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SOLOMON WEISS
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is June 6, 2014. This oral history session is being conducted with Solomon Weiss at his home in Cleveland, Ohio as part of the NACA [National Advisory Committee for Aeronautics] Oral History Project, sponsored by the NASA Headquarters History Office. Interviewer is Rebecca Wright, assisted by Sandra Johnson. Thank you for letting us in your home. We'd like for you to start today by telling us how you became involved.

WEISS: I studied aeronautical engineering at Polytechnic Institute of Brooklyn—that's New York [University Polytechnic School of Engineering]—and the head of the department gave them my name. They were beginning to hire people, so they contacted me in a place up in the Catskills [Catskill Mountains, New York], where my folks had a place and I was helping them run it for the summer. Vic [Victor] Gordon—he became budget officer, but he was personnel. He hired me on the phone. The reason I took the job, they offered me $300 more than anybody else.

WRIGHT: That's a good reason. This is in 1948?

WEISS: Yes. The reason for that was that they were interested in my piloting experience. They put me in flight tests. First, they had me geared to run the new 8 by 6 [Foot] Tunnel because I ran the wind tunnel at the school as part of a job. They thought I'd fit right in, but by that time

we were into supersonic flow, and it was entirely different. Rather than waste, you might say, my experience, they put me in flight research, and I spent several years there. That's where I was involved in the program to crash airplanes, to determine why they burn, how they burn, what you can do about eliminating the ignition sources of the airplane.

WRIGHT: Can you share with us how that project was first started, and then how you determined the results that came from it?

WEISS: I don't know how it started, really. When I came on board it was already in place. A fellow by the name of Pinkel—Irv [Irving] Pinkel—was the head of that program. He was really the main man. He okayed everything we did. That's about all I can tell you. I got involved first in establishing a bibliography of various fuels being used in aircraft, and various ignition sources that we could readily recognize. For example, hot parts of an engine, things of that nature. We built an airport at Ravenna, Ohio. It's an ammunition dump. We took part of it over and built a runway about 1,700 feet long. We put a rail down the center of that runway, and we attached the slipper to the airplane to guide the airplane into a barrier.

One of my jobs was to create different kinds of barriers than an airplane might experience when it crashed. I worked with a fellow who was a civil engineer, and as we talked he would draw the thing up. Now he's gone. He was a Russian, although he had a Jewish name. His name was [Edmund G.] Rosenberg. I don't know if you knew him, but he was Russian. I think he was part of the elite, so when the [Russian] Revolution [1917] came he had to get out of there. That's how I met him.

I was one of the people that reduced the data and drew various conclusions and spoke to the people that wrote the report, and also invented a system to eliminate ignition sources from the engine and from electrostatic charges. For example, one airplane we crashed, the landing gear came off. It tumbled in dirt, it built up a charge, and when it hit the ground it discharged a big plume of electricity. It allowed the fuel that was spilling to catch fire.

That's what I mean by electrical sources, but most of it was due to the exhaust system of engines. This guy, Scottie [Scott H.] Simpkinson, invented a vapor detector. He invented the vapor detector that would tell us where in the engine was there fuel vapor that could catch fire, where there was a combustible mixture. He also invented sort of a thermocouple bridge that could trace where the flames started. That way we determined where the ignition sources were. There must have been about three or four of us that went to the crash site the day after the crash, and we plotted where pieces of the airplane were, where the fuel spilled. That was my first job as an experimenter, to determine are there any things like fireproof paints—is there some way you can control the fuel so that it doesn't become like a fog, which makes it easy to ignite?

There was a guy by the name of John [P.] Campbell, he was one of the fellows in that group. The fellow who was leading it was a guy by the name of Dugald [O.] Black. A fellow by the name of [G.] Merritt Preston was the Branch Chief, and he ran the program. I'll never forget this one time I almost blew up an engine. I was in charge of the jet phase of this thing, and I couldn't get a jet engine. I had difficulty. I finally got one, but in testing it I almost blew it up. I was in my office about eight or nine o'clock at night, trying to figure out why. My boss came by, Preston, and he said, "I understand you're upset because you almost blew up an engine."

I said, "Yes."

He said, “I understand you’re also upset because you didn’t get your money on your promotion.” He said I would get it as soon as money becomes available.

I said, “Yes, what happened to that?”

He said, “I just had a meeting with the big shots. You’re number one in the field. If any money comes in, you’re the first one to get it.”

I said, “Oh, baloney.”

He said, “Sol, we’re doing the best we can.”

I said, “Well the best you’re doing isn’t good enough.” That’s another place where smart-aleck Weiss got involved. But he [Preston] was a great guy.

The guy who was my immediate boss was a guy by the name of Gerard [J.] Pesman. He was a professor at the University of Montana [Missoula]. One of my jobs was to determine, in a crash fire, do the passengers burn to death or do they become asphyxiated because of various fumes that come off? So I had to rig up a system of sampling the air in the cabin and the pilot’s compartment, which I did do.

There’s only one thing—I went through aeronautical engineering, and the only electrical course I took was a 12-volt course in DC [direct current] electricity. Because that’s all they taught you. That’s all an airplane had, a 12-volt battery. I’m trying to design a timer to open and close valves to capture various atmospheres, and I was having trouble. I used books that had inventions and what have you, and I spent a lot of time in the library. I think I spent about three weeks trying to design something, and the design was so complicated.

I really didn’t understand it, but I had different planes of onion-skin [lightweight translucent] paper that would lay on top of the other. One day, this guy Pesman comes to me, “How you making out, Sol?”

