

## ORAL HISTORY TRANSCRIPT

GERALD D. GRIFFIN  
INTERVIEWED BY DOUG WARD  
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WARD: This is an oral history interview with Gerry Griffin, a former flight director, flight controller, and former center director of the Johnson Space Center. The date is March 12, 1999. Gerry, you cut your teeth in Mission Control during the Gemini Program as a flight controller responsible for spacecraft guidance and navigation. How did you manage to get in on the ground floor of a program like this? And, what was your secret?

GRIFFIN: It was not easy. I had actually tried to go to work for NASA in 1962, and the guy that interviewed me was [Eugene F.] Gene Kranz. And Kranz and I couldn't get together on money. And so I said, "To heck with you," and I went off and I did something else. I went—in fact I went to General Dynamics in Fort Worth. But I knew I wanted to get there so bad that, finally 2 years later, in 1964, I took a pay cut and I went to work for Kranz (actually with [Melvin F.] Mel Brooks) and started out as an Agena flight controller. And the reason that I did—and that Agena was what we were going to join up with Gemini with in the rendezvous. And I had worked on the Agena at the Satellite Test Center out in California right after I got out of the Air Force in 1960. And we flew those early flights from Vandenburg [Air Force Base], and I knew something about the Agena. And finally I swallowed my pride (and my wallet) and came to work in Houston.

And—at that time we weren't even at the center. We were all over—in offices all over Houston. And—the best step I ever made in my life was to do that. The interesting thing, too, was that I only worked the Agena for about a month and then moved immediately to Gemini as a guidance, navigation, and control officer. So I actually never worked on the Agena in flight at NASA. I started out actually as an Agena—or as a Gemini—

WARD: Even though the Agena was a real workhorse in Gemini.

GRIFFIN: That's right. And—but other people came on, and actually in those days we were short of people. There was a shortage of flight controllers. And the fact that I did know something, I had been a part of a unmanned space operation, I think was the reason Kranz decided to move me over into the manned side fairly fast, because I did have some experience. I was a little bit older, albeit not much. I was a little—I was only 30. But I was a little bit older than some of the real youngsters that we had in the control center then. And—so it was an interesting time and the best step I ever made.

WARD: You kind of alluded to this, but there really was no preexisting cadre of flight directors. There was no curriculum for flight directors in college. So if you're Gene Kranz and [Christopher C.] Chris Kraft [Jr.] trying to put together a cadre of people—a fairly large group—to fly all these missions, how do you do that?

GRIFFIN: You know, I think—I give most of that credit to the two people you mentioned. Particularly to Kraft in the early days, and then later [to] Gene Kranz. I think they were both uncanny at picking out people that could respond to this kind of environment. It was very unique. Like you say, nobody had actually been in that pressure cooker, split-second, decision-making on the ground. Plenty of guys had been in airplanes doing that, but there was not many people that had done it from a ground standpoint, where it had to be an instantaneous kind of thing.

I think Kraft was particularly adept at testing people in simulations and all of that sort of thing, and picking out the ones that he thought could cut it and those that he couldn't—that might not. Gene, I think, got better at that as time went along. And in fact,

we, as you (I shouldn't say that but) as you know, we didn't have too many washouts in Mission Control. By the time we got to a real mission, with all the simulations we had done and all the hours we had spent together, it was pretty obvious that the team we had on the floor for the actual flight were all performers.

And I had flown in the Air Force. I had worked the unmanned side with Agena for the Air Force after I got out. And I think I took to it like a duck to water. I—it was a fairly easy transition for me to make, because I had been in that split-second, decision-making position before. And I think the other thing that comes to mind when I think about that is how fortunate I was to be a part of that organization. There were so few of us, and we were all kids. Young people, with life-and-death decision-making capability, probably much before we really had ever been tested with that. So, it was a very unique time in a unique setting.

WARD: Even though a lot of it was just judging personality and abilities, there were also some criteria that went into the kinds of people they were looking for, weren't there?

GRIFFIN: Yes, there was a big criteria I think was the fact that we were all engineers or technical people. There were scientists involved, too. For the most part, most of us were engineers. So it had to—you had to have a very good technical grounding. The second thing I think is the personality trait. It was as close to being like a fighter pilot organization as I had ever seen. It took a bit of cockiness (measured) and confidence (measured). In both cases, if you didn't have the confidence to speak up and get the job done, you wouldn't last long. It just didn't work.

So, I really think that at the end of the day the confidence and the technical skill was what was the most important aspect. And then the other thing is that final thing: not being bothered by being out on the end of the diving board, fully exposed, so that all your errors

showed up. I—you know I've often said that astronauts, flight controllers, and all of that kind of thing, you know, they really didn't mind dying nearly as much as they minded screwing up in front of their peers. And you had many opportunities in that environment, both in simulations (thank God most of them happened in simulations) but sometimes in real missions where you were out—kind of out there by yourself and you had to make that call. And, the real fear was screwing up.

WARD: I've heard stories. I don't know if they were apocryphal or true, that early on in Apollo and Gemini and Mercury, Kraft had a bulletin board where he had all of his flight controllers' pictures on it. And if anybody screwed up badly enough, there would be a big black grease mark through their picture.

GRIFFIN: I never did see that. I heard that story. Chris was fast to scratch if he—In fact, on at least one or two occasions, and—at least one occasion I can remember we talked him out of it. We thought he scratched one too fast.

WARD: He had strong faith in his own intuition.

GRIFFIN: Yes. And I would say 99.9% of the time, he was exactly right.

WARD: One of the things (and you also alluded to this), but when visitors come through Mission Control even today, it was certainly true back then, the thing that they would tend to comment on is how youthful all these people were. And almost in no other field of endeavor will you find young people making those kinds of life-and-death, nationally significant decisions. And, it seems to have been something that happened almost without a great deal of forethought. Those were just the people that were available. They were given

the responsibility and trusted with it. And, I wonder how that felt—as being a part of that kind of a cadre.

GRIFFIN: Well, you know, two things come to mind. One is, when I—when it was happening in all of that era, I don't think any of us really recognized how significant what we were doing—it—we knew it was significant. We didn't realize, I don't think at the time, how fortunate [we were] and what kind of capability did we have to have to ever even get into this position. In many cases, I think I go back again to the analogy of the fighter squadron. You go into a fighter squadron today, just like then, and one of the things that always shocks you is how young these people look. And they are young. I mean, those F-15s and F-16s and F-22s that are coming along now, these—they look like kids flying them. And I'm sure that the—that we looked that way. Because in many cases, and I've discussed this with Gene Kranz, he was looking for people with flying backgrounds because he thought that skill would transfer, and there was no other place to go find them. And he thought that skill would transfer. And so I really think it—we were young. But it was the—it was a young person's business. Now the big difference I see today, which is of course a big improvement, is that we were all guys. All men. And of course, now we have men and women in Mission Control—and should have them. We just didn't have the skill base at that time to do that.

WARD: The rest of the country hadn't caught up either.

GRIFFIN: That's right.

WARD: You didn't have the people in the pipeline.

GRIFFIN: We were right along with the rest of the country.

WARD: So Kraft's protégés is that first tier of flight directors—John [D.] Hodge, Gene Kranz, Glynn [S.] Lunney—were all people that you worked closely with. I'd be interested in your kind of thumbnail sketches of each of those. And what did they pick up uniquely from Kraft? What did they bring to it themselves?

GRIFFIN: You know, the guy that probably became more Kraft-like was Lunney. Glynn Lunney had many of the same traits as Kraft. He was quick to make a decision. He was a little blustery every once in a while. Confident as all get out. And I always thought that Glynn had a lot of Kraft look to him and feel to him. Kranz was—had some Kraft kind of features to him, but he was his own guy. As you know, he—we always called him the Prussian General. He—and he had that very military bearing, preciseness, the—that Kraft didn't. Kraft, I think, went more on gut feel and emotion and—, where Gene was more of a do-it-by-the-numbers, by-the-book kind of [guy]. John Hodge, I don't think, matched any of the others. He came from a different—he was a technical guy.

WARD: Hodge came out of the Canadian—

GRIFFIN: Avro—

WARD: —Avro group.

GRIFFIN: —group. And John brought a different set of skills to the table. He was a very strong technical guy. And I think operations was not his first choice or first love or anything like that. And I think that's one reason he didn't stay in it very long. I think he had

other talents that went to work somewhere else. And, you know, he got—I think, as I recall, he went into advanced programs when he left. He was very good. He was a visionary almost. Flight operations didn't have much room for visionary. You had to make the hardware work that you had in front of you at the time. So I think John did fine as a flight director, but he just didn't stay in it very long because I don't think it was his bag. But they were all very capable people, and all fun to work with.

