NASA DISCOVERY 30TH ANNIVERSARY ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

RON SEEDERS
INTERVIEWED BY SANDRA JOHNSON
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JOHNSON: Today is May 25th, 2023. This interview with Ron Seeders is being conducted for the Discovery 30th Anniversary Oral History Project. The interviewer is Sandra Johnson and Mr. Seeders is in Denver, Colorado, and talking to me today over Microsoft Teams. I appreciate you taking time out of your schedule to talk to us for this project. I want to start by briefly talking about your education and your background and how and when you first began working with Lockheed Martin.

SEEDERS: I started out as an auto mechanic back in high school. I took some automotive classes and decided I wanted to be an auto mechanic. My father made me work on all my cars, so I thought it would behoove me to try to do it myself instead of having people do stuff like that. My uncle actually took me for an intro flight when I was 14, and I went for a ride in an airplane with him, and absolutely fell in love with it, and decided well, I think I want to change from being an auto mechanic to a pilot.

Then I started taking flying lessons and got my pilot's license within about three or four months of getting my driver's license, which was very early at that time, and started continuing on, and decided that I wanted to be a pilot.

Back in those days pilots starved to death in the first part of their career. They said, "To make yourself more of a useful wrench, if you will, we want you to go to A&P [Airframe and Power Plant] school," which is a mechanic school for airplanes basically. That way when you fly

out of the country, you will have knowledge if you're being swindled. There was a lot of swindling going on and stuff where somebody would fly their plane down to Mexico for instance, it would land down there, and then the Mexican mechanics would say, "Sorry, your plane can't fly today. It has this problem, it has that problem, and we need to do something to fix it." Like the air in your headlights are not right so we need to change your landing lights out. Weird stuff like that.

The corporation people started catching on to that and saying, "Well, not only do we want to have our pilots certified as pilots. We want to have them certified as mechanics," so that their mechanic, whoever it might be, and it's not just Mexico. Anywhere out of the country who say, "Sir, we have a problem, and you can't go," then they can actually talk technically to you. You could understand the reasoning of yes, there is a problem with the engine, and call back and say, "We really can't go because the engine has a problem." Or we can tell them, "I don't think that's a problem. Let me call back to them and talk to them and say, 'No, these guys are just trying to swindle some money out of this or trying to do something that they don't need to do,'" or something like that. To make you a much more rounded type of a person.

So I went to A&P school, got my certification there, and then started looking for a job in the world. I went out and found a couple different jobs as far as flying goes.

My mom worked with a lady whose husband was named Vern Wooten, and it turns out that Vern Wooten was a very high person in Martin Marietta corporation at that time. What he did was flew software packages down to Cape Canaveral [Florida] to put them into missiles that they would launch for the different test programs. This was pre-[Space] Shuttle and post Apollo. They would make up the software program and then they'd put it in a briefcase and lock it to his arm and send him down there. A lot of it was in preparation of the Shuttle Program going forward. Then he would load it into the thing and they would fly it.

My mom was talking to her and saying, "My son is trying to find a job and he's looking around. It looks like he might have a job but it might be in Kansas."

Mrs. Wooten said "How do you feel about that?"

"Well, okay, but I'd like to kind of keep him closer by."

She says, "Well, why don't you turn in an application at Martin Marietta and see what he does out there? He might be a fit out there."

I talked to my mom. I was like, "Oh, Mom, I like airplanes. Rockets are pointy and they go up. Airplanes, you get to mess with them and they fly."

Mom said, "Just try and put it in, son."

"Okay. I'll put in the application, Mom." Handed it to her, and she turned it in. Of course when you have somebody that's way up in the company like that, it's not like putting the application in through the Acme Employment Office. This guy comes out and puts your application down on one of his underlings' desks and says, "I need you to review this and check it out and see what you think. I have a potential employee."

I go on. I'm just about to accept this job out in Kansas, and I get a phone call from a person that says, "Hi, this is Joy" something, I can't remember her name.

I'm like, "Well, yes."

She says, "I'm with Martin Marietta and we have your application here in front of us."

I was just like, "What? Okay."

She makes me an offer and says, "Want to do this?"

I said, "Well, no, I'm not really interested, I would like to go flying."

She says, "Okay, all right, thanks for your time." We had a little bit of an interview. Thanks for your time, blah blah blah.

Then I went and talked to Mom and said, "Okay, we're going to go do this." Then I flew out to Kansas for an interview out there and came back. This was about another month I'd say later. I was just about ready to pull the trigger on starting with them.

I get a second phone call and the second phone call comes up and says, "Have you talked with Joy?"

I said, "Yes."

He says, "Well, I'm her boss. We've looked at your application and you are really a good fit for what we want. I know she made you an offer but I'd like to make you another offer."

I said, "Well, okay, I'm really close to joining another company right now."

He comes back and says, "Well, we would like to pay you *X* if you would like to join with us."

I said, "That's almost three times more than they were going to pay me in Kansas. Let me think about it. Okay." Because one of the things my mom told me back as a kid, "It doesn't matter who you work for but who you can make the most from." I said, "Well, I guess I like spaceships."

He said, "Come out and we'll interview you, get you through the process and do an interview." Okay, Mom, I got to go have an interview with these people. I showed up out there at the interview and they said, "No, you need to go do a drug test. Pending your drug test you can start on the following Monday."

The drug test was the easiest test in the world to pass. Next thing I know, I'm in on Monday and they are sending me off to classes and doing this and doing that.

First thing I did is start working in the [LGM-118] Peacekeeper program [intercontinental ballistic missile], which Ronald Reagan was a big advocate of back in the day. He said that if

Russia wanted a war, he would basically run them right out of the business. Build them out of business. That's what made them bankrupt, from this.

I started out on that program. They then moved us from there to getting a bunch of background stuff done to go to work behind doors. What we call behind the doors on secret programs. Went to go and work on those and found out that I couldn't talk to my wife about anything to do with work because she's not cleared. The next thing, well, we'll get her cleared. Okay, but we can't get her cleared now because it takes money.

I didn't meet my wife to have secrets from her. Even though it's not secrets between me and you or me and her, it's secret. You come home from work with a bad day and all of a sudden you can't talk about it. I just said, "Really I'm not sure that I wanted to do this." Then they came up with the Magellan Program[1], which was going to Venus, and said, "Well, you might not be too happy with this job but you could do this job." I said, "I'm going to try it."

I started my life out in quality control in Martin Marietta. I then worked through about four, five, six programs, and got in one program called TOS [Transfer Orbit Stage] Program. The TOS Program was launching a Mars Observer[2] from a rocket and then it had an AXAF [Advanced X-ray Astrophysics Facility] satellite which was basically a communication satellite.

The communication satellite was having a lot of technical problems, and I was actually holding them up from doing their job. Holding them up, I mean my job was quality control. If it's right it goes out the door. If it's not right you got to fix it. If something's not right I'm writing documentation against it so that we know what to fix and what's wrong. One of my bosses came

[1] Magellan was the first spacecraft to image the entire surface of Venus and made several discoveries about the planet.
[2] The Mars Observer was based on a commercial Earth-orbiting spacecraft and designed to study and take high-resolution photography of the Martian surface. In 1992, it was to be the United States' first mission to the Red Planet in 17 years.

up to me and said, "We're trying to fly this thing, not put it in the Smithsonian Institute. So I'm going to move you to a different job and lay you off basically."

I said "Oh, okay, if that's what you want."

Then the vice president of test came over and asked the quality manager, "Are you actually getting rid of this guy?"

He says, "Yes, I don't want him, we're going to move him on."

He said, "All right, then I'll take him." That moved me into the world of test. It was kind of funny because at the time I was in quality, I was MRB [Material Review], I was very highly rated as far as knowing the ins and outs of paperwork and what you could do and what you couldn't do.

