NASA MSFC Oral History Interview
Steve Johnson Interviews – Apollo/Saturn Program

Luke Talley
Interviewed by Steve Johnson
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Steve Johnson: I am talking with Luke Talley, who worked on the Saturn Program from 1967 to 1975, first on ground support and later on the Skylab Program. Luke, would you talk about your education that made you able to work in the space program?

Luke Talley: I went to the University of Alabama in the electrical engineering school. We finished there pretty much a power systems and control systems engineer. We had gotten married when we were in school. About six or eight months after we got out, my wife was pregnant, so we went back to Montgomery and I worked for a little company there. I actually got started up here through going to an employment service, Snelling and Snelling. Remember them? They sent me up here for a job interview. The guy that I came to interview with, they were in a little hole in the wall down on Bob Wallace [Avenue]. I thought, "Man, what kind of place is this?" We talked for a little while. He said, "We are going to go out there to Marshall and look around." We went out and went into the ME [Manufacturing and Engineering] Lab where they were building a couple of the flight models of the first stage, the S-IC stage. They had mockups of the stage there, the engine sitting around. I told them, “I don’t know what the job is, but I’ll take it.” (Both Laugh) That is kind of how I got here. Double E [Electrical Engineering] to begin with. Of course, later on, we got a lot of training out of the Saturn Program.

The fact that you have this large research and development program, there were a lot of things they were doing that we never had in school. NASA [National Aeronautics and Space Administration] had training courses set up, and they would teach us what we needed to know. A lot of that was digital electronics, which today we just take for granted. In those days, very little of that was around. I had never had any digital coursework at all down in Tuscaloosa [Alabama], but taking those courses over the next thirty years at IBM [International Business Machines], I used it every day. Part of my education was university-based, a lot of it came out of this program.

Johnson: With IBM, you worked in conjunction with Marshall Space Flight engineers and technicians on ground support and then on the Skylab, as we said. You were actually brought to the space program through just trying to get a job?

Talley: [I was] just trying to get a job.

Johnson: First, let us talk about ground support. What were the main technical challenges that you worked on during the Saturn V days?

Talley: The Saturn is such a monster vehicle, and it is so complex. So many things have to happen in rapid succession and correct order and so forth, so all of that had to be automated. Saturn was probably the first large-scale rocket to really be automated, the check out of it, from start to finish. A lot of that was how do you, given the capabilities of computers that you had at that time, which was not very much, make that work? We were all coming up with new ideas about how to interface with the different pieces of equipment.

The first thing we were working on was the ground equipment that went in the crawler for the Saturn rocket itself to take it out to the pad. That gray base of that thing that you see, you just think of it as this big gray platform, but inside that, there are about two stories of electronics equipment loaded inside that thing. All of that had to interface back to the firing room and the VAB [Vehicle Assembly Building] there at the Cape [Canaveral, Florida]. What we were doing was checking out the equipment to make sure we had a computer in the VAB and it is talking to a computer on the pad and do these pads all work and do what they are supposed to do. In fact, those of us that worked on it, we actually created classes to teach people coming on board how to write in this particular language they used for check outs. It was an effort to make things talk to one another. That was the hardest part.

Johnson: Let us go ahead and point out that we are not talking about twenty-first century computers.

Talley: No, not at all. This was an RCA [Radio Corporation of America] 110A. I do not remember what they call that thing. It was some kind of a crazy memory system. It had this big spinning drum. It probably had 16,000 words of memory, something like that. You are in the middle of your checkout, you are going along, and all of a sudden there is this high-pitched screech. The drums crashed again. (Both Laugh) You are down for a couple of days, and you come back up and get it working again. It was not highly reliable, either, but it got the job done. RCA is not known for computers today.

Johnson: Looking back on that time, is it almost amazing that with the tools you had on hand you and everyone else were actually able to accomplish what you accomplished.

Talley: Yes. We give tours over there at the [U.S.] Space and Rocket Center and I will point to a model of the Instrument Unit. There are some boxes on there that are probably sixteen or eighteen inches square. Some of those boxes held as many as 150 or

200 relays. I tell people that all this control logic was all done using relays. They just marvel. Nobody can imagine that many relays working okay, but we had very few failures related to relays.

Johnson: The crawler that transported the Saturn V, I do not think most people would even think about it containing electronics.

Talley: It was loaded.

Johnson: Why was it loaded? Looking at it, it looks like a big motorized trailer.