WARD: Which of the bunch, if you were working as a flight controller, a member of the team—which was the easiest for you to work with and to work for of that bunch?

GRIFFIN: Oh I think when I was a flight controller, the guy that I probably related to the fastest (and of course he was an icon to me, even though he probably shouldn't have been but was) Kraft. I always felt honored to work with him when he was flight director. But, Gene Kranz was always easy, and so was Lunney. They were—none of them [were] difficult. They were all demanding to the point that they wanted you to be prepared. And that was not an issue in those days. We all worked so hard at what we were trying to do and, as I said earlier, nobody wanted to screw up in front of the peers. So it was—the best motivation we had was the peer pressure.

WARD: Kranz's organization always struck me as being helpful because he worried every little issue and problem and communicated them so thoroughly over the loop that everybody knew what was going on—

GRIFFIN: Right.

WARD: —and it got worked over and over and over again. So the problem and the approach that was being taken was so clear.

GRIFFIN: Yeah. Gene was by far the most detailed guy and all that. But he—everybody knew what he was trying to do and where he was headed. Kraft and Lunney [were] more gut feel. Strong technically also, but [they] had that guy feel that could—most of the time they knew the answer already. So did Gene.

WARD: Yeah.

GRIFFIN: Even when I became a flight director, by the time you elevate to that point you pretty well know what's going on. But you've got these great guys that—

WARD: I never had the pleasure of seeing Kraft operating as a flight director. But the one trait that I sensed all of you had, from him, was the tendency to make the flight controllers take the responsibility for the decision.

GRIFFIN: Amen. That is what we learned, all of us learned, from Kraft, watching him. He would never, ever try to do your job. I recall on Apollo (I think it was Apollo 12), after we got hit by lightning, I was—

WARD: I was going to ask you about that.

GRIFFIN: Okay. Maybe I should wait—

WARD: No, go ahead. That's fine.

GRIFFIN: I was just going to say: I can remember, we got hit by lightning right after liftoff, and it tumbled the spacecraft's platform, and thank God the Saturn V continued to work just fine. And I was the flight director, and it was my first job as a launch flight director. And I thought we were going to have to abort. I never will forget that feeling. My heart was in my throat. I could—but the training came through. We are—I've gone back and listened to that voice tape a lot of times. And nobody was ever hurried. Nobody was panicked. First thing I did was I looked at the plot and asked the FIDO (the flight dynamics officer), were we still okay? And we were gaining altitude. And I remember, flashing through my mind very fast, that, "Well, if we're going to abort, let's don't abort early. Let's get some more altitude and we'll just punch off this thing if we have to."

To make a long story short: We got everything back under control. But the platform was still rolling. The inertial platform that measured your attitude in—

WARD: This was in the spacecraft?

GRIFFIN: It was in the spacecraft. It was tumbling. It was in a gyro, gimbaled system. And it was tumbling, and I knew that could damage it, particularly when you got under high gravity (at high g forces), that you could damage the platform if you—if it continued to do that. So I asked the GNC (the guidance and navigation control officer) what he wanted to do. I knew what needed to be done. There was a circuit breaker [pauses; clears his throat] (Excuse me—) There was a circuit breaker you could pull, called the IMU—breaker. You could pull that and it would automatically cage the platform. Stop it where it was. And he said, "Stand by." And if you listen to the voice tape, you can hear my impatience.

I knew what to do. I knew—I wanted to tell the Capcom, "Tell him to pull the IMU circuit breaker." But because of Kraft's leadership and training, and what I had seen him do

in similar situations before, I just let the situation go on. I figured we were not going to hurt it too bad, even if it kept going and that. So I asked the GNC—I asked him about three or four times, “What do you want to do about this IMU? The tumbling IMU?” And he kept giving me the “Stand by. Stand by. I’m checking with my back room. Blah blah.” Finally he said—well, I said, “You’d best hurry.” I knew—because I knew—we were getting up to the point we were going to be under very high g’s. And he came back to me in a minute and said, “Have him pull the IMU circuit breaker.” And then I told the Capcom, I said, “Tell him to pull the IMU breaker.” And I was standing up by that time, and I was ready to—just about to scream. But I let him make the call, because I knew that was the way it was supposed to work.

WARD: How quickly did you realize that the vehicle had been hit by lightning?

GRIFFIN: We didn’t get the first hint of it until [Charles C.] Pete Conrad [Jr.] said it. He said—and this was after we had at least gotten the power restored back in the—

WARD: So you were either on orbit or close to it by that time.

GRIFFIN: Yeah. Well, no. Because actually, this thing happened about (as I recall)—about 50 seconds or so after liftoff. And in only about 2 minutes we had the fuel cells back on line that provided the power to the spacecraft. Incidentally, made on a call by a young flight controller named John Aaron, who I think at the time was 23 years old. So we had it didn’t take us long to get the power restored. We did have systems that were still off line, but we had—at least had lights again and all that. And so, it didn’t take too long. And then, kind of in a quiet part there, Pete said something like, “I don’t know what happened. I’m not sure we didn’t get hit by lightning.” And later we found out, even after they got on orbit, that he saw

a flash. You know there was a boost protective cover over the windows while the launch escape tower was still on there, so he couldn't see out real well until—

WARD: That was to protect the windows from getting covered up with soot?

GRIFFIN: Yes. That's right. And so he—but he thought under all of that he saw a flash. And so that's what started us thinking that it may have been a lightning strike, and it's what worried us. Because at the point that we got into orbit, we weren't sure if we'd fried something back in the back end in the service module. Because we didn't know where it had hit—and—the lightning, if it was lightning.

We got some quick pictures out of the Cape. I think that we might've already even started on our way to the Moon by then. They got some pictures out of the Cape that showed some lightning discharges back down. We probably created our own lightning, is what we finally figured out months later. A week later.

But we were afraid we may have fried something so badly that we jeopardized the mission. So what we essentially—we took an extra revolution in Earth orbit. We didn't go the first chance we had to go to the Moon. We did it on the next chance. And that gave us a little more time. We essentially, in that time, checked out everything we could in the rear end on the service module. And that proved to be a good call. We went on to the Moon. We still had that worry about the heatshield. We had *a* worry about the heatshield. And the reason that we did is because we didn't know if it had done any—if the lightning had hit right back in that area, it might've cracked it or damaged it or something. Of course that played out later—

WARD: Yeah.

GRIFFIN: —during the entry phase with the leak—

WARD: Well, it wouldn't have made it any worse if you'd gone on to the Moon before coming back around anyway.

GRIFFIN: That's right. And once we got into orbit, I mean, we had that that trip to make anyway.

WARD: You had to come back sooner or later.

GRIFFIN: That's right.

WARD: I don't know how many vehicles have been struck by lightning in launch, but I know of at least two Atlases that were struck by lightning that that were lost.

GRIFFIN: Really?

WARD: One of them a couple of years after—well, several years after. In fact, it was fairly close to the *Challenger* [51-L]. They were after the *Challenger* accident when an Atlas was launched in very similar circumstances at the Cape [Cape Canaveral, Florida], hit by lightning, and it tumbled—

GRIFFIN: Tumbled it.

WARD: —the guidance system, and it was lost.

GRIFFIN: You know, we were so fortunate in Apollo 12. I—you know we had the separate guidance system for the launch vehicle (the Saturn), and then we had the spacecraft guidance system. And during the launch phase, the spacecraft guidance system was just along for the ride. And somehow that lightning, when it hit, got this guidance system, but it did nothing to the Saturn's guidance system. And if it had been the other way around, that could've been a—it could've been a real disaster. A real tragedy. And, so we were very—we were extremely lucky.

WARD: Well, in fact a couple of people were in a position (the commander, Pete Conrad, and you and the flight controllers) to have made an abort call on the information you had—

GRIFFIN: Yeah.

WARD: —if you had reacted immediately, wouldn't you?

GRIFFIN: You know we did. The thing, as I alluded to earlier, the thing that made that—and this all happened—it was happening very fast. And—but I remember I had two displays on my own console, and one of them was a display that had five circles. It was the five Saturn engine representation. And in the middle of each one, it had a chamber pressure that was read out digitally, so that you could see what the chamber pressure was. And as soon as the first hint of something—when he said, “Got a main—”—he started reading off the caution warning panel which had just—Pete did. I think it was just going crazy. I looked—I remember looking down at those five engines, and they were all still right on the money pressure wise. So, I knew the engines were burning. And I glanced up and looked at the front board, and we were gaining altitude right up the flight dynamics officer's preplanned

plot. And immediately I said, “We don’t have to do any of this.” I was thinking to myself, “I don’t have to do anything right now. We’re gaining altitude. We’re okay.”