I said, “Everything’s been tested. I got all sorts of cylinders to capture gas, and we can take so many samples,” and what have you. I rigged up within the laboratory to analyze the gas, to see what’s in it. I said, “The only problem I have is I’m trying to design a timer to open and close valves.” He looks at it, and I’m trying to explain how this thing works, and he knows I don’t know what I’m talking about.

He was a great guy. I hadn’t been there very long, and he said, “We have an instrument research group that could probably help you.” He arranged for a meeting between me and one of the research guys, and the guy says, “I think I can help you, Sol.” I came back to my office, went back to work on what I was doing, and about two days later he calls me, he says, “I think I have what you need.” I got to his office, and he built me two timers within those two days. He had microswitches. I don’t know about microswitches. I didn’t know anything, but I learned an awful lot from him and he helped me an awful lot.

That turned out pretty good, really. There is a film about the crash fire [program]. In fact, I think I have a copy of a VHS [Video Home System] tape. If you want it, I’d look for it.

WRIGHT: Maybe we’ll see when we get through. We can do that.

WEISS: You can probably get one at the lab [laboratory]. Irv Pinkel, Merritt Preston, Dugald Black—they were recognized for the system that they built up to inert the engine and avoid ignition sources for reciprocating engines.

Getting in a jet engine was kind of interesting to me. I attended a meeting of a NASA committee on aircraft operating problems. In fact I was a member of that committee, and I gave a talk about oxygen, I recall. One of the airline operators—I think it was United [Airlines]—said

to Irv Pinkel, who was the head of the program, "What are you guys doing about jets? We're going into jets and you guys are still working with reciprocating engines."

Irv Pinkel says, "No, we're working with jets. Sol Weiss is the project manager." All of a sudden, I became a project manager, and I didn't know anything. I never even saw a jet engine.

A big problem I had—I couldn't get an engine. I tried to get the Air Force to give me one, but they wanted $400,000. I didn't have a dime. Normally when I start a program I get all the mechanics involved and we talk about the program, we talk about what we're going to do, what we think the data might mean, and what will we do if the data shows such-and-such? If they make suggestions and I couldn't put holes in it, we would do it. We would do the experiment.

They were involved. I went to them and I said, "Hey, we got to cancel that program because I don't have an engine, we need an engine to start with."

They said, "When do you want the engine?"

I said, "I'd like to have it yesterday."

They said, "We'll have it for you in three days."

"Where the hell are you going to get an engine?" They went out to [Building] South 40 [Rocket Engine Test Facility] and got a bunch of old jet engines, and they put one together for me, from various engines.

It's kind of interesting because GE [General Electric Company] had an engine out there that had an experimental compressor, and I used that compressor in my engine. When they came around to take inventory, they saw that compressor there and they said, "How did you get it? It was written off a couple of years ago."

I said, “Hey, that engine has 15 different parts to it.” These guys put an engine together. They had run jet engines so they rigged it up. All I had to do was press a button, and it started the engine going. They were good.

The mechanics here, they make you or break you. They were really good to me. I have nothing but good things to say about them. They were terrific. The best part of it was that they felt so close to the program that they would stay—we couldn’t pay anyone overtime, and we couldn’t even give them comp [compensatory] time anymore. We told them, “Look, we’re not going to run tomorrow. Take the day off, but don’t get killed.” We would keep two sets of books. They were that good. They were really terrific. They would donate their time.

As I say, they really made you. So much so—this guy Pinkel became our division chief. We worked in a place called the B Building. It was a metal building out near the runway. What happened is George [W.] Lewis [Jr.]—the guy whose father’s name is on the lab [Lewis Research Center]—he went to Pinkel. He said, “Hey, this guy Sol got all the mechanics tied up, and I can’t get a mechanic.”

Pinkel called me and he said, “What’s this I understand, you bribed the guys by buying them coffee?”

I said, “Look, when a guy is busy and I’m not doing anything, if he needs a part I’ll go get it, rather than take him off the job.” The cafeteria was across the street from the equipment building, so I would pick up coffee and bring it back. If they went for something, they would bring me coffee.

Pinkel said, “Get the hell out of here.”

After that, I got the foreman of the mechanics—the guy’s name was [Beverly G.] Gulick—I said, “Put somebody on George’s stuff. Don’t give me all the guys. If you can’t give

me more guys tell me so, because we have to share all these guys." It worked out after that, but that was kind of interesting.

The thing that really made me feel great is that we were like one big family. Like the fellow who built me those timers. I'm the guy who got credit for it—it's in a report, I got credit for it—and he didn't care. I said, "Don't you want your name on the report?"

He said, "No, you'll probably do the same thing for somebody else," which was true. We all took turns helping other people. That was the crash fire program. Where do I go from there?

The second thing we took was flying an airplane on liquid hydrogen. We had a [Glenn L. Martin Company] B-57 [Canberra], which was built in Maryland. They were in Baltimore. They built the airplane, and we had one. It's one of these airplanes that can land vertically. We flew that airplane on liquid hydrogen, which meant we had to change the fuel system to operate on liquid hydrogen.

We had to invent various kinds of throttles, which was done by a fellow by the name of [Harold] Gold. In fact, we used to call this the "Gold valve." He invented pressure transducence to measure pressure, and also invented this throttle. The throttle was based upon the flow of jet fuel. We would fuel the airplane with a wingtip tank, which was my responsibility, to use conventional insulation. Liquid hydrogen is at -423 degrees [Fahrenheit]. We would put insulation around a tank, ordinary insulation, and between the tank and the insulation, there's a little space where we would solidify air. It would be like ice between the two. So we came up with something to avoid that because you lose a lot of hydrogen when you do that. In fact, it helped the boom shock because they did something similar—they were a lot more sophisticated than we were. That was part of it.