Talley: Just a big rack.

Johnson: Why did it need all of the electronics?

Talley: When you are on the pad and you have to do checkout, you have to do a manual checkout. You put the stage on, and you go through and check and verify everything is okay on the first stage. Then you put the next stage, and you go through this. A lot of that is done manually by people inside this area. You have to have that equipment so that you can verify everything on board is connected and working and doing what it is supposed to do. When you get down to time for launch, you start fueling. You do not have people down there. It is a data link back to the firing room where the other computer is, and the people back there and the computer program are now flipping all the switches and turning the dials because everything has to be timed just so to get it all to work. It is quite remarkable that all that stuff came together and worked as well as it did.

Johnson: To make that system work, what kind of system were you going to have? To make it work, did you have to develop any new tools or were there any new materials you had to come up with?

Talley: For the ground equipment, you did not, but when you got into the Instrument Unit and the various stages, then lots of materials. If you look at the Saturn booster itself, there is probably every known alloy of aluminum known to mankind in that thing in one way or another. The lower stage is just strength. It is so huge and so heavy that you have to have something that is light, but yet you have to have something that is strong. There is a tendency for people to say, "Why did you not use titanium?" When you take titanium and try to make a tank out of it and fill it up with liquid oxygen, titanium is so reactive that it just eats itself alive. Titanium was out of the mix, so pretty much the whole thing is aluminum, and there are so many different variations.

On the engine on the first stage, the main thrust chamber is made out of a metal called Inconel, which was relatively new at the time. Today, the nuclear power industry uses Inconel everywhere. There is a big manifold that is used for ducting the turbo pump exhaust down and actually using it to cool a part of the engine. That material is called Hastelloy. It is used in jet afterburners, jet engine exhausts. All of the stuff that came along with the space program has gotten out into the industry everywhere.

Johnson: I believe people understand how complex the Saturn V vehicle itself, the rocket itself, was. Do you think they understand even the crawler that transported it to the pad had to be a complex piece of machinery?

Talley: I think all they really understand is that it had to be big and strong, if nothing else, to keep that thing level as you go out and start up the pad. You have to keep that thing level. It is almost 500 feet from base to the top of the crane. That is a chore in and of itself.

Johnson: All this had to be developed concurrently with the rocket?

Talley: It was all part of the development program.

Johnson: What was the pace of work like? How fast did things have to be accomplished during that decade when we were trying to meet a presidential promise?

Talley: You had things to do, and you tried to get them done as on schedule as you could. Sometimes it would not happen, but for the most part it did. There were a lot of long days and long weeks. We would work seven-day weeks. When we first came here, my wife and I and our three-month old daughter, we lived in a little apartment down on Whitesburg Drive. It was three shifts a day at the [Redstone] Arsenal, and there was traffic on Whitesburg continually, day and night. You go down there now and you do not even see that today. Once it gets past midnight, there is very little traffic down there. We would hear traffic going by all the time.

Johnson: What about the work environment? With all the long hours and strained shifts, was the environment good?

Talley: To me, it was. I think if you ask anybody that worked on that program, the thing that comes out is we all felt like it was a privilege to be there. This is something that mankind has never done before. It is peaceful. It is not warlike or anything like that. We all had this feeling that we were part of it and that we were going to make sure our part worked. The leaders, too, from [Dr. Wernher] von Braun and those guys all the way down, there was not much of this, "this is my part and you keep away." It was share the knowledge. In the first couple of years when I was at the Arsenal, I worked out at Marshall, I would go over to the headquarters building at lunch to the Public Affairs Office. They had a big office with these shelves just like a big library. They had every kind of pamphlet you could want on the program, on astronomy, on anything you wanted to know about. We would go over there and just help ourselves to whatever information we needed. I think it was a real team effort. Everybody felt good about what we were doing and where we were going.

Johnson: Was von Braun involved in what you did to the point that you saw him?

Talley: Not really. I was not high enough on the pecking order to see him. We would see him once in a while when he would come through the lab or something.

Johnson: How much discussion of controlling costs was there? Did you worry about money? Was it "we have a limited amount for this and we have to make it work?" What was that like?

Talley: It was not as tight as it is today by any means. You had budgets and you tried to live within your budgets. Everyone was trying to do their best, and part of it was controlling your cost. To the engineers, if you had something that needed to be done, you would go to your management and say, "We this here and it is failing. We need to do so and so to correct this problem." It would get addressed, and they would find the funds to do it. It was go out to Marshall and get another bag of money sometimes. (Both Laugh)

Johnson: Were there any dead ends or things that cropped up that set this part of the program back, or was it kind of a smooth progression up to launch?