My vice president in test was Ron Singley. He came up and looked at this guy [quality manager] and said, "You don't know what you just got rid of." He goes, "I'm going to give it to you in an analogy you're going to understand." He said, "You are a drug dealer and you just gave me your head drug dealer. I know now how to get my drugs through, how to get them around, and i.e., what I mean by that is if we have a part that we're working on in engineering that doesn't work, Ron knows whether we can use it as is, whether we can fix it, whether we have to do an engineering analysis to make it, or whether we have to scrap it. So we just run it past him and he'll tell us which avenue we need to do and then we're going to give it to you and tell you what you want to do knowing already what it is that needs to be done."

That quality manager looks at him and said, "Well, okay." Two weeks later he calls me back and says, "Hey, I'd like to bring you back on board."

Ron Singley looks at me, says, "Do you want to go back?"

I said, "No." I want to stay here with you. That started off my test career; that's when I started hands-on stuff. Because a lot of the stuff in quality I was doing, if you can't do it right then, I'll do it, and make sure it's right. I'm a very meticulous watchmaker type person. When I see you're doing something and you're struggling with it, just let me do it. The reason I would do it was because if you do it and you mess it up, now I've got to write paperwork to fix it, got to take it back apart, and then we've got to put it back together. That's not very efficient. Where if I just do it myself and then you sign in and I sign in as being coauthor of doing it, then it's done. He goes, "But that's not your job as quality. You're just right there to watch them do it." It wasn't very efficient, and I had a real struggle with that because I'm a very hands-on kind of a person.

Once I moved into test, it was like okay, I can do this. I can sign it off myself. Quality can look at it. We move on. We've streamlined the situation and it's gone very well. At that point in time I was hands-on and moving through building programs. I was part of the solar array team, solar panel teams, in most of the programs that I was doing. Because one of the first things that has to happen when the vehicle launches and comes out of the shroud is the solar panels have to unfurl, open, or whatever. You're going to need power. You've gone from internal battery power to now we need to draw energy to keep the spacecraft working. It's one of the first critical functions in the launch process, once you're off of the launch adapter.

You launch, you come up, launch, separate. Once it separates then you have to unfold, unfurl, spin around, whatever. I was very mechanical when it comes to those kinds of things. I was very good with set nuts, we had to have low friction bolts, and we had all kinds of weird things like that. I just had to test one and put something together that if it didn't feel right, it wasn't right and then I would have to redo it. After about two or three missions, one of the two engineers I worked with very closely said, "Ron has a touch and a feel like unbelievable. If he feels like

there's some friction going on in this bolt, we need to look at it, and we either need to replace it or do something with it, because if he doesn't like it, I don't like it."

I moved on and on and on, and finally we started slowing down to the point where there wasn't as many launches going on. It was kind of funny because when we first started working on Stardust, I worked on the solar panels. The solar panels on Stardust actually were a pancake situation where when it came out and it launched the first thing that would happen is the front panel would release and it would fold out on a big hinge to the left. Then the back panel would fold out to the right. You had this big, gigantic, long kind of a pancake thing from there and then to here [indicating size]. It was going. I built that and did that and was working on Stardust.[3]

One of the weird things was we built Stardust first. Then we built Genesis.[4] Then we recovered Genesis, then we recovered Stardust. Genesis was within the whole entire window that Stardust went on. After I got through doing panels on Stardust, I was working on the Stardust team to get other stuff going. We just got the solar panels done, and the next thing we know it went from hardly any work to now we have two spacecraft.

Now Genesis is coming along, and it's in its infancy as far as what they wanted to do, and then along comes 2001 [Mars] Odyssey[5] and 2001 lander which was later canceled. So now we've got one program, one in the wings, and two others. Now I've got three in build and one waiting. We ended up starting working on the 2001 Odyssey, so working on those solar panels, getting them going, and working on the lander solar panels. The lander solar panels were very unique because they were folded up against and sitting in the shroud and then they would come out once

[3] Stardust was the first spacecraft to bring samples from a comet to Earth. The collected matter was sealed inside a sample reentry capsule, which separated from Stardust and landed in the Utah desert on Jan. 15, 2006.
[4] Genesis spacecraft spent more than two years collecting samples of the solar wind. The spacecraft then brought the sample canister back to Earth where it parachuted to the ground. Despite a hard landing in the Utah desert, the Genesis samples were recovered.
[5] The 2001 Mars Odyssey mission is NASA's longest-lasting spacecraft at Mars.

it landed. It had solar panels in flight that were attached. Then once the shroud came off it came down, they folded out, and then folded out again.

Every one of these type solar panel deployments was unique, one was an open wing that opened like this, one was an open wing that opened like that, one unfurled. One fell down and opened out. There was a lot of different mechanics that went on. I just had gotten through doing the Odyssey orbiter and lander type stuff. Other people built the panels. I just put in the hinges and what we call the dampeners and the spring assists. In space there's zero gravity, so if you just release something it's just going to go slam, so we have to put these dampeners in there that were viscous type that would allow it to slowly open and latch so nothing gets broken and busted. Once we got the orbiter going and the lander going, as I take a breath and think, "All right, I'm going to go back to Stardust and start working on it again," I get a call. "No, Genesis just came through." Like Genesis just came through. Okay. Now you're going to start doing Genesis.

Genesis was very unique because it was a spin-stabilized spacecraft. Okay. We've done a whole bunch of different things right now, but most of them were all propulsion this, propulsion that. Fire this way, fire that way. Genesis once it gets up there and goes into space, it had this system on it that was very interesting. It was like a yo-yo. Genesis was very unique because, like I said, it was what we called a spinner. It had a very unique launch mechanism because when it launched, if you look in here [referring to model of Genesis], this is the big capsule and this is the solar panel, and these were the attach points. These were the attach points that hold it together.

In the launch shroud it sat actually like this with the mushroom shaped canister in the middle. Then when it deployed it folded out to make the big wing one that you see here, where it was just a big canister in the middle.

After these deployed, they fired what we called the yo-yo thing out on a wire that went out about 50 feet or something like that. Now it's got this wire. It's really interesting. As they bring the wire in, it started causing the spacecraft to spin. You know how when you have a yo-yo it goes down on a string and it comes back. As they bring this yo-yo back in, it rolls back faster and faster.

That started this to rotate. That's what caused it to go into its rotation, which then it was rotational stabilized. So it was a very unique situation. We had to make sure that all these wings on the spacecraft on both sides weighed exactly the same, because if they weren't balanced, you're going to wobble and do all kinds of stuff. That one to me was one of the more difficult ones because we ended up having to put glue in different spots in the back when we were trying to balance it. Okay, this one is just a little bit heavier, so we've got to add like 4 grams. Then we go into the back in there, have these holes that they had made in the substrate, and we're squirting glue that's like a steel/epoxy in there to make it so it was perfectly balanced. Genesis was unique in a lot of ways and you can talk to the other engineers about it. Like the JPL [Jet Propulsion Laboratory, Pasadena, California] people who designed it. I'm just the guy that put it together, they're the ones that came up with these exotic designs. It did very well all the way through, and it basically separated at the one corner when it came back to Earth.

This is the heat shield here and this is what they called the backshell when it came back to Earth. It had an okay mission through its time. There was a few incidences that we had gone through thermals and stuff like that. But somebody else can talk more on that. I was the lead for building the STL, which is a systems test lab; when they sent spacecraft commands to the spacecraft, they had to run them through a lab that was identical to the spacecraft so that if something went wrong, we'd go into the lab, turn it off, turn it on, reboot it, or whatever, and run it again. Because if you send something bad to it, it's mission over.

JOHNSON: That was in Denver.

SEEDERS: That was at Lockheed Martin, right. But we actually had to build another STL, systems test lab, and what was weird about it is that its harness was very very similar to this harness electrically in lengths, so that when you send signals down it's going down the same travel time so it's got the same signal loss and those kinds of things to do it. So we built a system test lab and then we started running sequences through it. Once we'd run it through and it came back, quality would look at it. Oh no, this needs to change this. Okay, we'd run it through, run it through, run it through. Okay, it's good. Okay, now it passed. Now we've got a product that's ready to send up to the spacecraft.

