desert, I told you about the place we bought for $10,000 over the phone, we could see the landings from home. That's why I rode my bike to work. See, it was so close. It was only 8 ½ miles by road. If you went, as they say, as the crow flies, it was less than half that, maybe 3 miles. So you could see it very well. [So I could view the landings from work and my wife could see it from our front yard.]

JOHNSON: That was a treat, every time they landed. And it was an interesting time, because all of a sudden you had so much media attention that you weren't used to. People at Johnson or at Kennedy [Space Center, Florida] were used to that kind of attention, but you didn't normally get that out here.

SALTZMAN: Yes, that's what we were told.

JOHNSON: You mentioned the pilots that you were friends with, but during that time, being test pilots, it was pretty dangerous work, and of course there were a lot of accidents and pilots were lost. How did that affect the work that was being done here or the feeling about the work, the danger?

SALTZMAN: Naturally, my answer will be sort of personal, because we all invest our emotions in a little different way in various things, so I don't pretend to speak for other people. Although I would have to allow that their reactions may have been similar. You're very aware that bad things happen, and you don't lose sight of that. Probably one of the most emotional ones for me was the X-15 casualty we had, because I had equipment on board the airplane that was involved in complicating the task for the pilot, and other people did, too, because I was not the only person involved with it. There were operations engineers that decided the installation details of the equipment, and there were data systems specialists that did the wiring and all of the details of the electronics that were not my specialty, but I needed their help. However, I had responsibility for the thing even existing, and I was really emotionally wrapped up in that, and so were [those] other people. That's just one example that ended up very tragically; loss of an airplane, but more importantly, loss of a man's life, and the impact it had on his wife and children. There were other losses, too.

I arrived after [Howard C.] Lilly's accident that was early on in the NACA days out there. Let's see, we did lose some other guys, though. We lost a pilot, what was his name? He was flying on a weekend, recreationally, a sailplane, and got killed. That was entirely different. No one was thinking ahead of time that something dangerous could be involved. Lost his life on a weekend. And then a pilot named [Richard E. "Dick"] Gray died, [but that was a congenital

heart problem. The inflight collision of the F-104 and the XB-70 was a terrible thing. NASA pilot Joe [Joseph A.] Walker and Air Force pilot Major Carl [S.] Cross were killed, and the accident badly injured North American test pilot Al [Alvin S.] White.]

My boss, Don Bellman, was so gifted and such a broad-shouldered engineer that he was involved in virtually every accident [investigation] as a consultant, sometimes chairman of the investigative board. Don Bellman, top-notch. He's no longer with us.

JOHNSON: You mentioned you did some work on the XB-70?

SALTZMAN: Yes. [Dave [David F.] Fisher and I did skin friction and] boundary layer work, and also [Sheryll A. Goecke, Chris Pembo, and I did] base drag work. The B-70 had a huge base. It had a large amount of transonic base drag. Consequently it used a lot of fuel just getting through the transonic region.

We found that it had more transonic base drag than was predicted in the wind tunnel, and less [base drag] at the cruise speed than the wind tunnel predicted. A significant part of our responsibility was to try to establish how well the wind tunnel [people] did their job.

JOHNSON: So what they came up with, and then when you actually flew the vehicle, then you compared how well they were doing? Would they recalibrate or redo things in the wind tunnel to match what they found exactly?

SALTZMAN: [All flight data exposing differences between the real vehicle results and the model data were published. As a result, over the years, the wind tunnel and model experts came up

with numerous improvements and thus, later, their efforts provided more reliable data from the models.]

JOHNSON: During your time there, things changed a lot, because you were there for 51 years. And technology changed quite a bit over that time period, from those early computers, who were women reducing data, to modern-day computers. Do you want to just talk about that for a minute and how that affected the work you were doing?

SALTZMAN: The main way it affected me on the aircraft work was that I would be involved [les in processing] the raw data that came to me, as the large computers that occupied part of a room [came into use—what were they called?]

JOHNSON: Mainframes?

SALTZMAN: Yes. They took over the actual calculation of the results, and I would get the results on big printout sheets. I wouldn't really be involved significantly until they gave me the printout sheets, and then I simply ran and used them, [after careful checks to assure] that they were reliable. Whereas, if you went back to things from the X-1 up to the early X-15, the earliest X-15 still used the old kind of recorders. The engineer himself, or herself, were more involved then because you'd read up your own tare corrections and apply them, and you'd examine the raw data in detail before you let it get into the calculation process.