Talley: No, it did work pretty well. Ground support, the part I did on that was only a couple of years. The rest of it with IBM was in mission engineering and systems engineering. In mission engineering, we were basically responsible for taking the requirements from NASA that said, "This next mission, we are going to do these things. What does the Instrument Unit have to do to make those happen?" We got all that stuff in place. If we did not, we would then work with the systems engineers to say we needed to do so and so. Most of the time, the first few flights are experimental or your development flights. From then on, once you started getting men onboard, most of your equipment was pretty well developed. Most of the changes after that come in your guidance and navigation, how are we going to get from here to there, we are launching on this day of the year, so you have to take that into account.

A lot of that became your computer program, which was pretty meager. We had a 16,000-word memory on the Saturn Instrument Unit computer. We could do 8,600 operations per second on a good day. A cell phone probably does three or four million operations a second. It was not integrated circuits as we think of today. They were hybrid circuits where you had little discreet chips that are transistors and then they are mounted on a carrier circuit of some sort. These pieces all tie together. The computer drew eighty watts and would actually flow coolant through it to keep it cool. A lot of the problems associated with that were not dead ends, but they definitely became real headaches.

Johnson: The first flights were test flights as far as what you were doing with the systems engineering, the guidance, and things like that. Did you also participate in the ground testing, the actual live firing? Did you test your equipment there?

Talley: We did with the ground support equipment. They used the same equipment out there at the blockhouse that they used everywhere else for the S-IC. The firings were here in Huntsville [Alabama]. We were not really involved with any firing. They were done out in California with the S-II and S-IVB stages. With the Instrument Unit, we used the same equipment in the test facility in the IBM building over on Sparkman Drive. The same equipment that was used at the Cape was used there. It was common.

As you go from one place to another, you know that everything is going to work correctly.

Johnson: Was every flight of the Saturn V almost a test flight?

Talley: It kept you kind of tight when they were flying, no doubt about it. (Laughs) About the first three missions, you had a lot of extra instrumentation onboard. Our job being mission engineering was, once the thing flew, to take the telemetry data, analyze it, and determine what worked, what did not work. The things that did not work, we then worked with the systems engineers and the component engineers to fix whatever needed to be fixed so you would be ready to go for the next flight. The first few flights, we had tons of data to deal with. On later missions, you cut way back on your research and your development equipment. Now you are kind of down to the operational phase. When something would go wrong, it took a little more digging to determine what the problem really was. There are so many crazy issues that can come up with these flights.

The first few flights that we went to the Moon, once the crew separates and goes on their way, they are going to go around the leading edge of the Moon. Think of it this way, they go into orbit around the Moon and do their thing. Now the question is, what do you do with that big S-IVB stage and that Instrument Unit hanging around out there in space? The earlier missions reoriented the stage, pumped the propellants out of it, did not ignite the engine, just pumped it out to give you some thrust. We would go around the trailing edge of the Moon and try to hit it, miss it by about 1,500 miles or so. You would get within about 1,500 or 1,200 miles of the Moon, then the gravitational attraction of the Moon would throw that stage into orbit around the Sun. There are a handful of those things floating around the Sun out there.

Beginning with Apollo 13, we would crash the stage into the Moon. Crew of previous landings would leave seismographs on the Moon wanting to measure moonquakes. We would slam this thing into the Moon and create about a six-hour earthquake, or moonquake. We had some problems with that thing where once the crew would separate and move away, we had to put an extra battery onboard to power our RF [Radio Frequency] system so we could track it. About three hours later, it quit. Son of a gun, this thing is supposed to last for seventy-eight hours until it hits the Moon. It turns out the Sun was shining down inside the Instrument Unit. We had coaxial cable, an aluminum cable, around the top of this thing, and it would actually melt the dielectric in the coaxial and it would short out and kill our transmitter. We had to cover it all up with Kapton in later missions, beginning with 13.

Johnson: Did you learn that after just one flight, or did it take more than one flight to discover that?