I did that for both Stardust and Genesis. I actually did it for eight other programs because I was the STL guru. I didn't do it all myself. I had a team that had built the harnesses. I actually built three or four of the boxes that was on this thing that went into it as far as electronic boxes so you could turn them on and turn them off to cause different conditions, if you wanted the air-conditioning on, you wanted the air-conditioning off. For a car, you want the radio on, you want the radio off. Because we had two different radios, a backup subsystem for everything. They would say, "Well, we want to run this test totally on the B side," so we'd have to go set up stuff that electrically was sat in the spacecraft because its C&DH [Command and Data Handling], computer data handling system, was much more automatic. We didn't have a C&DH in the test lab because it was so expensive. When they would want to run a test like this or that, we'd have to go in there and flip these switches telling it, "Okay, we needed to do this on the B side or the A side."

That is how we were able to keep the spacecraft flying all the way through its mission basically, by truth and dare. Truth to the sequence, dare and send it up to the spacecraft; it worked great. We never had any problems on almost—I can't think of any sequences that we had that were on almost any of the spacecraft, on all 10, 12 of them that we ever had a problem like that, because we always ran it to ground on the ground. When it came up there it worked meticulously for everything.

So, we practiced recovery for Genesis, what we were going to do when it came back. It was going to come back! They were going to hook it; Bob [Robert A.] Corwin could tell you more if you get ahold of him. But they had basically a large kind of a hook mechanism that they put underneath the helicopter. After the arm comes down, it snags onto the parachute. Gigantic parachute. When it hooks onto the giant parachute it's floating. The helicopter was going to come by with a hook and grab the parachute and then bring it to Earth.

They were so afraid of damage to the SRC [Sample Return Canister]. In the SRC it had all of these elements in there that were pure elements, had pure gold, pure diamond, pure sapphire, pure copper, pure everything that you can think of. They were thinking when they sampled the winds, whatever the winds were up there at the Lagrange point, when they take this gold panel and look at it anything that's not gold on there was an element that came from space. Then they look on silver and anything that came on there that's not silver came from space. They were able to isolate everything that was out in the dust world from what was on the plates. There was different panels they had that would fold out. They would be exposed for certain periods of time depending on what it was that they wanted to do.

Then we had a concentrator that was out that was basically like a funnel with a solid gold sack at the bottom that was like a vacuum that was just sitting out there. Whatever particles would go through it would go through into the concentrator and be collected.

They were very concerned because a lot of these things were very very brittle. Very thin 24-karat gold plating or pure gold plating foil is very soft. They were afraid that things would happen if we weren't very careful on how we landed it. Because they were very concerned, they wanted to catch it with a parachute. Bring it down. We had a big kind of a reverse mushroom cap sitting on the ground. As it comes down, we're supposed to hook it with a grounding probe and then guide it down to its place, set it down, release the cord for the parachute. There was a drogue chute release that would release it. The helicopter would fly away, and then there we'd have it sitting on the ground in this mushroom kind of a cap.

Then we'd roll it into the hangar. This was out at [U.S. Army] Dugway Proving Grounds [Utah]. We would roll it into the hangar there. It was funny because it was all latched together with these J-hook latches that would open up like this and then close and then we had latches that would lock it down. We all had code names so when we went in to talk to it, we could take it apart.

It was funny because my code name was Saws D. Latch and my counterpart was Saws D. Other Latch. This comes back into the jovialness of having code names. Was asked would you know who I'm talking to if I called you Saws D. Latch? I said, "Yes, okay." Do you know who I'm talking to if I call Saws D. Other Latch? Yes. Okay, well, what's the problem here? So we walked around giggling and talking about I'm Saws D. Latch and he's Saws D. Other Latch. There was a whole bunch of different names. There was seven of us that were all involved between safety and everything else. Quality was The Guy. It was a little bit off cue if you will. But yet as

a team like that it worked very cohesively because everybody knew who they were. There's only seven of us.

JOHNSON: This was on the recovery team.

SEEDERS: In Dugway, yes. Where's The Queen? Karen [McNamara] was The Queen because she did both of them, and she was the head of curation, so what better name than The Queen? Hey, guy, get The Queen. Okay. Because sometimes you get thinking about this. I'm one of these people that's very good mechanically and with numbers, but if I hadn't seen your name written down all these times in my email, I would not be sure of what your name is. Unfortunately. I'm sorry. That's just the way my computer works. So when you have these funny names for some reason, they stick more than a regular name. At these times we were meeting all kinds of people, like [Donald E.] Brownlee and [Donald S.] Burnett and all this. I can't remember these names. But yet The Guy and The Queen and The Other Latch, those names for some reason stick. That's how we got it.

We practiced doing this, practiced doing that. We were going to open it up, take the concentrator out. Set it in here. We were going to purge it with nitrogen and send it down to Houston [Johnson Space Center, Texas, Genesis Processing and Sample Storage Facilities]. The Air Force had a plane set up to send it to Houston. Then we had a test box that we were actually going to plug into and interface with down in Houston because the lock had a twist lock on it kind of like a pressure cooker; If you've ever seen a pressure cooker, you rotate it, then that unlatches it and we open it up, and now we've got all our goodies inside.

It was a great plan, and we were out there, and it was kind of ironic and sad at the time, because we were all out in the back. We had everything staged. We had the mushroom sitting here. We were actually playing a little bit of catch football. We look over, and if you've ever seen the movie *Platoon*, there's a scene where five of the helicopters are all in a row and they all take off to go off to do a mission. That's what it looked like.

We were sitting there playing with the football. All of a sudden, we hear this noise, because the airfield is only about a mile away from us. We hear this noise and it's helicopters, and we look over. There go the helicopters. They're all heading off. They've got a Black Hawk in the front; they've got the two recovery helicopters. One was a spotter, one was the capture helicopter, and a safety helicopter and what we called OSCAR [On-Scene Commander] was in behind, which gave us an overview of everything that goes on.

We're out here da da da da da da da da da da. Look and here these guys go off, and we're like, "This is just like the scene in *Platoon*." As these guys are all going off. We're like, "This is getting real now, guys. We're going to go get this thing."

In this building over here, there was the avionics hangar. They were watching real-time descent of the vehicle and where it was at. Our job was basically when the helicopter comes flying back in with it hanging off, we had large grounding hooks to help guild it down to the transfer dolly.

A couple of us were playing catch. We played for about 15, 20, 25 minutes, something like that and we decided to go over there and see how this is progressing, because once we watch what it's doing, we'll know how much time we have to get prepared. We had to put on clean smocks and gloves and all this because we didn't want any contamination of anything. We didn't have to wear any kind of mask or anything like that, but we had to have clean hands, and all those

kinds of things, so when this came down, we were not going to contaminate it with anything or have it contaminate us, because it's been in space. We don't know what it was. Is there aliens on it? Is there going to be some guy hanging on to it saying, "I'm a Martian," or whatever. I mean we had no idea. We went in to watch the screen, and it was about a 21-inch screen, and we're in there listening. We're talking, and they're talking; the vehicle is on course, on time, projected entry is so-and-so such force blah blah blah coordinates this and coordinates that and on and on.

You hear them talking to the helicopter people and saying, "Helicopter on station." OSCAR saying, "We're here, we're there, blah blah blah."

It was on, and then they said, "We expect reentry." Basically cut it down. In 10 seconds. Ten, nine, eight. They get down to 0 seconds, and they said, "Reentry." We're like, "Okay, it's on."

Then they had shifted the cameras like they do with the Space Shuttle. They shift the cameras so you can watch it so far out you can't even tell. It's right up at the edge of space. When it comes and they shift it to the entry cameras and then it starts going plus one, plus two, plus three, as it's counting down on the other side of entry, we've got this real faint picture on the screen, and we're looking. We all come up to it really close and we're looking at the screen and we're like, "What are we seeing?"

What we were seeing was this thing was tumbling back and forth because it did not get its drogue chute trigger, which would actually slow it down and make it start doing a kind of drag if you will. It was just sitting here doing like if I had a saucer in front of me flip back and forth.

You're trying to look at it because the one side where it came through space is black, and the backshell is white. You're seeing this black, white, black, white, black. It's like black, white black, white. Just flipping. We're looking at it. What are we seeing here? About the time we're

thinking, "What are we seeing?" you're hearing him calling it out, "60,000 feet, 40,000 feet, 20,000 feet, impact." We went, "Impact?"