Now, when we did our truck work, incidentally, one of the things we were able to do to grease the skids was to simply do our own calculating with our own little [hand-held calculators].

Then no one could tell us that we were holding [up the higher priority projects]. And we loved that [because it gave us independence]. It was so easy to do on your own little handheld calculator that it was a breeze. Sometimes I'd just take all the [raw] stuff that's printed out on paperwork, take it home, and do it on the kitchen table at night, and bring it back the next day, and it was done. [The other people doing truck work operated the same way.]

Something I probably should mention is that it might sound like we spent a lot of time working on the trucks, and actually we didn't. When it comes to bang for the buck, it was probably the most ridiculously fruitful effort we ever did. I know that, if you added up all of the weeks or days, hours, whatever, in my career, that the truck work would be 2 or 3 percent. Everything else was aircraft. But when it comes to the number of publications, then the truck work would appear to be [bigger than it was].

JOHNSON: And going from using those 20-inch slide rules to little handheld calculators to do that, that's pretty interesting too.

SALTZMAN: What a joy.

JOHNSON: Made your life a little easier.

SALTZMAN: I used to have pretty good eyesight back when we did the 20-inch slide rules, and as the years mounted—see, I worked till I was 76, and long before that my eyes couldn't handle a slide rule anymore. So the handheld calculators saved the day in that regard.

I have an aside here, which is just for your own chuckle, about the first time I went on a

vacation, or I should say our family went on a vacation, after the trip out here that I told you about. Well, it would have been the second October after arriving out here that we took a vacation home to Iowa. We wanted to go late enough in the season that the farmers would have their harvesting pretty well under way, so we'd get a chance to visit with more of them and all of that. We didn't want to go during the bitter cold, because of ice and snow on the roads; that's why we chose October. Our children, of course, weren't [of school age].

So we get back there, my grandfather—such a character, had a huge impact on my life, just huge—he wanted to know what I was doing out there. "Well, Grandpa, working on airplanes."

"Yeah? What are you doing on airplanes?"

So I briefly summarized, "Well, I work for an organization that's called the NACA," and then I articulated what NACA stood for.

"What do you do?" He was very direct.

"Well, we do experimental work on airplanes, try to improve them, see how efficient they are or how inefficient they are, how safe they are or how unsafe they are. Try to make them travel farther and more comfortable and safer and all of that, Grandpa."

He says, "Hah. Sounds like a fly-by-night outfit to me."

JOHNSON: He was a little suspect, huh?

SALTZMAN: He was a kick in the pants.

JOHNSON: I think it's interesting that your father insisted that you go to college, even though

you'd had this long line of farmers in your heritage. Did you ever ask him why? Or do you know why he was so insistent?

SALTZMAN: Oh, I knew why. He wanted to be an engineer.

JOHNSON: So he wanted you to have that.

SALTZMAN: He was a smart cookie. When I was a little kid, that would be like five, six years old, something like that, I remember he was working on what today we would call an inline skate. He was trying to invent an inline skate. I recall seeing the drawings of it. His skate—after all, he was just a farmer—but his skate didn't have a whole row of [many] wheels, it had two wheels, and they were bigger, perhaps two and a half inches in diameter. The drawings, to me, looked quite detailed, but he didn't know how to [approach the process of applying for a patent, and] didn't have the money to get an attorney to help him with the patent, so he had to finally drop it. After all, he was busy being a farmer. [Dad's older brother,] Uncle Elmer, had an invention patented while he was still 18 years old, a Mennonite farm kid. It was an improvement on a grain wagon design. I have a copy of that patent at home.

JOHNSON: You had engineering in your blood.

SALTZMAN: I don't know, [perhaps so?] Dad didn't get to go to engineering school. I think he enrolled and couldn't even attend, because his dad, my [other] grandfather called Dad home after he had gone to Iowa City, [not long after enrolling at the University, and said,] "Edwin, you got

to come home and help me." So Dad did. That's back when you did what your dad told you to.

JOHNSON: Just like you went to school because he told you to.

SALTZMAN: Yes.

JOHNSON: Well, looking back over your time with the NACA and with NASA, also, is there anything that you'd point out that you're most proud of, or something that you consider your best achievement?