And you know it seemed like it took forever for John Aaron to get that call back up to say, “Have him reset the fuel cells.” Oh the first thing was “SCE [signal condition equipment] to aux [auxiliary].” There was a little switch. SCE was signal conditioning equipment. And there was a little switch in there that you had two positions—normal and alternate—and it was in the normal position. And he had seen a similar thing happen during a pad test on Apollo where he had lost all the telemetry, all the data. And they had gone—the Cape did it. He was just watching. The Cape went to the aux position and it restored it, because it put a new line of signal conditioning equipment into the loop. And so he said, “Have him go SCE to aux.”

And when we—and this was a funny time because—and a lot of this happened on the air path. We weren’t talking on radios. He said, “SCE to aux,” and I yelled over the top of the console, “What?” I’d never heard of the switch. We’d never touched it. Never used it, out of all those hundreds of switches. He said, “SCE to aux.” So I turned and I said, “SCE,” to the Capcom, “have him turn the SCE to aux.” I said that on the radio. And he yelled back at me, “What?” The same thing I had said. “SCE to aux.” That was [Gerald P.] Jerry Carr, I think. And so he yelled—he radioed that up, “SCE to aux,” and [Alan L.] Bean knew where that switch was. He—thank goodness, because—

WARD: Bean didn’t say “What?”

GRIFFIN: No, he didn’t say “What?” He had remembered it, and he—as soon as he did it, it restored our data. And then we could see—he—John could see that the fuel cells had been kicked off line and the reentry batteries were the only thing holding up any voltages at all. And—

WARD: The crew was in the dark for part of that, weren't they?

GRIFFIN: Well, they—almost the dark. They—the lights—the main cabin lights were out. But he still had the caution and warning lights, and there were some other minor lights. They never did go completely dark, but it was a touch-and-go situation. When I listen to that on tape now, from the time the thing started till the time we had power restored, I think is something a little less than 2 minutes. At the time it seemed like it was forever. But all that time we were gaining altitude, and so I figured, "Let's don't do anything here until we—" It was obvious that the Saturn was steering okay. So—

WARD: As I recall, you got the tape from the internal crew conversations in the cockpit at that time. With downlink, very quickly we had those in Mission Control.

GRIFFIN: We did.

WARD: That was a pretty lively tape.

GRIFFIN: And I've still got a copy of those. And they're very funny. It was a little bit—those three guys were a little bit like—you know sometime in a car accident or a near car accident when you have a close call and then you talk about it and everybody gets kind of giddy and "Whoa boy, that was close!" "Yeah, yeah, that was—" These guys, between themselves, Pete had that giggly laugh anyway, and he started laughing. He said, "Good Lord!" he said, "I had no idea what was happening there. Yeah." They were—they sounded like three kids. But it was because of the giddiness of damn near buying it and getting by it.

WARD: They were also, in a very methodical way, however, amidst all that going step by step—

GRIFFIN: Step by step.

WARD: —responding to the ground and putting stuff back on line.

GRIFFIN: Getting stuff back on line. And when you listen to the air-to-ground voice tape, it was very disciplined. Click click. It—I have to say, every time I hear it and I listen—I had reason to listen to it several times. It kind of makes you proud of the way the whole thing got carried off and was responded to. It was a lot like the Apollo 11 landing. You listen to that and it will make those team members should have a lot of pride over that.

WARD: One of the things that the—, of course, the press pointed out at that time was that President [Richard M.] Nixon was in the viewing stands. And there was a suggestion that if the President had not been there, NASA might have been a little more conservative about launching into a solid overcast with lightning potential.

GRIFFIN: Yeah. I didn't buy that.

WARD: That had no bearing?

GRIFFIN: No. In fact, I think that day we learned so much that it—we had launched in conditions not—maybe not quite that bad. But, in the clouds. We had never worried about that too much. The – [Walter J.] Walt Kapryan was the launch director (“Kappy”), and it was his first time as launch director. It was my first time as flight director. And he and I

have laughed about it on several occasions, that we were—our start in those new jobs was—was a little bit dubious about our ability. I think we would have made that call any time. I didn't—the fact that—I didn't—never thought about Nixon being there. And I'm sure he didn't either.

We just didn't know that a vehicle that big, with that ionization capability of all that heat and fire out the rear end, could actually trigger—could actually make lightning happen. And I think that's what happened. I think we actually created a lightning strike. And from that day forward, as you know, we've never launched again into clouds, and particularly if there's any lightning anywhere near, it's a no go. And we learned that, that day, the hard way.

WARD: It was a real tribute, as you pointed out, to the Saturn instrument unit, the IBM-built instrument unit, that it withstood that and it didn't tumble.

GRIFFIN: Yeah. And I will not forget, I—calling the people at Marshall [Space Flight Center, Huntsville, Alabama] after we got on orbit, and telling them how glad I was that that IU had—the instrument unit had held up.

WARD: Yeah. Before we get too far beyond it, I wanted to talk to you a little bit also about Apollo 8 and get your reaction to what to a lot of people seems like an audacious decision at that point, when we had never flown the Saturn V with a crew on it. The Apollo command module, we had flown only once since it had been very extensively redesigned after the Apollo fire. And yet on Apollo 8, the second flight of the spacecraft with a crew on it (the first flight of the Saturn V with a crew on it), we said, "We're going to the Moon." Not only are we going to the Moon, "We're going to go on orbit around the Moon."

GRIFFIN: Right. Not just to fly there, but—

WARD: Yeah. How did that happen?

GRIFFIN: I get—ever since the Apollo Program ended, in public and forums and in private, I've gotten a lot of questions about what I thought was—which mission stands out in Apollo to me the most. And I know everybody thinks I'll say Apollo 11, because it was the first landing. But it doesn't. It was Apollo 8, to me, was the biggest step we took. And when we—to leave the Earth's influence and to come under the influence of another heavenly body was a big step.

And I don't—I can remember, it was almost (later we got a little better about this) but on Apollo 8, when we did the translunar injection burn, you could have heard—(that was the burn that sent us toward the Moon), you could have heard a pin drop in that control center. I mean, there was nobody even breathing hardly; and it was almost like a religious experience. And then when cutoff—and the engine cutoff and the trajectory—we did a quick check on the trajectory and it was good, we were headed out, we all kind of looked at each other and said, “Well, we've done it now.”

It's a little bit like the solo you do in an airplane the first time when you get off the ground. You're really happy, and then all of a sudden you say, “Good gosh, I got to get this thing back on the ground again.” But it was—you know, it was a very quiet period going out there. And then right after, oh shortly after TLI, Borman got sick. Our first thought was that there's something we don't understand about going toward the Moon or something. It's going to—it's going to make them all sick. And we got a disaster on our hands. Of course that proved not to be true. But it was just a—it was a—kind of a gut check time.

And then I remember when they went behind the Moon. When we lost signal, as they went behind the Moon. They were going to do a maneuver back there to

slow themselves down so they would go into lunar orbit. I never will forget how quiet that whole room was for that entire—I think the backside took about 50 minutes, as I recall (45 or 50 minutes). And nobody—hardly nobody—hardly anyone moved that entire time. And when they came around the corner on the other side and started saying—reading out what they had done: “Everything’s right on.” “The Moon looks like this, this, this.” “It’s brown.” “It’s gray.” “It’s—.” A great relief. A great relief.

And then—but then we stayed that way. It got a little lighter until they were going to do the transearth injection burn. And when they went around that corner the last time to do that maneuver that was going to bring them back home, again it got very quiet and almost churchlike in the control center.

I don’t think there’s any doubt that Apollo 8, it did accelerate the program. I think it allowed us to get the program going. It clearly stuck a knife in the Russians. And, let’s face it, we were in a race with them. Getting men in orbit around the Moon at the same time that they were trying to, and then later, with their Luna and Zond, later trying to land on the Moon. It was all in that same timeframe. We weren’t eaten up with that in the control center. We weren’t eaten with the Cold War or anything like that. But it made us all proud. And we knew we had taken a step that was going to get us to the Moon, and land on the Moon, faster.

But I was not a part of the decision-making process at that time. That happened at Headquarters and at the director level and the flight—director level at Johnson Space Center. It was—it probably took place with, I’d say, 3 to 10 people. I don’t even know how many were on that. But, boy, it took guts to make that call and get us there.