The guy from the helicopter, the main guy from the helicopter, goes, "Would you repeat that, sir?"

The guy says, "I said impact."

You could hear the guy's voice from the helicopter go, "C—c—copy that. Impact." Everybody broke up at that time. This is a scenario where we're all waiting to go to the wedding and the bride got killed on the way to the wedding. All of a sudden everything that was so good and so happy was over in 30 seconds. I don't know the real timeline back there. You can talk to them.

Immediately we have gone from a here's what we're *going* to do to here's what we've *got* to do. We had contingency plans. We had good day plans and bad day plans; just depends on what procedure we would need to follow. We had rehearsed both of those kinds of procedures. We had shovels. We had all kinds of stuff that you would need to do a recovery, like a fire department.

Basically we were all getting ready to go and we looked at that. The other guy comes in and says, "How are we?"

We said, "It hit the ground."

He goes, "Yes, I know it hit the ground."

"Like no, it crashed."

The guy goes, "What the *expletive* are you talking about?"

We said, "No. The parachute didn't work or something, we're not sure. But it's gone."

What are we going to do? They looked at me, and since I was such a flyboy back in the day, they looked at me and said, "How many people can we get on a Black Hawk?"

I said, "Well, if it's got machine guns on it you can't get but about seven or eight."

He goes, "This one doesn't have machine guns."

I said, "Well, then we can get about 9 or 12 people on it."

They said, "Okay." At that point in time we could hear in there that they had routed one of the Black Hawks back to the base as part of the plan to pick the recovery team up to go out to the field.

We're standing there and we're gathering buckets, shovels, cameras. Everybody's got a camera on us. We need to photograph the scene before you touch anything, that kind of a thing. The helicopter comes back and lands. Actually it lands and we all like good little firemen hop off onto this helicopter to go take off.

Right as it's getting ready to take off, we're getting a no-go from the field that says that so-and-so—I think it was like "Rescue one ready for departure," and they said, "No, rescue one, you need to go to the tower."

We're like, "What?" Basically they—I believe it was JPL more than anybody. It's not to say bad things—but they were just as much in shock as we were. I'm watching it happen. The boss comes in, hears what happened. These guys are sitting over here. Then they find out what happens thirdhand. Basically they taxied the helicopter over by this hangar and they unload all of us and run into this hangar. I can't remember who it was, Brownlee, and was it [Edward A.] Hirst [Genesis mission manager]? I think it was. Brownlee was the PI [principal investigator].

They were sitting in there with this team of four or five people, and we come running in there to sit down on this table, and he goes, "What are you guys doing?"

We said, "We're going out to the vehicle."

He says, "Do you know what you're doing?"

We go, "Yes, we have a procedure. We have a contingency plan and our procedure on everything we needed to do and you're just stopping us from going out there." We'd had rain for about the two weeks previous to this all happening out there. There was rain almost every day. We were expecting the salt flats where it landed—it was in the bombing range—to be in water. Salt water. Because you're out there right next to the Great Salt Lake. We're expecting it to have landed in a foot-deep swimming pool. Only thing in our mind is contamination, get there as quickly as we can, to see what we can do.

As soon as he said that we have a contingency plan, sir, we were enacting it when you stopped us, our boss at that time, who was with us, Pete [Peter] Doukas, said, "Well, we have our contingency plan." He just takes the book and he flips it to this side of the book, the big folder, because it's a big bible if you will of what you're doing, flips it to part B of the bible that says, "In case of recovery in case it goes bad."

The guy looks at about a page or two. He goes, "Go. You guys know what you're doing. Go." We go running back out to the aircraft.

It's silly because a reporter from someplace, and we don't know where, we figured it was some kind of national reporter, comes running out with us, says, "I'm part of the recovery team, what are we doing?" We had guards standing there because here's the people in the line back behind from the base. Here we are running around, and this guy is trying to get on the helicopter.

I'm like, "You're not part of the recovery team. Pete, he's not part of the recovery team. You're not part of the recovery team."

"Yes, I am, yes, I'm part of the recovery team, I'm going out with you."

We looked at an Army guy, and said, "This guy is not part of our team." He grabbed him, pulled him aside. I don't know how this guy even got underneath the barriers. They pulled him back and we let him go. We know our team; there's seven of us, we know we've never seen you before in our life.

We hop in the helicopter. This time we take off. We fly out there. We were talking amongst ourselves because now all of a sudden, we've got this very sobering feeling. This is late in the fourth quarter. We're losing the game. What are we going to do? There's no jovialness going on here at all. This is all me to you, you to him, what are we going to do. The boss says, "Well, here's what we need to do." He's passing out the cameras. He goes, "What I need you and you and you to do is start photographing the area. What we need to do is look at this, look at that, look at that, look at this. Ron, we need you to assess the vehicle when we get there."

The ordnance that should have fired the parachute is the same ordnance that they use for an ejection system in a fighter. It's a mortar that sits underneath the seat so when the guy pulls the handle the mortar fires and shoots the guy out of the airplane. That's the exact same ordnance that we used to pull the drogue chute and the parachute out of the vehicle. When this thing has crashed, first they had to get up there and assess whether there was any kind of toxic noxious gas that would kill anybody. They had already done that. By the time we got there they had already had their safety people and their life support people and all those people assess that there was no harmful gases, deadly gases, or anything like that leaking from the canister.

We didn't know this but as we're getting out there, this is what we're formulating in the copter. As we get to the site, the pilot starts to turn the helicopter to the left, and we all look out, and it still gets emotional. We look and God had actually allowed it to land on a pitching mound [raised area]. There was water almost all the way around on the baseball field but there was about

a 50-to-60-foot mound of mud dirt that was above the water. This thing had hit like a Frisbee. It opens like this [indicating opening like clamshell]. It hit like this [indicating the side of the vehicle], pure vertical in the side. Like a Frisbee that sticks in the sand, if you will, straight sideways. As we come around, we see it and we're like, "Wow!" We were thinking we're going to be in water, we got boots, we got all kind of stuff like that. Here this thing is sitting. We're looking around. You couldn't have done this twice if you tried to, where it landed in the mud. It was kind of crumpled in the mud. I do have a picture I can send you of what it looks like.

The copter guy, he goes, "I'm going to do a sideslip in and land so that we keep the air away from the site so we're not contaminating it and we're coming around from the side." Everybody looks down, looks back up at each other. Like this is not the time to cry. The other analogy was that you spend all your life building a race car and then it goes down the drag strip and hits the wall at the end. We poured our life into getting this thing to where it was.

Coming around, land, hop off the helicopter, run up to the chief ordnance guy. The chief ordnance guy was telling us that the vehicle is safe, there's no noxious fumes, toxic fumes, or anything like that, but the mortar did not fire. It's dangerous right now. The first thing we have to do is make the mortar safe before working on the canister.

Pete looks at me and says, "You built this thing." Because I'm the one that actually did the cabling and the harness and installing it. He goes, "And you know what you're looking for."

I said, "Oh yes, I got to get in to look. I know exactly what's connected and we got to get into. I know right where it's at. I don't know how it's oriented this way right now." Because when it landed it landed like this [on the side]. But somewhere around that rotation is the connector that we need to get to. I said, "Give me a second. We'll look at it." The barrel end is pointing off

over here. It's in a container, so if it goes off, it's going to fire that way. The container itself might jump back some like a mortar. It might jump back. But all the danger is out this way.

I come in from the back side. Basically this is where it's at, this is where the mortar is right here if you can see the picture. This was basically the safe side when it was sitting just like that in the ground. This is where it separates right here from the white to the gray. I went back up behind it. It was broken in a couple places. I'm looking around and I move one piece and I'm like, "Oh, there it is right there."

We didn't really want to take the chance of pulling it out. We basically had to go in, break into the wrapper, the shielding that was in there. There's only two wires, hot and cold. We had to unwrap it, get the two wires, pull the two wires apart, cut the one wire, cut the other wire, strip the two wires, and twist them together from the spacecraft side, and then strip the two wires, and then put the two together from the mortar side. Now the mortar has got a complete loop and there's no way it can fire. You've connected plus to minus and there's no battery. No signal that can be sent through. Usually you close the circuit. Shuts the circuit fire.