SALTZMAN: One of the things would be the work on the X-29. There would be three things: X-15, X-29, and the truck work. The X-29 was hailed as a very innovative change of configuration. You already know, I think, that it had forward swept wings. There were very smart people, a lot smarter than me, came up with the idea, studied it theoretically, postulated based on sound theory, actually, that it would have less subsonic drag, less transonic drag, less supersonic drag than aft swept wings, and that the shock strength would be such that the shocks would be much weaker than for aft swept wings, and consequently the transonic drag would be significantly less. Sad to say, that wasn't true. I had to buck the tide, so to speak, to get that uncovered. So I feel like that was an accomplishment in terms of uncovering the truth, so to speak. So I feel good about that.

On the X-15, the drag work was very satisfying, [analyzed the lift and drag from subsonic speeds to Mach 6!] Anybody could've done it, but it was just so much fun. It wasn't that difficult, but it was a ride. I was associated with a thing that was so much bigger than me.

Everybody [working on the X-15] felt that way.

The truck work was immensely satisfying because of how it has been received. It's been received in a grand way. It's very, very satisfying. I think you can imagine how that'd be.

There's one other thing, goes back to Dick Whitcomb, and there's two of us guys that were so fortunate. Larry [Lawrence C.] Montoya, who worked with me in my branch, was involved with the flight verification of the supercritical wing, Whitcomb's invention, the winglets, which is Whitcomb's invention, and the truck work, which we generated ourselves. All three being efficiency type things that give you a good feeling. Then in addition, I was involved with those same things, but also I was involved with [Whitcomb's] area rule in addition. To be involved with those major efficiency type things, it's nice.

JOHNSON: Makes you feel like you really made a contribution.

SALTZMAN: I think Larry Montoya would agree with me that we were just at the right place at the right time. We were smart enough to grab it and hang on, but others could do the same thing. It was an extremely fortunate thing for us. [The way so many things fell into place and so many doors were opened was amazing, and not just luck. I believe God was behind all of it!]

JOHNSON: I want to ask Rebecca if she has any questions, if you don't mind.

WRIGHT: I just have one. Were there some ideas that you had that you never got to put forward? Something you had hoped to bring to the table?

SALTZMAN: There's some things I wanted to do that I ran out of time on. I was so captivated by this efficiency, or lift/drag work, or whatever you want to call it, on each of the airplanes that I worked on, and there were quite a few. I worked on a total of 27 airplanes, I think, but it was only a part of those that were actually lift and drag. We did other things on other airplanes that were related to lift and drag but we didn't publish, just added to our experience. A goal of mine was to create a compilation of about 30 airplanes, which would include many that I did not work on, but I could include the results of those other airplanes, [which were published by other aerodynamicists,] in my compilation. It would be a matter of getting the publications of other authors and including them with mine, and then having a grand unifying type compilation. I didn't get to do that. Also, I was disappointed that our idea for a livestock hauling truck never grabbed hold, was never picked up by a manufacturer. Were you aware of that?

JOHNSON: I was looking through that book, and I think I did read some about it. You mentioned it took 25 years for them to start putting those side curtains on there.

SALTZMAN: [Yes, but] it took much less to get the front end of the trucks nicely rounded. We published our first big truck with the nice rounded front in '77, and I think Peterbilt and Kenworth and Freightliner and Volvo and International began making nicely rounded front ends about 1981 or '82, so that was more like four, five years. That was fairly quick, but that was so obvious, and the reason they would've done it is because they look for new designs anyway every so often, perhaps every 5 years. [I suspect it was the oil crisis plus common sense that caused the truck builders to make the "front end" change.] These side skirts are add-ons, after manufacture type thing, [and that idea was picked up by smaller manufacturers. For them it

would seem like quite a risk to gear up for production. In addition, I suspect these small concerns spent a long time coming up with a design and then testing it.].

JOHNSON: Is there anything that we haven't talked about that you'd like to mention before we go for the day?

SALTZMAN: I've probably talked too much already.

JOHNSON: No, it's all good information.

SALTZMAN: That's probably about it, I guess. I've had so much fun. You can tell that, can't you?

JOHNSON: Yes, I think we can. We can tell you really enjoyed your career.

SALTZMAN: I was so blessed for so many years. I wouldn't change a thing.

JOHNSON: Sounds like it was a wonderful career.

SALTZMAN: Oh, it was. For a person of modest capabilities, nothing outstanding, [and then to] have so much fun, so many opportunities appear that I could grab, and then receive recognition for it, how can you beat that? And get to work with such wonderful folks. [I am so very content and pleased by all of it.]

JOHNSON: Well, we appreciate you driving all this way, again, and talking to us. Thank you for sharing your history with us.

[End of interview]