Talley: It quit after the first flight. The RF, people thought there was a problem with the coaxial switch, so they changed that switch out. Then on Apollo 12, it did the same thing, so we started looking. I happened to be out there at HOSC [Huntsville Operations Support Center] when they were watching one of the playbacks from Houston [Texas], and they were showing the crew backing away. You could see the Sun down in there. That is not right. We are not supposed to have that much sunlight down in there. We went back and cut up some cables, made some samples, and put them in a vacuum chamber. We put some heat tape on it and determined that at those temperatures, this stuff will melt. Black coaxial cables in space are cooler than aluminum cables. It was aluminum cables that were getting us because in the vacuum of space, it is how much heat it absorbs versus what it emits. Those are some of the kind of crazy questions we got into.

Johnson: If I ask you what the surprises were, it sounds almost like there was a surprise on every flight.

Talley: Oh yeah. On the first flight, the first Saturn V almost hit the tower. The fairings and fins on that first stage stuck out. It came within a hair's breath of hitting the tower. If it had hit the tower, that would have been bad news because the safety estimates were that the Saturn V, if it blew up on the pad, would create a 1,500-foot diameter fireball. That would have totally wiped out the transporter and a lot of stuff around it. The next flight, we put in a yaw maneuver. As soon as the hold-down arms released, we would can those engines and move it over so that it would tilt away from the tower and then fly. We had the guys at the Cape zoom in so we could see the top of the stage and the tower and see how it was moving over. We zoomed in so far that when it started moving, it looked like it was falling over. We about had heart failure. (Laughs) Then we backed up and could see where it was still flying. We thought, "Oh man, it has fallen over!"

Johnson: That yaw maneuver that you put in, that became a standard practice?

Talley: That is standard practice to keep it away from that tower.

Johnson: Can you talk about the difference between working with Marshall and with some of the other centers? Did you have experience working with any of the other centers?

Talley: When I was working on Skylab, we had a computer on Skylab, again, about a 16,000-word computer. The computers in those days were core memory. Core memory has a lot of electrons to make it work. They are very unreliable just by the sheer number of parts. NASA decided that we had so many parts that we had to do something to be able to recover if we lost that computer. The computer is made in modules, so we could have a 16,000-word program or we could have an 8,000-word program if we lost one of the modules, or we could have a hiccup, lose everything. Could we reload it from the ground? I was working on that project, and my responsibility on that was to make sure that all worked. I dealt with all the centers, with Johnson [Space Center], Marshall, and Goddard [Space Flight Center] and the Cape. Dealing with the people, it was really strange that a contractor could deal with the center people better than the center to center people could.

Johnson: There were rivalries?

Talley: There was definite rivalry, yes, tremendous rivalry between Johnson and Marshall. That became evident on the shuttle. That was very evident in the Shuttle Program because, if you watch the film of a Saturn V launch, you see all this white stuff coming down around the booster stage, that is ice. There is anywhere from a ton to a ton and a half of ice on the outside of that thing when it launches. Marshall knew that from way back. The business of “I will insulate the tank so that I do not have the ice forming,” there was always a bad feeling that even that can come off when you are going 5,000 or 6,000 or 8,000 miles per hour or whatever and do serious damage. That was really kind of a head butting issue. Even in the Saturn V days, I think a lot of that came out of the battle for money.

Johnson: Most people think there was not a money problem in the Saturn Program. Was it a problem?

Talley: Yes, it was an issue. You had to pay for it. (Laughs)

Johnson: You literally knew it from the ground to the computers onboard. When the entire system was put together and it worked, how amazing was that? I know everybody was more than competent and I am sure everybody expected their part to work. When it all finally came together, was assembled and worked, what was that like? Did that cross your mind, "I cannot believe this stuff is all working?

Talley: You always have that thought in the back of your mind just by the sheer numbers of parts. What do they say, that there are something like 3.5 million parts on the Saturn booster and a couple of million in the spacecraft? The boosters, just from the sheer size of those things, and for that thing to hold together, it is an aluminum can. (Both Laugh) For it to stay together, that always amazed me. The logic, the electronics, all of that, I always kind of felt pretty good about that because you tested this over and over and over. Once you welded these tanks together, you went and did some X-ray testing, but that is about it. This thing got stuck on a transporter and hauled downed to the river and put on a barge and shipped across who knows where and then got mounted and launched and stacked at the Cape. To me, just the fact that it stayed together, amazed me, still to this day amazes me.

Johnson: For the stresses, I know extensive static testing was done, but a lot of folks will not let you touch their stereo equipment because they are worried about something happening. How were you able to make the electronics and, what I guess we would think of as primitive, computers last with what was, I am sure, some incredible vibration?