WARD: I think—I never, except for one occasion, remember Kraft looking visibly nervous and agitated.

GRIFFIN: Yeah.

WARD: And that was when he was waiting for the spacecraft to come out from behind the Moon after they had supposedly fired their engine to start them back to Earth.

GRIFFIN: Yeah.

WARD: And of course, that was on his shoulders.

GRIFFIN: Right.

WARD: So he was—

GRIFFIN: And that was a single engine had to work. And, of course, we did that every mission after that, that went to the Moon. But that was one engine. One engine bell. A lot of redundancy in the piping and all that. But there was only one rocket chamber, and only one set of fuel tanks, and it had to work. And it did. Thank goodness.

WARD: Well the crew must've had an awful lot of confidence in Mission Control by that time to trust those sets of numbers that would put them into an orbit that was just 60 miles—

GRIFFIN: 60 miles.

WARD: —above the surface instead of 60 miles into it.

GRIFFIN: Right. In fact Al [Alan L. Bean, or Alan B. Shepard, Jr.] said, you know, every one of them said it. The impression they had when they got a look at the Moon up close, before they went into—that they were going to hit it, because they had watched this little bitty circle get bigger and bigger and bigger. And then all of a sudden they were right up against it, and they couldn't see the horizons even. And they all had the feeling they were going to hit it. So, yeah, 60 miles is not very far.

WARD: Did they ask you to double-check the numbers?

GRIFFIN: No. They never asked us to double check. I can recall, and I think it was Apollo 14 and I think it was [Edgar D.] Ed Mitchell that said something about, “You guys, you sure you're right with those numbers?” or something like that. He meant it as a joke. But I think the message was there.

WARD: As I recall from the questions at the time, the crew didn't really get a good visual look at the Moon until they got very close to it because of the—

GRIFFIN: That's right.

WARD: —attitude of the spacecraft.

GRIFFIN: That's exactly right. They didn't see—they saw it fairly far out. And then once they started getting closer and they got into position with the injection burn and all that, they didn't see much of it. And so it was a leap of faith that we had any—

You know, a lot of people don't understand. I've explained this to folks that this problem was a little bit like a shooting a shotgun, shooting a clay pigeon moving across in

front of him. That the Moon was in orbit, and our vehicle, we actually had to aim out this way and let the two collide. Rendezvous, if you will. And it just—intuitively you think there could be a lot of room for error. And it turns out that we had learned early on in Ranger and some of those Voyagers and things like that—Well, Voyager came later, but—some of the Ranger stuff they had done. We'd figured out pretty early that we could navigate to the Moon. And—but it—I'm sure some of them thought that we were going to hit it.

WARD: It's no longer precise, but once you were in orbit it was a little different question. Because you didn't understand the lunar gravity that well.

GRIFFIN: That's right. The lunar gravity is not consistent, caused by these concentrations of masses [mascons]. And we did see some early indications that we didn't understand the Moon's gravitational pull as well as we thought we had. But we learned what those were later and refined it.

WARD: Before we get completely away from Gemini, that program seemed to have a tremendous bearing on the success of Apollo. And I'd like to get your thoughts on what you and the flight control team and the astronauts, the operations team, got out of Gemini that made Apollo successful.

GRIFFIN: You know I actually heard, and I suppose somebody thought it out this way. But, when I look back at Mercury, Gemini, Apollo, I think we could have just as easily called them all Apollo. It was actually one program. The Mercury capsule—and it really was a capsule—all it—about all it did, it says that you can put a man in orbit; you could put a person in a pressurized volume; he can eat, sleep; and that was about all Mercury did. It was getting through the atmosphere and landing.

Gemini was just kind of a slightly bigger version of that same thing except we learned not only how to stay in orbit longer, but we learned how to rendezvous. And we learned how to do an EVA, an extravehicular activity. You could go outside a spacecraft and do work. So, when you think of Mercury, Gemini—it was really then this precursor to a real command module of different—a real working environment.

By that time, we had done the major task it was going to take to go to the Moon. We had done EVA. We had done rendezvous. And we had stayed in space long enough that we knew the 10-day mission told us we were okay. So Gemini, I think, was a—and Mercury ended just about the time I got here. I think they had—I can't remember when MA-9 [Mercury-Atlas No. 9, *Faith 7*] flew, but it had flown not too long before I got here. And Gemini was a superb program and a great spacecraft, and it worked well. We had a little—some thruster problems throughout the program, and it was always on my systems that I was dealing with. But other than that, the thing worked fine.

And it—Mercury had worked so well, and Gemini had worked so well, and they were both built by a contractor that was not building the Apollo command module and service module. And I can recall one of the interesting transitions from Gemini into Apollo was wondering whether we had a contractor that knew how to build spacecraft. Because the only one that had ever flown had been built by McDonnell Douglas and—McDonnell at that time. And so—and—but that proved to be—gosh I can remember on Apollo 7, when we finally flew the first mission, it was clear that that was a fine piece of machinery and it worked extremely well.

The fire had obviously set us back. That was no fault of that module. It could've happened in Gemini. Or it could've happened in Mercury even, because we were flying the same kind of pressurized system, 100% oxygen. And we got kind of faked out, I think, in those two early programs. And we were going right on with Apollo, just like we had always done.

I think the flight hardware that we went to the Moon with was just outstanding. The lunar module, [an] outstanding piece of hardware. And it really came to its fore not only when it landed, but when it pulled us out of the fire on Apollo 13. Had it not been for the lunar module, we would've lost that crew.

And, so, I think all those programs fit together in a nice integrated kind of fashion. And I—like I say, I assume somebody sat down and thought through all of that before we did it. We—at the time we were pulling it off, it all felt kind of like we were just doing the next step and the next step. And I'm sure somebody was back there saying, "Yeah, this is going to all fit this big puzzle before it's over."

WARD: It certainly all fit.

GRIFFIN: It did.

WARD: I don't know if somebody planned it that way or not.

GRIFFIN: Right.

WARD: A couple of the things that Gemini advanced, of course, was the rendezvous (as you mentioned) and the spacewalking, EVA.

GRIFFIN: Yeah.

WARD: But both of those were not without their difficulties in Gemini and—

GRIFFIN: Right.

WARD: —those repairs that were called for, rendezvous was almost counter to it—what needed to be done.

GRIFFIN: Right.

WARD: And there—once people understood what was going on they said, “Well, of course” and [Sir Isaac] Newton—cited Newton’s Laws of Motion to explain that.

GRIFFIN: Yeah.

WARD: But it wasn’t apparent to the fighter pilots who were flying those spacecraft at first.

GRIFFIN: Right. In fact in Gemini IV, [James A.] McDivitt was trying to—you recall, was trying to chase the booster. And he kept thrusting toward it, and—which is the worse thing he could have done at the time, because of the dynamics of the setup. That—but when we actually got to doing a real, you know, co-elliptic rendezvous, they all worked just fine.

WARD: Yeah.

GRIFFIN: But it had to be set up correctly. And the training paid off finally that you can’t just start thrusting and manhandle your way into a—to a rendezvous. It’s got to be done just a very delicate maneuver.

And I’m amazed even today when we’ve had zillions of Shuttle flights with all the rendezvous with the—and never one has been blown. It just—it works.

WARD: Now EVA was a bit problematic. The early missions—

GRIFFIN: It was.

WARD: —the EVAs didn't go well.

GRIFFIN: And, you know, there was a reason for that. Gemini wasn't really designed to be an EVA vehicle. But when [Aleksei A.] Leonov did his thing (the first Russian that did the spacewalk), we kind of, I think, said, "Well, we can do one of those, too." And Leonov didn't do anything much except get out, and that's essentially what [Edward H.] Ed White [II] did on Gemini IV.

And in later missions, you know, they did do a little better work. Better hand rails; better foot restraints; actually tried some tools and that sort of thing. And so we learned a lot. I think by the time we got to Apollo, the Gemini rendezvous or the EVA work had been very helpful. But I—you know, we didn't start Gemini with a big EVA thing in mind. It was more of a rendezvous, long-duration—longer duration kind of purpose. But we added that EVA stuff in there, and it worked okay. It was just not easy. It wasn't designed to work.

WARD: Well wouldn't Apollo have been a much more difficult enterprise if you hadn't had the rendezvous—the EVA experience in Gemini?