If you've dead-ended this end of it there's no way that end can ever go shut. I have a picture that I can send you that I'll have to dig it up but I'll be glad to send it to you.

JOHNSON: Yes, that would be great.

SEEDERS: It is one of the very few they released. You look, Pete is on this side of it over here. He looks like he's right in front of it. You got another guy that's standing up here looking down like oh my God, what. Then here I am. I got these rubber gloves on. I'm down in here like this

working on it. It's quite the picture to look at. It just got away from me and now since I'm talking it's all coming back again.

We safed the wires. Meanwhile everybody's taking pictures because as this thing landed and hit like this it spit stuff all the way in this long line clear out like little pieces. But if you talk to Brownlee and those guys, they got hundreds and hundreds if not thousands of pictures. Just ch ch ch ch. Digital camera. Everybody had one. This is your view from over here, this is my view from over here, this is her view from over there, of just everything to make a giant photo document of the whole entire spot as we're doing things.

Once I got the mortar done, we were safe. All right, what do we need to do here. We start looking in there and we breached the canister, which means it had actually opened up. It actually opened up the lid of a pressure cooker. The lid was off. It opened. It was fractured and it was open. But it was all inside the outer case, and we were looking at it and thinking what are we going to do with this. I knew through my training with building the spacecraft, how everything is contaminated from something else, if you know what this is, then you know everything else is a contaminant or is a specimen.

We had taken out these gigantic trench coats that were rubber like the firemen wear, covering clear from top to bottom to the ground, and they were yellow. Rubberized raincoats like hurricane raincoats that you see. I looked over at Pete and said, "Pete, why don't we pull the front of the back, this part of the shell here, this is the part we're trying to remove now, and pull that off? We can take one of those rainsuits, stuff it under the canister, and roll the canister into it, and then make like a Hershey's Kiss to seal it up and take it down away."

He's like, "Well, won't that contaminate things?"

Karen was right there with us as we're all making these decisions and we're talking on the fly. Karen goes, "Yes, but that's a great plan because anything that's not rubber rainsuit is going to be what we're looking for. We can analyze the rainsuit and know that there's rainsuit on this piece or that piece. Then that didn't come from space. That's a brilliant plan, Ron. That's thinking on your feet."

We pulled it off, folded this whole big thing out so it's almost like a blanket you would lay on for a picnic, stuffed it under the edge right underneath there, got back till there's like two spots, some cables we had to nip off, rolled this thing right into it. To this day I can still hear it. It reminds me of a gigantic trash container full of pins and needles, bolts, nuts. Tinkle clink clink clink clinkle tinkle clinkle clinkle tinkle rinkle tinkle. As you're tipping it over, the sound tells you most of it's still inside. "Oh my Gosh. Oh. This sounds so bad." Then we tucked the thing up on there.

There was some particles that had got down in it when it breached. There were some particles that got into a little bit of dirt there. Karen had us collecting mud samples all around. They were actually taking mud from where it had hit and scraped it and then putting them all in buckets. Then the buckets identified as bucket one, bucket two, bucket three, bucket four, by location of where it was. Taking pictures so when you go back—where was bucket 21? Bucket 21 was sitting right here. We know it was over there. Bucket six was over here. We knew exactly what coordinates it came from.

When we tipped it over, spread it up, put it into a big Hershey's Kiss, how are we going to hold it together? Well, I still have the belt that I pulled off like a tourniquet. Stuck it around this thing, pulled it like a tourniquet. They said, "Ron, you need to get this back to Avery [Technical Center, Michael Army Airfield, Utah] right now." That was the base.

Two or three of us picked it up and I was holding it by the Hershey's Kiss. We stuck it over here and slid it onto the helicopter and Pete looked at me, he goes, "No, your job is to get this back to the base. We will clean up around here." It took them four days of going back to site to dig up particles and pieces.

Next thing you know, I'm sitting on this helicopter, on this Black Hawk, they're putting the microphones on me and the headset. He says, "Are you good back there?"

I said, "I'm absolutely good. I love flying. You're not going to hurt me in any way, shape, or form, we got to get this baby back to the hangar as soon as we can."

The guy says, "Roger that." We're up. We took off like we were headed to a battle or had a dead passenger or dying passenger on board to get to hospital. They didn't mess around. We're flying, the guy was sitting there going, "I've been watching this from the cockpit." I had this big furry beard because I was supposed to go hunting in two weeks after this happened. I had the big hunting beard and when you're a hunter you don't take your beard off until you get in. I stuck out like a big furry sore thumb. They knew who I was. He said, "I've been watching you do all this kind of stuff and reaching down in there. What the heck were you reaching in there for?"

I said, "I was safing the mortar. We got a 30-millimeter mortar in underneath the seat."

He goes, "Oh my gosh."

I said, "No, you guys were down there."

We go out and we're flying in. As we're flying into the base, I'm seeing one person standing out there and I couldn't tell who it was but there's one body standing out at the helipad. I'm thinking who could this possibly be. As we get closer, oh, it's the [vice] president [and General Manager of Civil Space] of Lockheed Martin himself [James H. Crocker].

JOHNSON: Great.

SEEDERS: That was the last person you want to see. Great. I'm getting close and I recognize him standing there. He's standing waiting for it to come in. We come in; we land. As we're calling in to tell them, "We've got the canister, we've got it wrapped up, we need a fork truck and we need a pallet to get this to the hangar." They were like, "Okay." They just did what we said. Okay. As we were getting ready to land here comes this fork truck that's got a regular big shipping pallet on it. It comes out there and sets the pallet down just outside. Helicopter comes in, sits down. I don't know if you're familiar with the Black Hawk, but you couldn't jump up into the blades. They're 10, 12 feet in the air. It's sitting underneath there. This helicopter sets down just as smooth as you could imagine.

I'm telling him [the pilot], "What a great job you guys did."

He goes, "No, you guys did the great job."

I said, "It was a team effort. Tell them a team effort with the Air Force, JPL, Johnson."

We load it off, and he [Crocker] comes running up there. Load it off, set it off onto there. We put it down onto the [pallet]. We're walking it in and he says, "You can let them handle it."

I said, "No, I'm going to keep my hands on it till we get it set down in the hangar."

He's walking alongside me and asks me, "Well, how's it going?"

I said, "Well." It was kind of funny because at that point in time I made a comment to him I still wonder about today. But I said, "She's hurting really bad. But I think she's going to make it." How do you talk about hardware in a pretext like that? Her, she. Because we were still thinking of it as the bride. I said, "We were able to get in. The canister was breached, sir. We were able to get the backshell off of it, and we stuck this underneath it and got it all inside of there

with a minimal amount of contamination that's inside of it. We really didn't analyze it out there. We just wrapped it up like this, and I've had my hand on it ever since to feel what's tinking and bonking." It really didn't make much noise after we got it into the Hershey's Kiss kind of a configuration. I said, "And I don't want to let my hands off of it until we actually set it down in the hangar. Because then I can tell if there was a large clunk or when did something happen or where did it bonk." Because when you open it, bonk might have been where it came apart. That was my analysis of what was going on.

But when I told him that she's hurting really bad but I think she's going to make it, sir, he looked at me. I think that he was expecting me to give him more of a technical type of an answer than an emotional type answer. Then as we got closer to setting it down, I said, "Canister did breach. I think most of the stuff is inside. There were small particles that we could see out the side that was gone. But I think we got most all of it. It did land on a dirt mound instead of the water."

He goes, "Oh, well, that's good."

When they took pictures of it later on, they were like, "Okay, this thing is burning a hole through space coming down from up there and it actually hit a 60-foot dirt pile." You couldn't do that 1 in 100,000 tries.

I said, "It's funny, sir, but the biggest worry we've been talking about in the last two weeks is how we're going to break the wafers up into small enough samples for everybody to get a piece." Because we got to fracture them but if you grab them with vise grips now you contaminated them—how are we going to actually fracture these into pieces? I said, "We broke this thing into a million pieces, sir. There's going to be plenty pieces for everybody." He kind of—it wasn't smiling but kind of like you could tell he's like, "Yes, fixed that problem."