The hydrogen part was run by a fellow by the name of Paul [M.] Ordin. His wife is here. That's why we're here. My wife and his wife were buddy-buddies, and he was a great boss. He was a charming person. He would come and say, "How can I help you?"

I said, "Paul, what the hell do you know about this stuff?" He really was very knowledgeable. He was a chemical engineer. I knew nothing about chemical engineering, but I was put on this program to handle the flight aspect of this. The flight aspect—we can't fly for at least a year on this thing. At any rate, we did a good job. We designed the system to use liquid hydrogen. Some years later, when there was a fuel shortage, [NASA] Langley [Research Center, Hampton, Virginia] tried to build a liquid hydrogen airplane. It's difficult to design because hydrogen's very light, but it takes up a lot of volume. You might need 12 times the tankage to do the same thing you do with jet—in fact, you do need 12 times the tankage. That was a problem. I had to design a wingtip tank that could hold about 20 minutes of flight at about 30,000 feet.

We did that for the Air Force. What happened, from what we know—the Air Force went on bid to have an outsider do this. The lowest bid they got was a four-year course at something like $4 million or $5 million a year. The fellow who was the liaison officer between NASA and the Air Force was running that project for the Air Force, so he came to us and asked us to do it. We did it in just less than one year. We flew the airplane. We designed things that were useful, but we also realized you don't want to fly with liquid hydrogen. It's not easy.

That started programs here using hydrogen as a fuel for automobile engines. That started there. As I say, Paul Ordin ran that program. First it was run by Abe [Abraham] Silverstein. He was the [Center] Director. I don't know if you knew Abe, but he was like the chairman of this meeting we had. "Okay, what have you done?" A guy by the name of Loren Acker, he's the

guy that chose the material for the liquid hydrogen tank. It had to be a special nickel material, so it's almost custom-made. He got up and he gave a whole talk on why we chose that material, and Abe said, "Don't use that, use this." That's the way he was. If you didn't know your onion, you couldn't argue with him because he really was a very bright guy.

I got in the liquid hydrogen business, and I set up some guy with an experimental set-up where we can look at hydrogen in zero-g [gravity]. I think I built the first zero-g experiment. We got something like $^{3}/_{4}$ of a second of zero-g. Then we flew an airplane, and that gave us zero-g by the way we maneuvered the airplane. I think out of the airplane we got about a second or two. Kept increasing it. I got out of that business because I think by this time, Silverstein went to [NASA Headquarters] Washington [DC], and I was involved with liquid metals.

The liquid metal that I was involved with was potassium. By saying "involved," I had to come up with an electrical system that we could use on the Moon. We used a closed-circuit potassium system, where we used the reactor to boil the potassium to 100 percent vapor, then we used the vapor to drive a turbine, which drove a generator or an alternator. I got involved in that. He gave me a section called the dynamic power section, something like that, so I had a section then. From there, Bruce [T.] Lundin called me in and said he wanted me to organize a nuclear technology group. That's when I had an argument with him.

You might think I'm really a sassy old something-or-other, but Bruce Lundin was our Director then. We split into two sections, development and research. A guy by the name of Dr. [John C.] Evvard was head of research. Bruce Lundin was head of development. I worked in development, did contract work. We got in a contractor. When Lundin called me and asked me to organize this, I said, "I'm one of the few people at the lab that never took a course in nucleonics. I don't know the first thing about nucleonic. Why are you choosing me?"

He flattered the hell out of me. He said, "I know you can get the job done," so I got flattered and I said, "Okay, I'll do it." He said, "You'll have a complete staff that's competent in nucleonics." So I started hiring nuclear engineers. I was working right under him until we get organized, and every time I tried to hire someone he would reject them.

I say, "Bruce, you told me I would have a staff that's competent—I don't know the first thing about these things."

He said, "You know why I can't hire anyone."

I said, "Why?"

He said, "I don't have any slots."

I said, "You knew this when you asked me to take over, and you told me I'll have a complete crew." He disappointed the hell out of me.

I don't think he wanted us to be successful because if we weren't successful, the research guy couldn't be. They had to go through us to get all their work done. We're the only ones that could go out on contract. I was working with a bunch of guys in research, so I said, "I'm going to really play it hard with this guy Lundin." I didn't like that idea, roping me into this thing.

You know how they got me? Do you know Jack [John H.] Enders? He was a pilot here, and I think he got something wrong with his eyesight, so he became a person in Washington. I worked as his consultant. Every time he wanted to go somewhere he would take me along, so I knew what he was doing. When he retired, they got me drunk at Langley. I had to take this job—all these guys from the industry were saying, "Sol, we need you there," because they thought they could get everything out of me. As it was, I got into that game, and we did do a lot of good work with this liquid metal.

Thompson Ramo Wooldridge, TRW [Inc.], they worked with sodium. One of our boys had a contract with them to develop an electrical system using sodium. We went to potassium because potassium doesn't pick up the radiation as much as sodium. I think that's why we did it. I was in that job for quite a while.

What happened here, since I didn't have any nuclear engineers, I went to one of the divisions we had called nuclear systems. It was run by Roy [Leroy V.] Humble. He was division chief. I went to him and I said, "Roy, I'm working with your people. If I don't get the job done, you don't get the job done. Can you lend me some guys part-time?"

He had a lot of nuclear engineers. He said, "How many do you want?"

I said, "It would be nice to have about 20 guys part-time."

He said, "I'll give you 40," and he gave me 40 guys part-time.

It was really good, and I told these guys I had a big travel budget. I said, "Look, I've been a contract position now for a year or two. I want you to go see the contractor at least once a month, regardless of what you think he's doing." I'm going through a bunch of papers one day, and one of these guys in Humble's group had never seen a contractor. It's been in effect for about three or four months. I got him and I asked him, "How come you haven't seen a contractor?"