Talley: They basically answered all of that as test, test, test. What they did was make this circuit, this component, that comes off the same line as the components that you buy at Radio Shack. It is just the screening that you go through after you make it. If it passes all these screens, it goes into the NASA bucket. If it passes all but the last two or three, it goes in the military bucket. If it passes all but one or two, it goes in an automobile or your stereo. If it fails the first one, it goes to Radio Shack. That is kind of the way it worked. (Both Laugh) I am not picking on Radio Shack, but that is kind of the way it was.

Johnson: No, I understand.

Talley: I was always very confident in the electronics and the components. Even though, given what we were doing at the time, looking back it might be primitive, but at the time we were doing it, it was the latest thing on the block.

Johnson: It was cutting edge at the time and it is only primitive in a relative sense.

Talley: Looking back, you say, "Wow, it is pretty amazing some of that stuff worked."

Johnson: Working on Skylab, talk about that a bit. That was the space station that was evolved from a Saturn V upper stage. Talk about the development of that, of the whole idea. We have the International Space Station now, which was an assembled piece of equipment.

Talley: A lot of that goes way back to von Braun and the German guys, way before World War II. Their idea was to basically build rockets of reasonable size, which we would think of as maybe an S-IB booster, which would be a first stage and a second stage. We can throw a bunch of stuff in orbit. Their idea was to build a space station in orbit and then use that as your platform to go elsewhere. In the case of going to the

Moon, that would be called an Earth orbit rendezvous method where I throw these pieces up into orbit. I built a space station up here, now this is my command post, and this is where everyone is going to live. I have a bunch of astronauts and people here living in the space station. They go out and they get this stuff that we have launched into orbit. They reassemble it into a spacecraft to go to the Moon. Then you go to the Moon and do your thing. The next thing they wanted to do was do the same thing, but you assemble those multiple spacecraft and you want to go to Mars. I think a lot of the people at Marshall thought Skylab was kind of the nucleus of our space station. We want to go put this thing up and see how people are going to live and respond.

Right off the bat with Skylab were big, bad problems. We lost the meteoroid shield, took off a solar panel. Pete Conrad was the astronaut commander on the first Skylab mission. Conrad was one of these guys that just had ice water in his veins. It is the only way you can say it. It had a lot to do with Conrad's sheer grit, because when the thing was launched there were two solar panels on the side of the station. One of them was ripped off during the launch by this meteoroid shield. The other one was jammed shut. It would not open up. Conrad gets out there on a tether and jimmies down the outside of this thing, jagged metal all over the place, and he starts pounding on this thing until, finally, whatever was holding it sprung loose. It slings Conrad out. Joe Kerwin, was that the guy that was with him? I do not remember which one was with him. He was standing up on the ATM [Apollo Telescope Mount] and said all of a sudden he sees Conrad go whipping by.

Johnson: What does ATM mean?

Talley: Apollo Telescope Mount, it was up on the top end of Skylab. This thing was a solar observatory. The airlock module is near that. Kerwin, I believe it was Joe Kerwin, he was out there, and if Pete had trouble with something, he was supposed to help him. Conrad is down there, pounding away on this thing, and it turns loose. He had this big, long tether. It throws him off the arm. The arm swings up, and the panel starts folding down. Meanwhile, Conrad is sailing through space, and the slack runs out in the tether. Then, he comes back again. Kerwin said he was standing there watching Conrad going back and forth, and, finally, he gets it all together and gets in. (Both Laugh) My heavens. You go back to where we were, the amount of time doing space walks at the time, he deserves a gold star for really saving that mission, just by being Pete Conrad.

Johnson: When you tell that story, and we know that Skylab was the first space station, and you describe how it was to be used, it almost seems like we did the missions before we did the base.

Talley: If you go over there in the Space and Rocket Center in the Saturn Hall, there is an exhibit that talks about Earth orbit rendezvous, lunar orbit rendezvous, different ways of direct descent to go to the Moon. The lunar orbit rendezvous method won out because the Earth orbit required the space station, required a lot of extra activity, whereas, the one we used, lunar orbit rendezvous with the Command Module and the Lunar Module, turned out to be the most economical. That is why we wound up going that way first.

Johnson: I understand that von Braun actually preferred a different method but went with that.

Talley: I think he liked the Earth orbit rendezvous because that gave him his space station and that gave him the way to go to Mars. That is where he wanted to go.