Once we got in there one of the most important tests that we had as far as the different payloads that were on there was the sample I was telling you about that sticks out that's catching stuff all the way through there. It was the [solar wind] concentrator.

He goes, "What shape is the concentrator in?"

I said, "To be honest with you I didn't look. Karen and I haven't seen it. We don't know for sure. We tipped it in, herd it up, brought it in, and sat it down in here. I'm going to leave it until Karen comes back and Karen tells us how to unwrap it. Because I told her we wouldn't touch this thing till she got back. That's The Queen."

He says, "No, that's fine." We stayed in there and we roped it all off when I let go of it and stood there. But I stood there like a junkyard dog like nobody's going to touch this thing at all, anything like that. I guess about 3 hours later Karen comes back. She comes back with some stuff to get some more samples to go back out. She comes in and of course Jim Crocker was standing there and was like, "Karen, what shape is the concentrator?"

She goes, "I have no idea. We just rolled it into the container and we were trying to catch everything else as much as we can. We can look in there and see if there's anything that we can see at all because I don't want to do it right now. We're trying to get the field under control." She went back out to the field and came back in about another 5 or 6 hours later. Now it's getting to be late evening and she comes back and Jim is still sitting in there. I'm still sitting in there. We're still sitting in there. We're not leaving the patient.

She gets back and she goes, "I don't know. Let's go and take a look here and see." She puts on all of her gear, walking in, and she goes, "My biggest concern is that we've lost the concentrator. It's not in the field." It's about this big around and it goes about this big around [6.2

cm diameter], then it gets down to about a 2-inch, so it's like a giant funnel that's got a solid gold screen in the bottom that will catch whatever. It's a very small micron type filter, very small.

She says, "All right." She comes in, she opens up, takes the belt back off. She's like, "Whose belt is this?"

I said, "Well, I've been holding my pants up for the last 5 hours, Karen."

"You're great, you're taking it for the team. I can't believe it." Jim just kind of shakes his head. We're all in.

She opens this thing back and opens it back. We get over there. We got it open. We moved around, opened it up. She gets in there. She gets in there with a flashlight. She comes out of there looking like she's glowing. Like she has just seen the world. She goes, "You are not going to believe this but the concentrator, it twisted like a Hershey's Kiss like we had as a wrapper when it crashed. It wrapped itself around and around and around just like a Hershey's Kiss and was hanging off the end of the concentrator container, intact hanging there."

All of the data that was needed from it as far as we knew was still inside of it. She goes, "All I need to do is go in there with like a sample thing like this, snip, and we've got it." That was the most important part of the payload that we had. She goes, "It's intact."

We're like, "Okay." We hit a dirt mound. How many times could you do that? The concentrator didn't just dump like a bucket. It actually spun, sealed itself up if you will. All that kind of stuff.

It turned out as it was to be a very magnificent time. We were able to at that point in time, believe it or not, just opened it up a couple times, and thought well, anything else that we put this in is going to contaminate it. Recontaminate it. We don't want to do that. So as I recall we sealed it back up, got a rope, tied it off, flew it to Johnson. Curation started taking it over from there.

Curation opened it up and did all their other stuff in there. Then the next time that I actually saw it was when we went down for Stardust recovery to take the sample, to take the SRC down there to open it up. We went in there and said, "Can we go into the Genesis lab? How is Genesis doing?"

Because all data was shut off at that point in time, because of the anomaly of the landing. The investigation. The DoD [Department of Defense] and everybody came in and we wanted all the engineering, anything that you had, any pictures, any kind of whatever. They interviewed every one of us who built Genesis. Did you guys do this wrong? Did you guys do that wrong? Did you do this wrong? Did you do that wrong? We actually took the mortar and the two NSIs [NASA Standard Initiators] that we took and actually took them up to the ordnance lab in Lockheed and fired them. They did fire, so it wasn't a bum ordnance, it wasn't a bum, everything worked. Trying to find out what anomaly occurred to prevent the three-point landing.

When you talk to Burnett, he, back in the day, said that this was one of the most successful science gathering programs he's been a part of in his whole entire career. But yet there was nothing said about it anywhere because it was not what we would call a three-point landing. Back in aviation what we said is it doesn't matter if the airplane crashes, what's important is the people all got off. We can always get another airplane. We at Lockheed never got an award, we never got a commendation. I'm not trying to dig them, but that's how quiet this has been. People wanted to talk about what had happened on there. You're one of the few people that know blow by blow what's going on there other than the people who were there and some of these other guys. Some of these other guys, the big bigwigs, they might have been watching on the closed-circuit TVs and stuff, but they weren't actually in, see what it was like, unless they looked at these pictures.

Sometimes you can look at a thousand pictures and still not get a clue of the movie. Nothing was said. We were not allowed, because the DoD put a classification on it that says, "It's under investigation. If you know anything you need to tell us. If you know something that you did wrong you need to tell us." Like I did something wrong. They interrogated me. Did I not do this? Did I not do that? No. I built this race car and wanted it to win the race. Every mission I've ever been part of has been successful. I don't want to make an unsuccessful mission. That's not even in my blood or in my data stream at all. I'm here for success, 100 percent mission success. I want everything that we do to happen as much as we can correctly. That's the way everybody in the team was. Everybody in the team was success is all we want.

They interviewed everybody and I don't know what the findings came out as being to this day, what they blamed it on or what they were saying. We heard rumors that the G [gravity]-switches were put in backwards somehow. Were they installed backwards? No. You look at the engineering, and they were not, they were installed to print. So if it's installed to print, is it backwards? You have a little plus here and a little plus here and a little plus here and a little minus and a little minus. Like your battery. If you put the plus on the plus and the minus on the minus is that backwards? Or is that to engineering?

We never knew what went wrong with it. Other than what we could assimilate, which was weird that one spacecraft flew facing forward and one flew facing backward. Stardust flew with its nose into the front and Genesis flew with its nose into the rear. Would that dynamically cause something different? That gets into stuff I don't even know about. That's what we told all these other people on the record.

What we conjecture and we think but nobody's actually told us is that we think that since one was pointing forward and one was pointing backwards it did not allow the G-switches to fire

to go off because it's like a spring-loaded bullet. Because when we went to do Stardust and it came back and did fine, we did OSIRIS-REx[6] [Origins, Spectral Interpretation, Resource Identification, and Security – Regolith Explorer] and OSIRIS-REx has the same exact stuff inside it as Stardust did. But the G-switch box and all those kinds of things from OSIRIS-REx to Stardust, I was part of the engineering crew that helped put it all through acoustics tests and all that to make sure that these G-switches worked.

Since we were doing so much testing on Stardust G-switches and OSIRIS-REx G-switches, we surmised that it was something to do with that configuration that had not worked out. That's basically from my part, something that I construed from my mind, because we're really digging into this. Stardust worked. It only had three out of four that fired, and we can talk about that. Three out of four because there's one in each direction. They're sitting at 90 degrees off. All you need is one to fire and that's the signal and it goes. If it's leaning off this way that one points straight down, if it's leaning off this way that one points. If it's doing kind of a wobble thing any one of those signals goes, you fire one, gone.

And yet, we went through much much testing on OSIRIS-REx to make sure that every one of them fired. So we had isolation systems inside in the box that even though it was doing whatever it was doing inside of there, they were not feeling it, so they could do what they needed to do with the whole vehicle spinning.

We started looking because I did all three of them the same way. We're going, "Well, this is what we think really happened." We never read a report that says, "Well, this is what happened" because they never gave it to us. Us. Maybe they've given it to you and maybe you got it from a

[6] OSIRIS-REx is the first U.S. mission to collect a sample from an asteroid. It returned the material from asteroid Bennu to Earth on Sept. 24, 2023.

higher level. I'm sure it's out there somewhere now what they said it was. We believe it was the G-switches that didn't work, but we don't know.[7]

That was one of the tragedies. If there's a tragedy in this whole situation, we got so much credit from Stardust and what happened there because it was great, but yet Genesis got more science and no recognition at all.