He said, "Look, Sol, you get the weekly reports."

"Yes, I read them."

"And I'm on the phone every day with my counterpart."

I said, "I still think you ought to go see them," so he went out to California. These guys didn't do a thing that they said they did in their progress reports. They have to go to the California government to get a license to work in a nuclear field. They didn't even do that, but

they said they did. So I told Procurement, "Don't pay them." And I said, "How do I blacklist them?"

He said, "Sol, it'll take five years for you to blacklist them."

When I appointed a technical committee to review the proposals, I said, "If you pick this guy as one of the winners, I won't sign off on it." If they knew that when I was in business, they could put me in jail. That's the way I ran it for a while.

Eventually, some other outfit, a good outfit, took them over. They came to us and said, "Hey, you owe us money. We've been writing you reports and doing something, and we've never gotten paid."

This is a new outfit, and they're good, so I told Procurement, "Give them $1,000," and they were happy with that. It was a low contract, something like $50,000 to $100,000. Today you can't get a contract for less than $1 million, but when we were in the business I don't think you ever had anything over $100,000. We did some good work here. That takes care of the liquid potassium.

The next thing, I know I've told you, I went to Headquarters. I took over the Aircraft Safety Program, and I had something like $7 million to $8 million to spend at about nine different Centers. I was supposed to spend six months there as a volunteer, you might say. As it was, I told them, "I'll take the job if you advertise it, get somebody on board, and I'll spend a month with him to tell him what I'm doing, and he can do whatever he wants." He said, "Okay." We're almost in the ninth month, and they hadn't advertised the job.

I went to my boss—it's kind of interesting because my son met my boss. They were in the same musical instrument club in Colorado. He was a great guy. I thought I did a pretty good job in Washington. I took care of all the things, and I could see what Jack was going through.

When you make out those RTOPs, Research and Technology Operating Plans, everyone exaggerates what they need. I had $100,000 and I wanted to start Langley on it. I told the guy involved, "I got $100,000. You're asking for $300,000. I'll give you the $100,000, and I may be able to get the other couple of hundred thousand for you."

He said, "If I don't get it, I don't start the program."

I said, "Okay, you made things easy for me—I'll split the $100,000 amongst the other people."

He says, "Wait, hold it." He finally came around. He did the job for about $75,000. I worked for Jack Enders, who was the head of this group, and I was always honest with him. That's why I always got what I wanted. I was really very lucky.

WRIGHT: Did Jack work for the government still?

WEISS: He worked for NASA. I worked at Headquarters. He was one of our pilots here. A lot of guys here—for example, Neil [A.] Armstrong was one of our pilots here. In fact, Irv Pinkel hired him and I worked with him. I almost had to bawl him out one time.

I was trying to determine if you crash open a tank in the wing, where does the fuel go? It becomes a spray. As a spray it can move very rapidly, and if it goes to a jet engine, which is always hot, it'll catch fire and spread around the airplane. We designed some system to avoid that. My first inkling was to go to our chemist and find out, could I put a dye in the fuel? He told me the amount of dye you'll need will screw up the engine. I figured I'll do something else, so I went into nucleonics. I got the AEC [Atomic Energy Commission] to provide me with an isotope that had a three-day half-life, so we could get it prepared and use it in the engine. It got

kind of difficult to handle, and the AEC was on our back all the time. They were really very, very concerned about us handling stuff like that.

After about nine months, I wrote up a report of what I did in Washington, and then I quit. I came back and [John F.] McCarthy made a little coffee klatch for me. He was the new Director, and I didn't like him for a couple of things. First of all, I met him at MIT [Massachusetts Institute of Technology, Cambridge]. He was head of nucleonics there. I was working with the aircraft guys at MIT, and I met him and I didn't like his attitude towards a lot of things.

He had a coffee klatch for me, so some of the guys I was able to help. When you're in Washington, you know who has the purse strings. We needed to renovate an icing tunnel. Our Altitude Wind Tunnel was going to be a new icing tunnel. It was going to be the biggest one in the world, and they needed $38 million to get started. I managed to get them $38 million, but we found out later you need more than $38 million, so they never revived that tunnel.

WRIGHT: Can you share with us how you were able to get that funding?

WEISS: I think I spoke to the guy who's head of that subject, and I talked him into it. I had some guys from Lewis come down and give a talk about icing because we were heavily into that. When I got there, everybody worked on icing for a while—even I worked on it, but I did the mathematics. Because I was fresh out of school, I could still do the math. One time when Preston came to me—I'm working at my desk, trying to reduce the data, and he asked me, "What are you doing?"

I said, "I'm reducing my data so I can come to some conclusion."

He said, “Sol, you’re too valuable for that.”

I said, “What are you talking about?”

He said, “We have girls who are mathematicians. They’ll do it for you.” He showed me how to prepare everything for them, so they did all my calculation. I couldn’t do any computation at all after a while. I forgot all my math.

That took care of Washington. I came back, I had this coffee klatch, and after everyone left the Director, McCarthy, said, “Now that you’re back, Sol, don’t make waves.” The waves I was making was I was not enthused about space, and I would gear my money to aviation because I thought a lot of work ought to be done there. And I was being supported by people in Washington. One day Jack called me, said, “When are you going to get started on that program we talked about?”

I said, “Jack, I’m ready to go. All I have to do is see the check. I have to see the money.”

He said, “I sent it down two months ago.”