GRIFFIN: Absolutely. As a matter of fact, I think the thing we learned is that you had to have proper foot restraint, if you don't do any work. You had to have the proper foot restraint, and you had to have the proper handholds, and you also had to have the right kind of tools that were easily accessible and easy to use. So, yeah, I think Gemini made a foot—had we not known done the EVA work in Gemini, we would have been way behind in

Apollo. And likely, you know, the first real EVA work we did was Apollo 9, where we put the lunar module and the command module in orbit—Earth orbit—and separated and then rendezvoused and did an EVA and all that. That went extremely well.

I never will forget that day. [David R.] Scott in his red helmet, standing up and doing all that work out of the command module hatch. And it was a piece of cake for him. So, yeah, Gemini paid off in lots of ways.

WARD: Well, by the end of Gemini, they also discovered the training tools of the zero-g aircraft and the water tank to simulate partially at least zero gravity.

GRIFFIN: Right. Right. Everybody says that the zero-g airplane, you know, was worth its weight in gold many times over in terms of a successful EVA endeavor. And the water tank, you know, we had one here. We also had one in Marshall. And they made big use of those. And it's one of the best training tools still.

WARD: How are we doing on tape?

[Voices off camera]

WARD: Oh, okay. Okay. We'll keep going till we're at the end of it. I think the next subject I'd like to spend a little time on is Apollo 13. And we may have dodged a bullet on 12 with the launch and getting through the lightning strike. Things had gone very well with the Apollo 11, Apollo 8.

GRIFFIN: Yeah.

WARD: And suddenly I think perhaps the accidents that we had been braced for in Mercury, Gemini, and early Apollo jumped up and almost bit us on Apollo 13.

GRIFFIN: Yeah. You know the thing that—about 13 that I didn't think about it at the time. I thought about this in the later years, is how fortunate we were that that accident happened where it did. If it had happened after the lunar module had started down for the descent, we'd either have to have landed, if it had just been—after it undocked and started down to land, we would have bought it because we needed the LM to get home. We needed the oxygen in it. We needed the water in it. And we needed its propulsion. Now we never checked out the service propulsion system again after the oxygen tank exploded, and it might have worked. But we weren't sure, because we knew something had let go back in the back.

So, we were so—we were 200,000 miles from home, about 50,000 from the Moon, when this thing happened. But thank goodness we still had the lunar module with us. When that accident happened, I don't think anybody at first recognized the severity of it. You can read—you can hear it in the voice tapes if you listen to much of it again, which I've had to do—mainly to review what I was doing in the movie *Apollo 13* as a technical advisor. People were still talking about what we did—the landing.

After the—you know, in the early stages, the few—the first few minutes after the—they knew something had happened. People were still saying, “Well, we can't land if we don't do so and so and so and so.” So even—the first reality check came when they saw the second oxygen tank losing its oxygen. They could see the first one losing it, and the second one started losing it. And—

WARD: This was (what?) the second of three?

GRIFFIN: The second of three. And so at this point it was clear that the program—the problem wasn't trying to get to a landing on the Moon. It was to try to get home. And so I think I've heard it said, we—it was used in the movie, even that, this was NASA's finest hour. Certainly from the standpoint of Mission Control and the astronauts and the contractors and all of that working together as a team. I think it was NASA's finest hour. Because it was a reaction to something that had not been planned.

I mean, we really never had looked at that. We had looked at using the LM as a lifeboat, but it was a very low probability so we didn't pay a whole lot of attention to it. And we never thought we'd (a) have to do it and (b) we never thought we'd have to do it in a—in the situation where we knew it was going to be close. You know, when we first looked, we thought—at the consumables, we thought that oxygen was going to be the shortest supply and that that would be what we were going to have to conserve. It turned out that water was our most critical consumable. And we used water to cool things. We used water to drink and to eat and so forth.

But it turned out that, as a—I recall, I think we had about 6 hours of water left when we landed back on Earth. So if we had flied to the Moon about 6 hours longer, we would have run out of water. And then the thing would have really started to deteriorate.

I think it's a—not only a tribute to the people but to the hardware. The command module, even though the fact that the service module had its problems, the command module worked fine the whole time. And the lunar module came through. And then the people and the systems all came through.

So I really look at Apollo 13 as a damn close call, but we learned a lot from it. And it—and again it was a—as I mentioned earlier, a little bit of the—this may be a little bit of this measured cockiness I'm talking about. People have asked me several times, "Were you—?" In fact, before the people made the movie, "Weren't you guys scared? Weren't you guys in Mission Control scared?" I said, "No. We all—." In fact, they were asking a group

of us at the time. And we kind of looked at each other and said, “No, we were never scared. We had been trained that as long as there are options remaining, just to keep plugging and you’d be okay.” And we never ran out of options. We used up a lot of them. But we didn’t run out.

And I don’t think any of us—And I’ve also been asked, “Did you think you were going to lose them or any—?” “No.” And that’s an honest answer. I really didn’t. I thought we could get them back. But I thought we could do anything. And that was kind of our makeup, is that we thought, “There’s nothing can be thrown at us that we can’t figure a way out.”

You know, obviously, there—we knew under powered flight, like the *Challenger*, if something happened there, that was a different story. But if you’d given us a stable condition in orbit or in translunar travel or whatever, we figured there was a way we could work our way out of it. That may have been a little bit of bravado. But it was honest. We really did think we could get them back.

And so that’s what we set about to do. And I never will forget the—it is—again, Gene Kranz, the Prussian General, coming through with, you know, click, click, click. He actually took his team off line, you know, and let them develop all those power-up procedures and all of the reentry procedures and all that. And when they came back in, it just click, click, click. Right down the line. In the meantime, the other three teams were trying to cut power, cut power, cut power to save water and everything else. And of course, the astronauts almost froze to death. But we got them home. And so at the end of the day, it turned out to be a great—it was an experience that I’d just as soon not to have had. But was a great experience in telling us that, yeah, we could handle some very, very tough moments.

WARD: You had—are we ready to change [tape]?

VOICE OFF CAMERA: Okay. Okay. Go ahead.

WARD: Okay, Gerry. We were talking about Apollo 13. There was one aspect of that mission that also was a first for NASA. And that was, it was the first time that NASA management had agreed to let reporters in Mission Control where they could listen to the flight director and could hear all the deciding—decisions and discussions that were going on. And the decision was made before the mission launched.

GRIFFIN: Right.

WARD: What, in your view, did that contribute to the fact that this mission, which in many respects was a disaster, ended up being perceived as one of our greatest moments?

GRIFFIN: I don't think there's any doubt that having the press in there was a big plus. And I have to admit that early in the—earlier in the program, I wasn't sure having the press in was a good idea, because I was always a little bit skittish that they would take a—take away the wrong message. I learned, and this was when—way back even in Gemini is when I was thinking that way. After I became a flight director and dealt with the press a lot, I dealt with them some when I was a flight controller. But when I was a flight director, and the press in those days, of course, we had our tough guys that took us to task all the time. But they were a very fair bunch. And I think they reported very factually what they saw, what they heard. And I grew—in fact, I've got some of them have been lifelong friends, the guys I dealt with in the press, that I still am very close to.

And I don't know who made that decision. And I don't know how all it got made. I remember, I think “Gee whiz, I don't know whether this is the best thing or not, to have these guys in here.” But Apollo 13 showed to me it was. And I think the later missions,

where they were in there and when we got to those really—those “J” missions, where we were taking a rover around on the surface of the Moon and doing some excellent science and all, having the press right there in no—with nobody filtering what they were hearing or doing and all that, I think it was great. They could listen to all of our conversations. They knew what was happening and so I think they—having them in there was a big plus.

WARD: Of course the argument against doing it, earlier in the program, was that you guys who had the responsibility for making the decisions might not make good decisions if you knew you were being second-guessed. You might not have a full and frank discussion of something.

GRIFFIN: You know what? You know what happened, though? And it was very much—you may remember—well, I know you remember:

We always had photographers in the control center. We always had movie—a guy with a movie camera in the control center. And after about probably Gemini V, we flew the first—Gemini IV was when we had the control center up here for the first time in parallel with the Cape. And then on [Gemini] V, we went to this control center full time. We forgot about the NASA photographers and the movie guys even being there. You never saw them. I never saw [Andrew] Patnesky once while I was doing the thing.

Same thing happened with the press. The first time that they were there, you said, “Gee whiz, you know, there’s Roy Neal” (or whoever) “up in there.” And it took about probably a day or two and you forgot about them even being there. So, it was—they were never intrusive. They never bothered us a bit. I didn’t say one thing different than I would have said if—had they been there or had they not been there. And so, I don’t think it had an effect at all. And it opened up what we were doing to the people I call “the shareholders of

the space program,” that’s the public. The American public. And so I think it was a good thing to do.