It was interesting because when we were in there at the lab down there in Johnson, they had all the pieces that they had gathered. They were all in the nitrogen baths. The nitrogen baths, the vapor that comes off of them, they were in there. We talked to them about it, and what they were doing is they take a sliver and they put it in a clear cast. Then when they put it in the clear cast it's like putting it under a slide like a microscope slide. Then they put the top on the slide.

They can send it out. I can send one to you and you can look at it. When you're done you can send one to him. He said, "We have got more pieces to send to anybody in the world who wants them. We're sending them to them. The unique part about this is every piece that we have sent out so far has at least something else on it, no matter what." That's one of those good things that happened. I'd love to see what Burnett has to say about this now since it's been so long. Because his whole life was that mission.

When we talked to him for about 20 minutes at that time he was talking about okay, so I've sent out 500,000 samples, and every sample had something else on it. That's amazing. Because we would have never broken it into that many small pieces ever. Some of them were slivers. Like little. But it was big enough to put under a microscope and actually look at and see something on

[7] Genesis Mishap Investigation Board Report, Volume I: https://www.nasa.gov/wp-content/uploads/2015/01/149414main_Genesis_MIB.pdf

it and say, "Oh, this has a piece of gold on it or this has a piece of sapphire on it or this has a piece of whatever on it." Elements on there. That in itself talks of success.

We didn't plan it that way. If we could have taken credit for it, "Yes, we're going to smash it and then you're going to have a billion pieces," we could have the credit for the whole thing. But God gave us all the credit but he's the only one. He landed it on the dirt. He kept the concentrator together. The breach was only in two directions not scattered in all directions. They said it hit at 500 gs. Impacted the surface at 500 gs. Which basically is like meteorite strength. That's coming in. Nothing slowed it down. There was no aerodynamics to slow it down.

When it was tumbling so fast it could have easily landed this way or this way. If that impact, if it hadn't landed exactly square on like that to make it just stick in the mud, it could have spewed stuff for miles probably. When we look back at the day like that, it had to land perfect in the mud. The mud was a thick mud like Missouri kind of mud. It's not sandy dirt. You could make pottery out of it. It just went shunk.

You could not have done anything different and had it turn out the way that it did in my opinion from the way it crashed. If it had landed flat, it would have just pancaked everything and we'd have had contamination of everything you could think of in it. It was amazing. It really was.

It was one of the worst days I've ever had in my career because we were that close to having a wedding. But it turned out to be one of the biggest science days gathering kind of things that we could have ever seen. Like I said, I'd love to hear what Brownlee says about it. Be very interesting now that this is done, and people are all talking about it because he's going to talk a lot about the science, I'm sure. Here's what we found, here's what we got, here's what we've gathered. Now that it's been so long, I may be out-of-date on some of this stuff that I'm talking about. But as we knew it and what they told us at the time was that one guy that was part of the

curation team, I can't think of his name, he said, "I'm going to be putting pieces in amber the rest of my career." He was probably 20 years younger than me.

I wouldn't be surprised if we talked to Burnett and he said, "Are you still shipping out Genesis pieces or has there been enough in the world that nobody needs any more?" Send them to school, just call up and say, "I'm part of this school and we're looking in space and we want to do it." As far as I know they would send you samples to look at. Or anywhere, anybody, anyplace, wherever. If that's the case, the whole world benefits from something like this. But nobody knew about it. They will now, I guess. If anybody wants to look at it and look and see, they will see that kind of stuff. It'll be very interesting to see what happens.

I don't know if you have other questions now. That was a long front end to back end kind of a thing, synopsis of everything.

JOHNSON: Yes. I haven't heard some of that because you were on the ground and actually recovering it. You said there were seven team members. Was that mostly Lockheed Martin and then some JSC people or who were those team members?

SEEDERS: Basically it was Lockheed Martin and JSC that were actually there. Now at Dugway Proving Grounds where the whole thing went on, we did have JPL like I think it was Ed Hirst and we had very top-level JPL people there. But they were never out in the field. Basically out in the field it was Lockheed and Johnson curation. We also had representatives from Dugway that were safety and ordnance, because we landed in a bombing range. They had to make sure we didn't step on an ordnance or something like that. We had their safety people and what they call OSCAR, which is basically their safety coordinator. They go out and check to make sure you're safe

because you're in the middle of a bombing range. People don't walk in the bombing ranges out there in case of unexploded bombs. They had those people out there clearing the area we were at. They had to put little flags around that said, "Do not walk outside of this area, period. Or come get us if you need to."

But basically it was all Lockheed people and then curation. Out in the field itself when we went out there was Pete and myself. Then there was Tim [Welton]. Then there was Billy [Jones]. Jack [Dekker]. Chuck Love. And Karen. I want to say that that's seven people. Because yes, Pete was the head guy. Jack was safety. Chuck was quality. Tim was logistics, so he was the one that moved stuff around, got stuff there. He got stuff to and from the sites as far as trucking stuff like that. Billy was my backup in case I went down. Like the quarterback off sitting waiting to come in if you hurt yourself. Then Karen. There was seven of us actually in the field.

Once we got back to the hangar Karen had, I can't remember the name of the lady that you've been talking to?

JOHNSON: Oh, Judy [Judith H.] Allton.

SEEDERS: Yes. Judy was there. Yes. That's the one. Judy Allton. She had another young lady there and one or two other guys. I would say there was like four or five curation people there with Karen that were actually in the hangar. What we built, we built like a cocoon, a clean room inside of the hangar that we were supposed to move this thing into the clean room and then that's where we were supposed to "Saws D. Latches," take it apart, and then remove the canister, and then nitrogen-purge it, and then ship it off in its own container, its own special airtight nitrogen-purged container. We didn't have to use any of that stuff at all, until we used it on Stardust.

Then if you see Stardust, that is exactly the same one. They took it all apart and reput it all back together. But when we go through Stardust, that was the one that we did all the Stardust work in. Same exact kind of a clean room. It was purged. There was a HEPA [high efficiency particulate air] filter. We didn't need it for this obviously. We went to plan B which was unbelievable.

It was kind of sad because the rest of the team, Billy, Tim, Jack, safety, Chuck, quality, Pete, and all those people stayed out in the field and brought it in. When they came in that evening, they came in on the back of a tractor trailer they call a mudpuppy, which is a tracked dump truck if you will, just has tracks. It's like a tank with an open back.

They got out of it and they got to pick up the pieces of the rest of the car. I got the body if you will. They got the rest of the car. They needed credit too. They did a great job. Everybody did a great job. There wasn't a slacker anywhere. It was a team effort all the way around. I can't say any more. JPL did a great job. NASA did a great job. We did a great job. The only thing I have is that there was no accolades given plus or minus, even though the passenger survived. Nobody ever came through and said, "Well, we're not going to give you an award." We asked three or four years after that, "Are we going to get an award?"

"No. We're not talking about it. We're not." Nobody ever said anything about it from NASA or anybody. I figured it would surface at some point in time because someplace they're going to look in this book and there's a front page that says it crashed and we got all this data, and all these pages in the middle that are empty about how, what, where, why, when, who, all of the things.

JOHNSON: Anything that NASA does has to go through critical design reviews, the flight reviews. Before Genesis they also instituted those red team reviews because of the failure that had happened with the Mars Climate Orbiter. Were you part of that or the team you were working with? Did you have to go through those reviews?

SEEDERS: Yes. They went through those reviews but it was a much higher level than I was. It was more of the Pete and quality and safety. That was a higher level. But they had all of those. Yes. It's funny because Climate Orbiter and Mars Observer, when they had this problem, we actually built MGS, which was the follow-on to the Mars Observer, and we built it in like nine months and sent it to Mars. That was MGS, that was Mars Global Surveyor, was the replacement for that. We actually flew that.