“You did?” So I start checking. I find the Director used it on some space program. That’s when I gave him hell. I got away with it, but after that session I figured I’m not going to gain anything here, so I retired. When I retired I said, “Just let me use my secretary part-time because I got to write this report for Washington. And also, just get me a direct line to Washington. That’s all I want.”

He says, “We’ll rehire you as a rehired annuitant.”

“I don’t want to be rehired,” and we’re arguing. Finally I said, “Okay, I’ll be rehired,” so they rehired me. When I wrote the report, I knew George Mandel, who was head of publication. He worked in my group for a while. He helped me an awful lot, getting everything done. We

got the report out to about 3,000 people in less than a month, which is unusual. When that happened, I went to Personnel. I said, "I quit."

They say, "You can't quit, you signed on for a year."

I said, "If you guys want to pay me, you can pay me, but I'm not coming in." That was the way that ended.

I retired then, and I did consulting work. That's why I wrote that thing [gesturing]. I don't have a professional license. I do have—in something called System Safety in California, I'm grandfathered in there. It's not really sufficient to go to court with, so in order to be eligible for court, I had to write this thing for the judge. We never went to court, as a matter of fact, but there's a lot of garbage in there.

WRIGHT: It's probably very useful information for us.

WEISS: Maybe you'll find something. It does give sort of a run-down of all the things I was involved in. I'll be happy to entertain any other questions.

WRIGHT: Did you ever have an opportunity to fly the planes, or ride on some of the experiments that you were on?

WEISS: Yes. We flew out of [NASA] Ames [Research Center, Moffett Field, California]. They had a big airplane, and a lot of engineers had an experiment on that airplane. Each one is allocated, like, one hour. I was there—I forget now the reason. There was a professor, I think from Palo Alto [California], on this trip that I was on, and he was counting whales—they go

down to Mexico—so we helped him count. He must have gotten about four times more than there were. Everyone gave him a different number.

Also on that flight, there was some guy trying to test out some way of determining where clear air turbulence existed, because we hit a lot of clear air turbulence and we were not equipped to do that. There were people from all the Centers using that airplane. As I say, each one was allocated an hour. We'd go to Ames and we'd spend a whole day there. I'm trying to think of other things I may have done. That zero-g thing.

WRIGHT: Yes, that's interesting. What time period was that? I guess I could look here.

WEISS: Yes, it might be in there. There's a guy here who was a genius, a guy by the name of [Irving] Brazinsky. He was getting his Ph.D. [Doctor of Philosophy] in chemical engineering. He took over the apparatus that I put together, so he put my name on his report. The reason I found out about it—I was invited to an editorial meeting. I said, "Take my name off, because I didn't make any contribution."

He said, "Yes, you did. You gave me the apparatus."

"Forget about it," I said, "you'll be giving it to other people, too." The next thing I know, I get 10 copies, which an author gets. I call him, I say, "How come my name's still on this thing?"

He says, "Abe told me to leave it on." Can't argue with Abe. He was a damn good Director. He was a very bright guy and a very sensible guy. He ran the Apollo Program. We contributed to the Apollo Program to some extent. We did little things I can't even recall that helped the Apollo Program.

WRIGHT: You mentioned the work that you did with the liquid hydrogen possibly helped with the upper stage.

WEISS: I think it helped the liquid hydrogen stage. Also, I think we helped to prove the trajectory. It may not have been me, but somebody within our lab, because you had to get permission from the president to put anything on that had nuclear stuff on it. The president had to okay it.

WRIGHT: Could you talk about the work that you did that impacted industry? Some of the relationships that you had, or what they were looking for?

WEISS: For example, that work on the inerting system or fire prevention system for a reciprocating engine, that went to Walter Kidde [& Company, Inc.]. They were building hardware to encompass that. We all got credit for it. At that time they didn't give you any awards or anything. We got mentioned in the *Congressional Record* [official record of the U.S. Congress]. By "we," I mean all the people that were on that thing. We had a guy, John Campbell—did you talk to [Erwin V.] Zaretsky? He's been there for a long time. In fact, they had to make a new memorial pin for him.

JOHNSON: Erv Zaretsky, we talked to him.

WRIGHT: Yes, we did.

WEISS: He's been there a long time. He's from Chicago [Illinois]. When he came to Cleveland, we used to have him over for dinner because he was a bachelor at the time.

WRIGHT: You've stayed in Cleveland all these years—you didn't ever want to move?

WEISS: I'll tell you why. When we got here, we were absolutely broke. We didn't have a dime between the two of us. We had people help us, we never even knew them. We met such wonderful people here. We stayed here because the kids are not here, and if you go where the kids are they get transferred, so we decided to stay in Cleveland.

It so happens that my son [Robert Weiss] got a job at the University of Akron [Ohio]. He's head of the Polymer Engineering Department.

MRS. WEISS: There were a couple of times, though, he wanted to leave. He'd tell me he wanted to go back to New York, and asked me if I wanted to go back. I didn't want to go back.

WEISS: Yes, I was very fortunate. I wish I'd gone to California. Ames wanted me to come down there, but I don't know, there really was no future. I was doing work that I really loved.

WRIGHT: You really stayed a lot in the aviation side, didn't you?

WEISS: Yes, I was the only one carrying the program really, except the guys in Washington. They were helping me out quite a bit. They would look to me for the next job. We did a lot of

things. For example, when you come in for a landing, all of a sudden there's an air burst that pushes you down and you might crack up.

Speaking of cracking up, I cracked up three airplanes through World War II, and the last airplane blew up at 24,000 feet. I was very lucky. I lost seven guys in that crew.

WRIGHT: I read you were a commander of a [Boeing] B-17 [Flying Fortress]?