Johnson: As someone who worked on the program, do you feel like we may have missed the boat, so to speak, as far as having a more sustainable space program?

Talley: The problem we ran into is Skylab was it was put into an orbit that they thought was going to be stable. In other words, it would stay there, the atmosphere would not affect it. Shuttle, they already had done some preliminary work to have Boeing build what they would call a Space Tug. An early shuttle flight was going to take this tug up, which is just a small booster stage, attach it to Skylab, and boost it into a higher orbit. Shuttle got delayed by several years. During that delay, the Sun did some crazy stuff, solar flares and so forth. Depending on the type of flare, you get a lot of ultraviolet radiation. If you have the flare that produces ultraviolet, then the outer atmosphere expands. What was happening was Skylab was in orbit and was running into this atmosphere. It was left in orbit. If you can think of it as a cylinder, the cylinder is lined up with the gravity gradient and the head end of the thing is pointing towards the center of the Earth as it goes around the Earth. When the atmosphere expanded, this thing is broadsiding these bulges in the atmosphere, slowing it down, so they called us.

I was working at IBM then, working for the Army. They called us and they asked if we had anybody over there that knew anything about the computer system. There was another guy there, Tom Coon, and myself, and I had some stuff at home in the garage. Tom had some stuff in his garage. We got our stuff together. He was kind of the software [guy], and I was the hardware guy. We got it together, and he says, "Here are the commands you need to send up to reorient this thing so that instead of hitting broadside, power everything back up, you will hit the atmosphere with the nose of the thing and cut down the drag." We did that. Several of the NASA guys went down to Bermuda to send these commands. They did not send Tom and me to Bermuda.

(Laughs) They powered this thing up, and for almost a year, it settled out. The decay stopped.

About a year later, the Sun went through an unbelievable bunch of flares. The atmosphere expanded out to where the Skylab was staying in the atmosphere all the time. That brought it down. The idea was Skylab was really going to be the nucleus of a follow on space station, but this is where the money problem really started, because shuttle got behind and all these other things happened. Meanwhile, Skylab comes down. Once that happened, all your money went into the shuttle basket. After that, they said, "We want a space station," so the International Space Station came along.

Johnson: We had a Skylab that did not fly, am I correct?

Talley: Yes, I think that is the one that is in Washington [District of Columbia] in the [National] Air and Space Museum.

Johnson: There was a nucleus of another space station that did not fly?

Talley: There was a piece that they might could have, yes.

Johnson: As somebody who worked on the Saturn V Program and on Skylab, were you disappointed that more was not done with that?

Talley: Yes, it is kind of a shame that we did not keep going. Von Braun had some ideas of going to Mars. I think most all of us that worked on that program had hoped that would happen. They would probably cut back on Apollo, but we had three Saturn Vs left. We might be able to launch something. Skylab was kind of like a big experiment. It was keeping people alive for a long period of time. There were lots of experiments onboard, but it was not really much of a platform like these guys envisioned. Even when [Richard] Nixon was president, I remember, who was his vice president?

Johnson: Spiro Agnew.

Talley: Agnew, yes. Agnew even went to the Cape and talked about their vision to go to Mars, but that was kind of the last we ever heard of that.

Johnson: Are you disappointed?

Talley: Yes, I was kind of disappointed because I had hoped in my lifetime I would see somebody walk around on Mars. I do not think that will happen now. (Laughs)

Johnson: You were a contractor. Describe the contractor experience from your end. Was it pleasurable working with NASA?

Talley: Yes, the people that I worked with at NASA were always terrific. We worked with bunches of them. I never had any heartache at all about any of the Marshall people. The people at Goddard, they were some of the most computer savvy people I ever worked with, even working at IBM. These were government employees. They had some computers up there, and what those guys used to make those things do just amazed me. (Laughs) I could not believe it. That thing was not much bigger than this table. They could make that thing sit up and just do anything. They were a remarkable bunch.

Johnson: NASA Headquarters during the time when you were working with Saturn and Skylab, how did you feel about that? Did you feel like Headquarters helped, hindered, was heavily involved? How did it feel?

Talley: I guess I was so far down the pecking order that Headquarters did not really come into play that much with what I was doing. Somebody like [Alex] McCool could tell you a lot more about that. I thought highly of all the managers out here at Marshall.

I always did. Von Braun, [Dr. Eberhard] Rees followed him, Bill Lucas. I go to church with him. Lucas is kind of one of my heroes. Some really fine people.