They grilled us extensively on critical design blah blah blah blah blah, all those kinds of things. Yes. That's why we had such an extensive recovery plan there, and I believe that when we went to the hangar and they looked at what we were doing, I think they were looking through the windshield, they were looking at what was going on, and they didn't realize what was in their rearview mirror as to what they had already been done. Because all that procedure had been tabletopped. It had been red team reviewed. It had been critical design reviewed. All those things had happened. That's how it got approved. It got approved by God and the whole country. I just think that it happened so fast that they went, "Do you guys know what you're doing?" Yes, and he flipped to part B and he goes, "Oh yes, I do remember red teaming this and critical design reviewing this and doing all that. Get out there and go."

No, they went through—because Mars Observer really created a whole new level. So did *Challenger* [STS-51L accident]. Except it was manned versus unmanned. Yes, we have to check it twice and then double-check it again and then check it another couple times.

We need to sift any grains of sand out that we might find that could be questionable. At any level. Yes. It went through all that kind of stuff, absolutely did. Stardust as well. Everything since then that I know of. Some of them lasted for three, four, five days. It felt more like a grilling. But I was not a part of it. I was lower. I just had the people come out of it, because they'd be in there for three four days, and you'd talk to them like how was it. It was just brutal. They were grilling us.

They have to grill you to find out this way or that way. Did you think about this? Did we think about that? Because you got all these different people asking different questions. Like if you had two more people on this thing today, they would be asking different questions than you. But it'd probably be close to being the same kind of an answer. It's just a different way of asking it. Yes. We clearly had all that kind of stuff in place. Everything we did was by procedure. It was just off-nominal procedure. Except for the Hershey's Kiss and all that. That was on the fly that we came up with because we didn't know what. We had a breach which meant go out and recover as much as we can, get samples. But yes. It was all per procedure for sure.

JOHNSON: I've been going through my questions and you pretty much talked about all of them in your overview, but one of the things I like to ask is what would you take away—since you've worked on other NASA missions after that—what would you take away as the lessons learned from Genesis itself, from that mission?

SEEDERS: Lessons learned. That's a big one because they always go over that on all kinds of missions.

JOHNSON: Did anything change in the way you approached things after Genesis?

SEEDERS: After Genesis, because as we talked earlier on, Stardust flew, then Genesis flew, then Genesis landed, and then Stardust landed. They were absolutely terrified of the Stardust return because we have a question mark. Genesis didn't make it. Stardust, we don't know.

We practiced a lot with Genesis what we were going to do both nominal and off-nominal. But we practiced 20 times more on Stardust of off-nominal than we did with Genesis because of, I guess, the fear that it might not come back either. It wasn't particles, it was aerogel. Aerogel is like cotton balls. It's very light. It's like liquid. If you've ever seen it, it's very light; it just blows away. We went through on Stardust and had, yes, very extensive off-nominal testing with it.

That was a lesson learned I'd say from Genesis that the program instilled. Me as a personal person, I don't know. We always built everything to the letter of the plan. If there was anything wrong with it, we would go tell quality, "This isn't right, we need to do this. I don't want to route the wires that way. I want to route them this way." As we're building it, we built everything. Everything we made was a custom one-off one of a kind. Every spacecraft we've ever built from MGS. Magellan, MGS. It goes on and on. All of the landers, all of the orbiters. Odyssey. Mars '98 lander, Mars '98 orbiter, 2001 Odyssey, Phoenix. Every spacecraft we've ever worked on was a one-off one of a kind.

Some of them used some of the stuff from the old one, but we'd always do something better to the next one in the planning part of it, in the build phase of it, and what we were doing. They

were always very receptive of you know what, maybe instead of build the loop this way, we should build two loops that way, stuff like that. But as far as lessons learned walking away from that is they've done a lot of off-nominal testing. More than they ever did.

I have no idea right now how much off-nominal testing they've done for OSIRIS-REx. Because OSIRIS-REx is exactly, exactly Stardust. It's coming back in September. It'll be landing in September. I wanted to stay to do all three of them. That's really what I wanted to do. They wanted me to. But I would have been almost 66 and a lot of my people said, "Ron, you need to retire. Not for health reasons. But you need to enjoy life. You've worked way too hard doing this stuff." It was a very emotional decision because I have an emotional attachment like you can't believe to leaving there. I still now that it's here wish I'd stayed there.

But the four years I've been gone I've enjoyed immensely. I've gotten to enjoy family and all these other things that I would not have got to enjoy had I worked there. Do you take family time, or do you take work time? At some point you have to separate those. But I would hope that they have done a lot of this type off anomaly testing and stuff with OSIRIS-REx. I'd even volunteer to go back to help them but they seem to think that they've got it. I'm like, "That's fine, okay. I'm just here to offer."

But lessons learned, other than more testing for the recovery of Stardust, I can't think of anything. We worked together as a team. We worked well with JPL. We worked great with Johnson. Karen and the team down there, they had things they didn't like, they would tell us, and we would do it. We had things that we didn't want to do because we didn't understand it; it didn't make sense. You talk to her; she'd listen to you. She was very user-friendly like that. It wasn't like my way or the highway, this is the way we got to do it. It's like well, you have something you don't like, okay, well, actually that makes sense, let's go and try and do that. Or we can't do that

because this is what I'm trying to accomplish by not doing it that way. Then you're like, "Oh, okay, well, since you explained it to me, I totally understand." There's always that open book. If you have a question, please ask it. Oh, I see why you're doing it that way. Or you see why I asked the question.

Really that's a tough question is lessons learned. I can't think of really anything other than like what you brought up about doing something like that. We're a cohesive team. We got together. We had one or two early on in the program that didn't work really well, and so they moved on to a different program. You actually build in a baseball team. Everybody on the team is a team player. If you're not a team player, you're not on the right team, like we always say, there's no I in team. Only E-A. That's what I said. I was hands-on and up-front like that. But I would not nearly have been successful without all of the other arms around me like Tim moving stuff there. Billy standing behind me. Billy kept asking a lot of the time, "What am I even doing here?" I'm like, "Dude, you're here right behind me. If I go down, you're up, buddy. You got to know everything that I know so if something happens here.

We were a very good team like that. I can't think of anything really. If it comes to me later, I can think of it.

JOHNSON: That's good information, because you brought it up, you brought the next question I was going to ask about. Working with those people from different NASA centers and that whole team dynamic, and how well it worked.

SEEDERS: On both of those programs, even though we had a different PI, Brownlee was totally different than Burnett. Burnett, he was a scientist's scientist, or is. You can almost walk past him and hear the numbers.

JOHNSON: The brain working.

SEEDERS: Brain working. Exactly. Not much chit chat like what are you doing or how are you doing. He's a scientist. But if you stop him for a second and asked him a question, he made time to answer. Brownlee was was more personable in a lot of ways. He would chit chat for a moment but then right back to work. They were both scientists' scientists.

Then there was another one that came in from Langley [Research Center, Hampton, Virginia] that did stuff too. He's not been mentioned here either. But he came from Langley. He worked with Mike [Michael E.] Zolensky. I'm trying to think what his name was too. He was very much a scientist kind of guy too. Actually he was training Mike Zolensky at the time. He's probably retired since then.

I never met a group of people that I didn't like, they were all almost like family in a lot of ways. We all had respect for each other and did everything that we needed. We never had "Oh, here comes that person again. Now we got to act different." Or we got to do this, we got to do that. We all went to dinner together and had a great time. We could talk about whatever we wanted to talk about. When it's time to do work, it's time to do work, and we did work. It was a very cohesive team, I would say. Some of the other people might not say that, and I don't know who it would be because I think everybody thought the same way.

JOHNSON: That's what it takes to have a success.

SEEDERS: To me to win a championship you have to have a championship team. We did right there. They'd ask a question of me and I'd answer the question, and I'd ask a question of them and they'd answer the question from me. It was very much I believe you if you tell me something, and you believe me if I tell you something. Because I'm not going to lie to you, and you're not going to lie to me. There was never any kind of cloak-and-dagger stuff that I know of, at all. I'd go do it again with the same guys.

JOHNSON: That's a testament. Right now I think we touched on everything. If I have anything else, I'll let you know. But I think that would be a good place to stop today if that's okay.

SEEDERS: Sure. Fine with me.

[End of interview]