WEISS: No, a [Consolidated] B-24 [Liberator]. I got time in a [B-]17, but they found they made a mistake on my orders. I had been sent to Sebring, Florida [Hendricks Army Airfield] to fly a 17. I got two hours in a 17, which means I soloed, and then they determined there's 60 of us got the wrong orders, so they shipped us up to Smyrna, Tennessee [Sewart Air Force Base] to fly B-24s. I picked up a crew in Salt Lake City [Hill Air Force Base], and we went to Boise, Idaho [Gowen Field]. That's where we got married.

WRIGHT: Wasn't the B-24 a more difficult plane to fly?

WEISS: It was a little more difficult, but not really. It was faster than a 17. It couldn't fly as high, but you wanted to fly high so that the flak [anti-aircraft artillery] won't reach you. By the time I was in it, the flak could go higher than I could. That's about all I can recall.

WRIGHT: Let me ask Sandra if she's got some questions to ask.

JOHNSON: I was just kind of curious, in those early years, you were young and raising a family during that time. The social activities that they provided at Lewis—did you do a lot of that?

WEISS: Yes, we had a group called NicNACA. I was the entertainment committee in that thing. You had no choice in this—you got a memo from Abe Silverstein saying, "You're it," and that was it.

JOHNSON: You don't know why you were picked, you just got picked?

WEISS: He probably had a list of people that weren't doing anything in their spare time, so he picked them. The NicNACA committee, they were really very useful. They would plan other things too, like some sort of celebrations.

When we first flew the [Martin] B-57 [Canberra], hell, we were scared stiff. To make it easy to fly, we got one of these trolley switches—the guy goes from one knob to another on the trolley—and hooked it up so that the pilot just has to go from one notch to another. All the circuitry gets involved that's supposed to be involved. That's another thing that Scottie Simpkinson rigged up.

We took off, and unfortunately it was a slushy day in the wintertime. It was in December. When the ship came back, we only had very little jet fuel left. We're supposed to switch from hydrogen back to jet, and make the landing. The nose wheel didn't come out, so the pilot made a run past the tower. The tower said, "No nose wheel." He couldn't do anything else, so he's going to come in. I was scared stiff because I got that wingtip tank that had hydrogen in it. But on the opposite wingtip, I had another tank filled with helium to purge the hydrogen out

of it. I was pretty sure that there are no ignition sources there, but you never can be sure. We were scared stiff.

As the guy came on this final approach, the nose wheel kept coming down, and it finally locked and he was able to land. We were in our control room, and every one of us, I think, were about ready to cry. Because we worked with the pilots, and Flight Research and Flight Operations were really one branch. We worked together. We were scared stiff that somebody may get hurt and might blow up. As it turned out, the nose wheel came down and locked, so we were very lucky. I remember Paul Ordin breathing a sigh of relief because he was responsible for the whole thing.

WRIGHT: Do you believe more research could have come out of that program if the Air Force hadn't canceled it when it did?

WEISS: I think they were happy with what they got. I think we sort of discouraged them. They wanted it for the [Lockheed] U-2 [Dragon Lady] because hydrogen has three times the heating value of jet fuel, so that means you can fly three times higher or go three times farther. As I mentioned before, you have to redesign the airplane because it can't carry all that fuel. You have to carry the same poundage.

We were very lucky. For example, we were always concerned that we might reach critical temperature before we get out to the runway, and boy, did we luck out. The taxiway was so broken up that it shook up the tank and mixed the tank up. The cold fuel went right back into the liquid, so the pressure went down. We were lucky. But we had cleared everything. We

were a little concerned because one of our pilots went off a taxiway into the mud, and we held up the airport for about an hour while we pulled it out.

They asked us not to do any experiments at the airport. We'd go to a place in Detroit. We'd fly for maybe a half an hour, do our experiments there. There was a naval base, and we'd do our experiments there and then come back. I don't know if you know Cliff Crabb, he was one of our pilots.

WRIGHT: I've heard the name.

WEISS: He was a screwball. He would do anything. I'll tell you about Neil Armstrong—but I'm with Cliff, we're coming back from Michigan, the wind is going like crazy, and we're drifting. The airplane almost had to do this to land [demonstrates], and kick out immediately. I'm sitting in the co-pilot's seat.

WRIGHT: Are you in the B-57?

WEISS: No, this was a Convair [aircraft]. We carried passengers. Cliff was flying, and he straightened out, and I went, "Phew!"

He said, "Why, were you frightened?"

I said, "You're damn right I was frightened—don't you ever do that to me again. We should have gone back and stayed overnight."

He says, "You were frightened? How do you think I felt?"

He was a crazy guy. We went to Jack Enders' retirement party. He has three of his own airplanes, so we used one of his airplanes. We took off and he said, "Okay, Sol, you got it."

I said, "What heading you want me to fly?"

He said, "Just keep going the way you're going. When we get close, I'll tell you what to fly." When we got close to Washington he said, "Okay, now pick up heading such-and-such."

Now when I was flying, there weren't the instruments that they have today. There was an instrument in his airplane—you hit a button, and a point moves to where the station is, tells you how far away you are, and how long it's going to take you to get there. When I was flying, you had to use a loop antenna and it was a big thing to find out where you are. That had changed quite a bit, so we did that with his airplane.

WRIGHT: Did you fly much after the war?

WEISS: Occasionally I'd fly a NASA airplane. I don't know if you knew [Warren J.] North, he was an instructor in a [North American Aviation] T-6 [Texan]?

WRIGHT: Warren North? Yes, I did meet him.

WEISS: I think he was head of instruction. He used to be one of our pilots, and he flew a T-6 as an instructor. There were a couple of times when he said, "Okay, you got it," and he let me do aerobatics, which I couldn't do with a B-24.