WARD: Brian Duff was the public affairs director at the center at the time, and he recalled some years later that when he went over with one of the flight directors for a press conference after the accident had occurred that this individual in starting off the press conference said, “Ladies and gentlemen, you know everything we know. The only thing you don’t know is what we’re going to do about it. And that’s what I’m here to tell you.” And I’d like to find that in a transcript somewhere, but it illustrates—

GRIFFIN: Yeah. It—

WARD: —the confidence that the media had that NASA was telling the truth because they were there seeing it. They knew that nothing was being covered up.

GRIFFIN: Right.

WARD: And I think that may have had a lot to do with the credibility.

GRIFFIN: Right. That was the big plus out of it. But I do add the footnote: That maybe it was the time, and maybe it was the people. I think we had perhaps the best group of press that had ever covered any major activity of any kind in this country. They—and even the foreign press; the foreign press was very fair to us. They caught us when we were wrong, and they lauded us when we were right. So I think we had a very unique time.

And maybe that period from—I’ve often said that Apollo in some ways got lost in the Vietnam War and in some of the social change going on in this country. And there was a

lot of kind of bad things happening. Unpleasant things happening. And the space program were at least these little glimpses of something very positive happening. And something that the whole world could understand and get behind. And I think the press, in their accurate reporting, caught those good parts. Yeah, they caught us in the bad parts, too. But they really emphasized the good and the space program kept kind of poking up out of the mud that was going on in the rest of the world with Vietnam and social change and all of that that was happening so fast. And so I think our press corps deserves a lot of—some of that credit.

WARD: Going on to Apollo 15. Paul Gast, who was the chief scientist at this center at the time, said after that mission that he firmly believed that if Apollo 15 had been flown before the decision was made, under pressure from the scientific community, to remove Joe [H.] Engle, because he was not a scientist, from the final Apollo flight crew, Apollo 17, and replace him with a scientist, [Harrison H.] Jack Schmitt, if they had had the experience of seeing how well this team of non-scientists performed on 15, they would not have pushed for that decision on 17.

GRIFFIN: Yeah. I'm glad we did get a scientist flown, you know, and I'm glad Jack Schmitt got that opportunity. It was a hell of a hit to Joe Engle. And—but you know, our crewmen, our astronauts, worked very hard at that science angle. And I think it showed. It paid off. Apollo 15 that's—Dave Scott was the commander. I was the lead flight director for Apollo 17. And I actually went out into the field with—

WARD: 15 or 17?

GRIFFIN: 15. On 15, I went out into the field on the field geology trips with Dave and his—and [James B.] Jim Irwin and the geologist and all that. And this was months before we

flew. And the reason I make that point is, is that it, to me, from Apollo 15 on (15, 16, and 17), the purpose of the mission was science, where before our purpose had been primarily to get there, get a little bit of science, and then get back. But by the time we got to 15, we felt confident enough in what we were trying to do that we knew we could get them out and back with a pretty fair assurance. So now let's turn the focus and really turn the heat up on the science.

So those last three crews worked their buns off trying to make sure that they made use of every minute that they had on that lunar surface. And getting the rover involved, we knew we were going to be able to go great distances from the lunar module for the first time. And sure enough, it paid off. I mean, some of the finds that they had—the finds that they had there in the—in those last three missions were extraordinary. And—but it was done with a purpose. And I think the astronauts responded to it. I know—I think I was the first flight director to ever go out on a geology field trip with the guys that were going to go on the Moon. And that was Dave Scott's idea.

He said, "Why don't you come along because—" And he got [Joseph P.] Joe Allen [IV], who was the capcom [Capsule Communicator], and so we had the flight director and the capcom and the two crewmen along with all these geologists. I learned more geology in a period, probably, 3 or 4 months before the launch of Apollo 15 than I'd ever cared to know about! But it—and I still remember it. Lee Silver, a great teacher, [William R.] Bill Muehlberger, Gordon Swann, those geologists were just outstanding people, and they were a delight to work with. And it paid off.

WARD: We had a tremendous amount, as you pointed out, of geology training for the crews. And yet the—on occasion they were, particularly early in the program, very hard-pressed to get the flight training that they needed done, particularly on Apollo 11.

GRIFFIN: Yeah.

WARD: But I think because of the late arrival of the simulators and the software. That ended up smoothing out some in the later program.

GRIFFIN: It did. In fact the Shuttle mission simulator really got down to be a—I say “Shuttle.” Apollo—

WARD: Apollo.

GRIFFIN: —mission simulator. (I’ll get it straight in a minute.) The Apollo mission simulator really became a factory operation about the Apollo 11 timeframe. It took us a while to get that thing to where it was going to—we could turn it around fast enough. So the training elements really did—in all those guys, even the later crews—the Apollo’s 15, 16, 17—started training pretty early in the Shuttle—(why do I keep saying “Shuttle”) Apollo mission simulator. What that did is, they started—those later crews were able to start their training cycle earlier than some of those earlier guys had. And that left them more time later in their training cycle to spend on the science side. So, yeah, there was a big difference in the training cycle; and it was much heavier toward the science in those later missions.

WARD: Yeah, I think it’s incredible, if you look at the amount of weight of scientific instruments that were carried on the first mission versus—

GRIFFIN: Yeah.

WARD: —what it wrapped up to on the later “J” missions—

GRIFFIN: Yeah, the J missions.

WARD: —the 15, 16, 17.

GRIFFIN: Right. Yeah. You had that—Not only did you have the rover and all of the stuff that went with that—all of the tools and all—but you also had—remember, you had that SIM bay (S-I-M bay) in the—

WARD: Command module.

GRIFFIN: —in the command—in the service module—

WARD: Service module.

GRIFFIN: —where they were mapping the Moon from orbit. And that was a fairly—that was a big outfit. There was a big camera and it had a lot of weight to that, too. So those later missions were probably getting very, very close to the max that we could push with the Saturn.

WARD: As we began to reach the conclusion of the program in Apollo 17, it was by that time clearly going to be the last Apollo flight, had you and the flight operations team reached the feeling that we had really accomplished about all we were going to get out of Apollo and that to fly it beyond that was risk that was probably greater than the return?

GRIFFIN: You know, in that day, you didn't—at our grade levels, you didn't think quite as much that way. You didn't think on the global, although we were actually in space. But you didn't think on that big basis. We would have—I think all of us would have liked to have flown some more missions. In retrospect, when I look at it, I think that we probably had done about all we could do with that flight hardware.

You know, there was people that wanted to go to the Tycho area, because Tycho was a very fresh, fresh bright, big crater and all that and it would probably be a very interesting geological mission. And it would. It definitely would have been. But we'd have shoved that hardware to the limit in order to do that. And maybe a little bit beyond the limit. But I think in retrospect, when I look back on it, at the time I thought we had dodged enough bullets. But I really now think that if, all things being equal, we probably pushed that hardware as far as we could. And it would have been fun to fly some more.

On the other hand, I was a little tired. I'd been in the control center for 8 years at that point. From '64 to '72. And it had taken a toll. We were all a lot older at the end of that. At the end of Apollo 17, I think we were all pretty tired. We had—it was a hard—we all were young and we had young families, and we were pushing hard to get it done. We were working tremendous hours. And it was probably time to have a break from a personal standpoint. And I went off and did other things for NASA, you know, right after that.

WARD: Well Apollo certainly had its close calls. As you mentioned we had, of course, the disastrous fire at the start of the program—

GRIFFIN: Right.

WARD: —we lost three crewmembers. Then the lightning strike on 12, which could have been a disaster. We lost, what? A parachute landing on 15.

GRIFFIN: Right. Right. 13. We had 13.

WARD: And 13, which was a near disaster.

GRIFFIN: And you know we—it wasn't a disaster. We almost didn't get docked up with 14. Remember, to extract the LM from the S-IVB? And we tried and tried and tried, and finally got it. But we could have lost that mission easily. Not—maybe not a life-threatening thing, but we could have lost that mission fairly easily if we had not been able to extract the LM.

Every one of them had their—you know, enough close calls that—you felt— But, in the end—at the end of the day, it kind of told you how good that design, you know, all of those designs were. Because we had a lot of redundancy. And we had a lot of ways to work around things.

And, man, we called it all into play on Apollo 13. I mean, every trick in the book. And, you know, we ran that umbilical—a wiring umbilical from one module through the tunnel to the other one and hooked it up to get battery power to flow. So it was—the hardware was really well done.