Johnson: When the Saturn V finally flew, when Skylab worked, that was exciting to you. The whole project, when you finally produced the product, got human beings on the Moon, what did that feel like?

Talley: It was just great. (Laughs) I guess that is about as good as you will ever feel. One of the questions you ask about the people and the spirit among the people, that program, even though you may have been a top-level manager or you may have been just a nut and bolt engineer or the lady that sewed the spacesuits or whatever, everybody felt a real part of it. You just had this feeling of pride that you only get a few times in life. (Laughs)

Johnson: What do you think [about] this feeling that everybody was important and contributing? I know that von Braun was very cognizant of the fact that it was a team effort and went out of his way in meetings of 100 people to make sure everyone knew they were expected to ask questions if they had a question. Is it the direction from above or the involvement that made everything work? Was it that, you think?

Talley: I think that had a lot to do with it. Like I said, the fact that you had the program where if you wanted information about the part you were working on or a piece over here that you really were not working on but you were very interested in, that information was always available to you. I would have never even thought twice if I had seen one of the center directors or somebody like that, if you had a question, you would just go ask him. I think everybody kind of felt that way.

Johnson: In your work experience before and after, has that always been the case?

Talley: Oh, no. (Laughs) I spent twenty years in the commercial world, and when you work in the commercial world, you know very well that it is a dog-eat-dog world. It is very hard to feel like you fit a lot of times. Am I making a difference or not? Does my management really even care whether I am doing what I am doing? Looking back, that was definitely different.

Johnson: Did you sense you were making a part of history?

Talley: I do not think so. I think we were just kind of doing our thing, but we were loving it. It was an incredible adventure. Looking back, you kind of feel like that was historic. We had never done that before and we have not done it since. (Laughs) I guess we were. You kind of had this, "this is where we are going and let us get busy and get there." Whether you thought you were making history, I never really thought of it that way.

Johnson: We know that the German rocket team, and certainly von Braun, received a lot of recognition for all that was accomplished. Do you feel like everyone else got the recognition they deserved, even yourself and the team you worked with?

Talley: There were a lot of people that I thought should have gotten more recognition than they did, but NASA had a very good program set up. They had a program they called the Manned Flight Awareness Program. Each contractor had several people that were trying to instill in you the fact that this is important. I have this business with Apollo 13 where we had the problem with the communications failure and all. I kind of came up with the resolution to that. NASA gave my wife and me a trip to the Cape to meet the astronauts for the launch of Apollo 13 and VIP [Very Important Person] stands. There were a number of us that got such awards. That meant a lot to me. It meant a lot to the people I worked with that were part of it. Those kind of things were part of that program, and I think they went a long way to giving you this feeling that these guys were putting their lives on the line for you, so everything you do has to be done right. That was the basis of the whole thing.

Johnson: Was that sort of thinking shared by everybody?

Talley: Yes, absolutely. That was the key point. In fact, we had a little card they gave us to carry around in our billfold. It shows a person holding two of the shoes or boots that they wear on the Moon. It just said, "Put yourself in these shoes." It has an IBM logo on it. They did things like that. Little things like that make you think. I believe everyone kept that in the back of their mind, these guys are putting their life on the line, you better do it right. There are so many ways you could end their lives in a hurry.

Johnson: When you look back on the program and your involvement, is there a bottom line on all this for you?

Talley: I guess the bottom line for me is kind of looking forward because I am seventy years old now. I do not see a lot of the young people having the opportunity that we did. I think a lot of our leaders are somewhat shortsighted. You take a big research and development program like this, and the things that come out of it are important. For me, like I was telling you, there were things I learned on that program that if I had not had I would not have spent thirty years at IBM, I am sure.

Here a while back, I took the ten years that I worked on that program and looked at what they paid me during those ten years. Most of us were in our twenties and thirties working on that program. I added that up. Over the last few years, I paid way more than that in taxes. To me, that is the bottom line out of these kinds of programs. You have no earthly idea how much the country benefits from a program like that. Why would we go to the Moon? So Luke Talley could pay you back. I think that is something that NASA never did enough chest-beating over, to let the world know this is a big R&D [Research and Development] effort here and it is going to benefit everybody in so many ways. For me personally, I have a nice house, a beautiful wife, two beautiful children, and we have been unbelievably blessed. It all goes back to those first few years working on that program, I believe.