I took her [Mrs. Weiss] up one time in an airplane in Elmira, New York. It's primarily a sailplane airport. I got an airplane that I could do aerobatics in, so I took her up. I hadn't done

aerobatics in a year, so I made a lot of mistakes. I keep flying up and redoing it, so I run the hell out of her. When we got down on the ground I figured she would say, "Don't ever take me up again." She said, "When are you going to teach me to fly?"

JOHNSON: It was fun, I imagine. You were going to talk about Neil Armstrong?

WEISS: Yes, Neil Armstrong. We had a program that I told you about, determining where the fuel is. At first we were going to use a dye. The chemist told me, "You're going to have to use too much; the engine won't run," so I gave that up and used nucleonics. That was a little too risky, so I went back to another chemist. He said, "We'll use a tablespoon of dye," and I could color 1,100 gallons of water that way. We did that.

Neil was taxiing down the runway. I put spoilers on the wings so he couldn't fly, and I told him, "Don't try to take off." We're going down the runway, and we're lifting up a little bit. There's a microswitch on each gear, so when it reaches a certain level it allows you to retract the gear. We got to that point, so he says, "Hey, we're going to fly." I said, "Neil, don't you dare try to take off with this thing!"

We built up a special valve to simulate a quick-acting valve, so we immediately lost 1,100 gallons of water. It just took a couple of seconds to do that. It was dyed, and we'd go around and see where the dye is, and get some idea of where the fuel would go. After we did a post-mortem on a crashed airplane, we would walk around. It would be nice to use a Geiger counter [instrument to measure ionizing radiation] because you can get the concentration and the place where the fuel is located. With seeing this thing splash, you had to find it. We had viewing ports all around this crash site.

I don't know if you've ever seen it. I think you ought to take a look at the film.

WRIGHT: We will have to.

JOHNSON: When you were doing the zero-g, you mentioned you went from the facility to flying that on the plane. Did you fly on the plane too, or just the experiment?

WEISS: No, we gave that program over to another group—I'm trying to remember who it was. It was a group that took over zero-g. We had a fuel tower that was about 100 feet. They dropped a package down there, and you'd get zero-g on the way down and the way up, if you hit something and you push it up. I think we got about a second out of that, but it still wasn't enough, so they got an airplane that they could do various maneuvers. They went over a hump and then went down, and they got zero-g for maybe 10 seconds. They got a lot of stuff that way. We got off that program because we were unsuccessful.

I went to [NASA Marshall Space Flight Center in] Huntsville [Alabama]. They needed a drop tower to check out their instrumentation, so they built something about 40 feet high. I said, "I have the money. We could build something 100 feet if you come in with me." All they did was talk German to me. They didn't want to get involved because the 40-foot structure was good enough there. They checked out their electronics on that. It's zero-g, but they couldn't get very much out of it. Maybe you got a half a second.

WRIGHT: There were drop towers at Lewis, did you have them there?

WEISS: At Lewis we had some old fuel towers, and they used that. They were 100-feet deep, so they started to use that to get a little more zero-g, and then later on they did use airplanes. It's kind of funny, being at zero-g. Everything in your body seems to go in every direction. They did a good job on that.

This fellow that wrote that report got my name on it—I could kill him because what did happen was the thing I was afraid of. This guy still knew his math—he's getting his Ph.D., he's a brilliant guy—and a guy from Lockheed [Aircraft Corp.] called me. He said he could get equation one, he could go to equation two, but he can't go any further than that. "Can you help me?" I said, "I'll try." I happened to have Brazinsky's chicken-scratching, so I went through all his notes. I couldn't figure out how he got it.

I worked at home every night. I worked at the lab every weekend till I finally did solve it. Boy, I felt good when I solved it. But I was afraid that I would never get the solution to it. I kept telling him, "When you write a report, we ought to put it in an appendix so people know how you do it." But they don't listen to me.

WRIGHT: When you said that you really didn't want to start being more involved in the space program, was it you personally, or you didn't want the Center to move that way?

WEISS: Me, personally. I had my budget and I could devote it any way I liked. It had to be approved by the Director.

WRIGHT: Did you have a lot of strong feelings about the Center moving into more of the space business, or did you feel like the Center should stay more toward aeronautics?

WEISS: I think we should have stayed in aeronautics. It's because I've been in aeronautics since I was 12 years old. I used to cycle down to a commercial field and I'd clean up oil spills and clean out airplanes just to get a free ride—until my mother found out. She said, "You've got to kill yourself now?" I'm already in the [Army Air Corps] Reserves, waiting for a class to open up.

WRIGHT: What's the first plane ride you took? What was the plane?

WEISS: It was a Piper [J-3] Cub on skis, in Utica, New York. I took one lesson, but I couldn't afford it. It was something like $10 an hour.

WRIGHT: Is that the first one you took a ride on, or is that the first one you flew?

WEISS: No, the first one that I actually piloted. The instructor told me I could take the stick.

WRIGHT: What's the first one you flew on, the first ride you took?

WEISS: I think the Primary Trainer, a PT-17. It was a [Boeing-] Stearman [Model 75 Kaydet]. That had about a 220 horsepower engine, and after that we went into Basic, that's a [Vultee] BT-13 [Valiant]. That was a dog. You know what happened in that airplane? I was going solo. I felt that if I can get out of a spin, I can do anything. I climbed up as high as I could, which may have been about 12,000 or 13,000 feet, and I threw it into a spin. It took me at least three turns

to get out. With the primary trainer, all you had to do is take your feet off the controls and it comes out by itself.