And you know, a reflection I have about all that sometime is that, I wonder if 20 years from now, or maybe 50—let's say 50 years from now, people are going to look back and—we did all of that roughly in the mid-1900s, say. Just to make it for the sake of argument. They're going to look back and say, "You know, those people created that great hardware. They did all of those neat missions to the Moon back in the mid-1900s or so! And then they did—they stopped." And they'll wonder why.

I think that's going to be an interesting question to ask. There was this little snippet of time when we went to another place, left this planet. Went to another place. It took place over a little short period of time, and then it just goes on and on. "Why did they do that? I

mean, was it just a Cold War thing? Was it—?” I don’t think so. I think, you know, I’ll ramble here a second.

But – Neil [A.] Armstrong, when we finished the Apollo Program, Jack Schmitt had a fellowship at CalTech [California Institute of Technology]. He had a little money left in it that he had actually spent most of it. But he had a little left. And we had—he pulled together about, as I recall, 25 or 30 people that had all worked on Apollo. We went out to CalTech and spent about 3 days contemplating our navels. Basically what it was, was to discuss what we had done, why we had done it, how did we do it, how were we able to have this little point in history where we could do—this was right after the flight of Apollo 17, so it was all fresh in our minds. But none of us had thought about anything majestic like that. We’d all been—had our heads down. And Kraft was there. And Armstrong, and Conrad, and Schmitt. And the geologist. And I was there. I think I may have been the only flight controller there, I can’t remember. There were some people from Headquarters.

And it was a great experience, because we—you know, none of us had been into anything touchy-feely yet. We’d been too busy with—and this was kind of one of those touchy-feely kind of things. What did we do, and why did we do it, and how did we do it? And we all had our ideas, and the Cold War was obviously a big piece of that. But Armstrong did something very interesting.

And—by that time he was up in Cincinnati, I think, teaching engineering. And he got up at a blackboard and he drew four curves. They looked kind of like mountain peaks. And he had them out all like this. And he had one of them titled “Leadership.” He had one titled “Threat.” He had one of them titled “Good Economy.” And he had one of them, I think was the last one, was “Peace” or “World Peace,” something like that. He said, “My theory is that when you get all of those curves in conjunction, when they all line up together, you can do something like Apollo. Apollo, or something like it, will happen. And we

happened to be ready for that when all of those curves lined up.” And, he kind of stole the show of this whole 3-day get-together. And he was right on.

I’ve used that several times with younger people in NASA who sometimes get a little discouraged. You know, “How long are we going to stay in low-Earth orbit?” And, “When are we going to break out?” And I use that story to tell them that, “You’ve got to be ready so that when those curves do line up again, that we as a nation can take it on and do it.”

So to me, that’s what Apollo was—it’s kind of becoming more meaningful to me now that’s what allowed us to have that little point in history. It didn’t last too long, if you stop and think about it. It’s kind of almost a blip. And—but what a great program and what a great result in the American and even worldwide spirit that it caused. I know I sound like I’m preaching a little bit here but I really do believe that was the—that was the worth of Apollo.

WARD: A good summation. Following Apollo you moved on to a top management job at NASA Headquarters.

GRIFFIN: Interesting time.

WARD: And NASA moved on to the Skylab Program.

GRIFFIN: Right.

WARD: As I recall, you were in Legislative Affairs initially, up there working with Congress.

GRIFFIN: Right. I ran—I went up and ran that Office of Legislative Affairs at NASA Headquarters. And it was interesting because I was the first non-lawyer to do that. I was—

also knew so little about Washington. I knew the Senate was on the left and the House was on the right if you were standing on the Mall side of the Capitol, but that was about the extent of my knowledge. I literally got a civics textbook called *How Laws Are Made* and studied it so that I could figure out how—you know—brush up on all of that business. And actually my job there in the early going was not Skylab was already well along its way—but was to get the Shuttle pinned down and make it stick.

This was 1973, and it had received its first funding in '71. But [Senator Walter] Mondale [D-Minnesota] had almost killed it the year before. It came within one vote of killing it in the Senate. And they wanted somebody that understood the technical side of the equation to deal with the Congress. And that's why I went there. And I did it for 4 years, and I was ready to get out. But it was a fun 4 years. And it kind of broke me—the thing it did more than anything, is it broke me out of the pack. I was no longer just a flight director. I was somebody, then, that had been to Washington. And that led on to other things that came later.

WARD: You were probably a good case study of the—let's see, what was the guy's name? Rufus Miles. Miles' Maxima.

GRIFFIN: Uh-huh.

WARD: "Where you stand depends on where you sit."

GRIFFIN: That's right. That's right.

WARD: And I suspect your perspective of going from a field center to Headquarters into that kind of job changed quite a bit.

GRIFFIN: You know, it changed my—it changed a lot. But where it really changed was my view of JSC [Lyndon B. Johnson Space Center]. You know, we, and rightly so—JSC is a very cocky kind of organization. It had always been kind of a I think our feeling was, we were—amongst all these other equal centers, we were better than they are. And that's not a totally bad assessment. But I also figured out that there were other centers in NASA that also had some very special skills, and some extremely capable people. And it changed my view, therefore, not only of JSC, but it changed my view of the Agency. And I—it was an eye-opener, that, yeah, I had worked with [Wernher] von Braun and his troops over in Huntsville, and I'd worked with [Kurt] Debus and his guys at the Cape, but they were kind of—you know, they weren't like [Dr. Robert R.] Gilruth. And—so it changed my perspective of the Agency.

And then I went on to be the deputy director at—in the desert at Dryden, and then the deputy director at the Cape. And I think was really fortunate to have those experiences before I came back here to be a center director, because then I really did have—I felt like I had—and I still feel like I've got a good feel for the Agency and what they do at different centers. And it was just educational.

WARD: How would you characterize the centers and Headquarters that you had direct dealings with as far as their personality or their culture?

GRIFFIN: By far the most (what word do I use here?) kind of snooty—JSC came across as a pretty snooty bunch. And of course I knew all the people, and I could—I was able to soften some of that a little bit. But we—you know, the—we were kind of like the Yankees. We had—we'd won a bunch of pennants in a row. I think the other centers chafed a bit because JSC quite often got the ink, got the coverage, and quite often it was the Cape or Marshall that

was maybe strongly behind something that had worked very well. But JSC was where the press really came and camped out. Now they camped out at the Cape, too. But that became pretty much of a launch system thing, and then it was done, and then they all came over here and were here for the duration of the mission. This was where the astronauts lived and trained and blah blah blah.

WARD: Yeah.

GRIFFIN: But I found the other centers—and JSC wasn't bad, I probably overstated that a little bit—but the other centers did resent (and I suspect there's still of that there)—did resent JSC's stature amongst the Agency waterfall, if you will. It always seemed like JSC was up here and the others were kind of catching the dribbles. But I really do think that at the end of the day, what I learned is that all of the NASA centers had these unique skills.

I mean, I went to JPL [Jet Propulsion Laboratory, Pasadena, California] for the first time after I had gotten up there, and I was—you know, they got control centers and they go to places like Saturn and those—places like that we hadn't been at JSC. I went to Ames [Research Center, Moffett Field, California] and looked at some of the simulation capability they had there with big airplane stuff and spacecraft. They do the Shuttle now. Every center had its – Langley [Research Center, Hampton, Virginia], my gosh! You know the capability those guys had back at Langley was just—I'd never seen it. I'd never been there.

And—so I think all of them were—the center directors were an interesting group, as you know. Most of them are—got fairly big egos. And some of them are easy to work with and some of them aren't. And I've worked with some that were almost impossible, and I won't name them all. But—and then some that were pretty easy. I had a real easy connection, obviously, to JSC when I was up there because this was where I grew up. So—and I—it took me a little while to get into the Huntsville crowd and—

WARD: When you came back in '82 as center director, did you have any plan in mind? Or did you consciously try to change the center's culture?

GRIFFIN: Yes. I knew that would not be anything that could take place overnight, and I knew it was not something that in the time that I had, which I didn't know how long I would have, but I knew I could not change it entirely. But I did try to do some things that—to try to soften some of that reaction that I had seen when I was away from the center.

And I did that in a couple—tried to do it in a couple of ways. One is putting the right kind of people in the right positions that were savvy and I could talk to; and then the other thing was just to—I got—I had gotten to know a lot of people at the other NASA facilities. And I spent quite a bit of shuttle diplomacy trying to make sure that they understood that JSC wasn't trying to dominate all of NASA. In fact, we couldn't.