I say, "There's something wrong," so I did it about two or three times. I said, "I better go down and get my instructor to take me up and show me what I'm doing wrong." When I went down, you turned the log over—you make out a solo log—and it says, "Do not spin this airplane until authorized by instructor." The next time somebody spun the airplane was one of my upperclassmen. We had the hazing system. One of my upperclassmen spun in from 5,000 feet, and they found the engine about 3 feet into the ground. I never spun the airplane after that.

WRIGHT: That's a good lesson.

WEISS: I pulled a B-24 out of a spin, lucky—which is kind of interesting. Somebody found me, some guy from Michigan. Apparently my group has an organization, so I went to our first convention, which was in Florida. We happened to be in Florida, so we went.

I did a lot of things that you shouldn't do, but when you were able to do it, you didn't do it. Especially with that BT-13. It was a hard airplane to control. In fact, we lost one instructor one time. He's sitting in the back, lighting up a cigar. He didn't have his safety belt on, and the guy said, "Do a slow roll." The guy did a slow roll and he fell out, but he had a chute [parachute] on.

That's what happened with me, really [during World War II]. I got blown out of an airplane, and fortunately I had the chute behind my seat. It's the kind you snap on. It got shot up, so when I came down, I came down pretty fast. I hurt my legs, as a matter of fact. I came down pretty fast. I figured, look, I'm Jewish, I'm going to take out as many [enemy soldiers] as

I can before they get me. I reached for my .45 [caliber ammunition revolver]—which I couldn't hit the side of a barn with a .45. I go for my .45, which I kept in my shoulder holster, and I didn't have it fortunately. If I had it I probably would have tried to shoot my way out, and I wouldn't be here today.

WRIGHT: It's an amazing time. I'm glad you survived them all.

WEISS: It's kind of crazy. When I got into this group, they told me about things that had happened to people in the group. For example, one guy gave his crew the order to bail out. He bailed out, and he's left-handed. He's looking for the D-ring, to pull the D-ring [to activate the parachute]. He went to his jacket, his flight suit, his underwear, and part of his skin before he realized he's got to use the other hand. They don't teach you how to use the parachute. They give you a sheet of paper, they call it Pilot's Information, and you have to sign a sheet that you read it. It tells you how to use the parachute.

In my case, I started to oscillate back and forth. I was facing the wind, which is no good, because then everything goes over your head and it'll drag you. You're supposed to turn around 180 degrees. They tell you how to do it—you grab the risers like this [demonstrates], and you unhook it, and it turns you 180 degrees. I started to do that, and I just started oscillating, said, "The hell with that, I'll wait till I get on the ground."

WRIGHT: You certainly were able to impact aircraft safety later in your career, weren't you?

WEISS: I don't know if you know Ken [Kenneth E.] Hodge. I worked for him in Washington. Jack Enders works for him. He was head of aircraft safety. I took that over for about nine months, and I used up all my money and left. I had a lot of money. As an NACA guy, never had more than $10,000. I built the most expensive experimental set-up you can find, it cost about $10,000. The reason for that was it was made of special nickel-plated steel, so it was rust-inhibited. We had to build something special. That cost a lot, it cost about $10,000 for that. They're still laughing at me about spending all that money. That was a lot of money, then.

WRIGHT: It was. Did you ever work up at the [NASA] Plum Brook [Reactor Facility, Sandusky, Ohio]?

WEISS: No, I did not. When Plum Brook closed down, I inherited a couple of the guys in my crew. I'm a funny character. I was told that I have to reduce a couple of guys in [pay] grade, most were guys who were coming back from Plum Brook. When they went to Plum Brook, they were reduced in grade, and now I'm supposed to reduce them again? I said I won't do it, so I stalled them for at least six months, until they said they met their quota, so I didn't have to do it. One of the guys was a branch chief at Plum Brook, and I broke him down into a section head when he came back to Cleveland. How could I make him any lower than that? I didn't do it, really. Personnel sent him a letter. I didn't like that.

WRIGHT: What was the most challenging aspect of your job while you were at the Center?

WEISS: I would say living through liquid hydrogen. Liquid hydrogen, all you have to do is look in the wrong direction and it'll ignite. It ignites over a big range of temperatures. I think that was our best contribution in the jet field. We gave them a graph showing them how long hot air resided on various hot components, so you knew how long you want to cool it, to bring it down in temperature. In fact, they had a cut-away engine somewhere that has all the systems on it, but the only one I know that really got involved was Walter Kidde. They make fire extinguishers. They were involved from the beginning because I think they contracted out to the Air Force. Is there anything else I can say?

JOHNSON: I was just thinking about the B program again—do you recall working with the photographers on that? I know they were writing some of those things, too.

WEISS: Yes. We bought them all the equipment. They had movie equipment. We bought Hollywood type of equipment and we had stations all around the crash area with armor plate on it because sometimes a prop would come off and fly 100 feet. We did protect the photographer. The guy who was most vulnerable was the guy who's lined up with the airplane, right at the end of the airplane. He was about 200, 300 feet away from the crash itself.

JOHNSON: That was on the crash fire program?

WEISS: That was in the crash fire program.

JOHNSON: What about the hydrogen program? Did you work with the photographers there?

WEISS: Yes, to an extent. We built timing marks on the airplane so that we could check timing frequently. We put a block every second, or something like that. The thing that was really, for me, a big responsibility because I was a new engineer—I was asked to find out whether the passengers were killed because of toxic gases, or were they burned to death? What I did first of all was I went to the medical library here to determine why do people die? I found the British had a lot of crashes, and the majority of them broke an aorta. You break the aorta, you've got a second or two to live, so we had to be careful to protect the aorta.

JOHNSON: Thank you so much for sharing everything.

WEISS: I'd be happy to share anything I could.

[End of interview]