That came to the foreground, mainly, in the Space Station arena. And then this is—and I'll tell the story right now. But one of the things that happened is, of course, NASA had not had a new big start for a long time. And here came this—down the Pike this idea of a Space Station. And [James M.] Beggs was the—Jim Beggs was the administrator. Hans Mark was the deputy. And then we had some very strong center directors at the other centers.

And when this thing started to take form, that we were going to have another big start, every center wanted its piece of the action. If you ran out the numbers that we were talking about, the program wasn't as big as Apollo, I mean, and—where we'd had a lead center to run the thing. And I guess because of my experience, Beggs and Mark turned to me and said, "Gerry, we want you to be our team leader and work with all the center directors to create these work packages, so that we could break the work up into pieces and give some to Marshall and some to Langley and some"—"so forth." My first push on that was, "Let's don't do that. Let's—why don't we give it to one center? It's not that big a program. It's—

it's big, but it's not any bigger than any single center could handle." And I even—and I said, "That ought to be JSC. We know how to do this. We've done it in Apollo," and so on.

And that kind of immediately got read as I was trying to—back to the old—And then finally, I even made the appeal, "If you don't give it to us, give it to Marshall. If you don't give it to Marshall, give it to Langley." Don Hearsh, who was their center director, said, "I don't want it." But I really felt that it was not a good idea to break this thing up into so many little pieces, and then have a terrible nightmare trying to pull it all together.

But I did get on old NASA 1 or NASA 2, I guess it was, and flew all over the country to different field centers. And I really did feel—I felt a little bit like Henry Kissinger: shuttle diplomacy back in the days he was Secretary of State. Because I had meetings. Sometimes I would have a meeting in Washington, Huntsville, the Cape, in the same day. Or Huntsville, Langley, Lewis [Research Center, Cleveland, Ohio. Now known as John H. Glenn Jr. Research Center at Lewis Field] in the same day. And trying to say, "Look, why don't—" In this little pie we were trying to divvy up, it didn't make any sense at all.

You know the history of that, probably. But it turned out it was a very tough management arrangement. And I think it's—probably still is. Although it's better.

WARD: Yeah, I was going to say: I don't think the Agency at that time really ever did come to grips with that issue.

GRIFFIN: Yeah.

WARD: And the Station did end up fractionated and split up along too many—

GRIFFIN: I really think one center could have handled it. And politically, it may not have been possible to do that. Maybe too many people in the Congress by that time had gotten their piece of the pie that they—but I really think the job could have been done faster and easier if it came in for one center and say, “Get it done, and use the rest of the centers—or the other centers’ resources where it makes sense.” Power maybe at Lewis. And Propulsion at Huntsville. And so forth. Science at JPL and Goddard [Space Flight Center, Greenbelt, Maryland]. And Ames for, I don’t know. But, I think a center could have done that better.

I’ve always had the feeling that Headquarters is not the place to try to run a program. It’s too distant. It’s not far—it’s not close enough to where the action is. It’s too far removed from the contractors. I really think the field center—and I’ve said this a lot. NASA has great, great strengths. And where those strengths are is in the field centers. It’s not inside the Beltway.

I could go hire almost anybody to do the job that was required—and that won’t—not be a popular statement. But I could almost go to any agency in the Federal Government and get the Headquarters job done. What I can’t get done is—anywhere else is the job the field centers do. And that’s where NASA’s talent is. And I’ve been to Headquarters twice. Because I went back there as a Head of External Relations. And it’s a very essential piece of the puzzle, but it ain’t nearly what it takes to run one of these field centers or to do the job these field centers do.

So I didn’t leave because of that. I left because I got bought out by somebody that made me an offer I couldn’t refuse. So I took early retirement and did it. But it—I don’t—I still think there is too much emphasis in the Headquarters function. It’s a necessary function. And it’s an important one. But—

WARD: Well, [NASA Administrator Daniel S.] Dan Goldin has cut Headquarters significantly from what it was.

GRIFFIN: Well, I'm glad to hear that. I'm glad to hear that.

WARD: One of your Headquarters' duties in that last tour was the transition from the [President James E.] Carter Administration to the [President Ronald W.] Reagan Administration.

GRIFFIN: Gosh, I didn't think anybody would remember that. It sure was. Yeah. That was an interesting time. That was probably as political as I ever had to get. I learned how to get political fairly fast in Washington, but, you know, NASA still had kind of an apolitical grounding. And it and NASA didn't have to live in the politics like a lot of the other agencies did. It was in it, but not like—nearly like (the U.S. Department of) Labor or HUD (U.S. Department of Housing and Urban Development) or some one of those outfits. But when I worked the transition team from Carter to Reagan, that was the first time I really—I felt caught in a vise a couple of times. Although it worked well, because Hans Mark was coming in and Jim Beggs, I didn't know at the time, but he was really liked—eventually. It was an interesting time. And I figured—and I also considered it a great honor to be a part of that.

WARD: What changes, if any, did it make in the Agency? Could you note any fundamental shift in policy or—?

GRIFFIN: Not so much in—

WARD: —direction.

GRIFFIN: You know what I think what I noticed first: [NASA Administrator Robert A.] Bob Frosch and then after Bill [William R. Graham, Associate Administrator] (the guy that succeeded?—we'll get that for the record)—Bill—a very short time before we got Beggs in. Anyway, he was a guy that succeeded Bob Frosch. Well—

WARD: Well Alan Lovelace filled the gap. And then—after Frosch resigned.

GRIFFIN: Well now this was even—Okay. This was before Lovelace. Anyway.

WARD: Okay. It's not coming to me either.

GRIFFIN: Frosch and then later this Bill [Graham] and Lovelace were all three different [people]. And Frosch, you know,—Frosch was a very bright guy. Very brilliant sort of guy. Not a very much of a hands-on kind of guy. Lovelace was exactly the opposite in that respect. He was very much a hands-on—

WARD: He was the deputy administrator?

GRIFFIN: He was the deputy administrator. And he—but he was a very much hands-on guy. Beggs came in, and the difference I saw was that Beggs came in and didn't really know NASA very well. He'd been with General Dynamics off in other—not the space side of it. So, Beggs was an open mind and an open book to some degree, although he—Joe had some ideas that he wanted, and he kind of tried to cram them down our throat. He finally backed off of that a little bit. But we had Hans Mark, who had been a NASA center director.

And I think Hans really understood the field center role in the—and that's what I saw different in that—in this changeover was the fact that, here was a guy—and you know the deputy administrator has always been kind of the general manager of the Agency. He's the guy that's out there all the time with his hands on the pulse. And we had a guy that really did understand the NASA field centers and what their strengths and weaknesses were. And make no mistake, one of the reasons I got selected is—to be the next director here is that Hans, I think, particularly, wanted somebody here that had had some experiences outside of JSC to kind of take that edge off of what I was talking about earlier. So Hans was really responsible for me coming here as the center director. And I enjoyed working with Hans. He was a good guy to work for.

WARD: What of your—in your experiences as center director, from about '82 to '85, what kinds of things were the most rewarding? And what were the most challenging from your point of view in that period?

GRIFFIN: Well, you know, the thing that was probably the most rewarding was the performance of the Shuttle. And in fact, I got here—STS-4 had just—I guess it had just flown. Yeah. And—but we ripped off those next several missions, and the Shuttle was just, you know we were bringing in new vehicles, new Orbiters. And the process was going extremely well. That was very gratifying. The other thing we did here is that I thought was a—kind of a milestone is that we started a change in getting away from what I'd call the final end of kind of the old style of doing business, like budgets and all of that. We got to a more modern approach.

And I never will forget, when I first got here, and I sat through a budget session over here in the headquarters building. The first one. And it took all day! And when it was all through, I might have understood a tenth of it. It was in such detail and in such laborious line

item detail. And I stopped that. I said, “Hey, *no mas*. I cannot listen to this anymore. We’ve got to get something that’s better so we can understand it.” And it was all a fragment or a part of the fact that the way we had reported to Headquarters. I said, “I don’t know how—care how you report it to Headquarters, but make sure I can understand it.” So I think it was a change in that regard.

But the other big thing was getting Station off the ground. I didn’t—although I didn’t agree with the work package thing, we got it started.

WARD: Yeah.

GRIFFIN: And again, remember the old Program Office and the A’s and the B’s and—

WARD: Right.

GRIFFIN: —and so forth, and the C’s. We got that all and I spent a—I probably spent the last 2 years I was here, I probably spent half my time on that. I was flying to every center, like I was saying earlier, and spending a lot of time on that kind of stuff. And, of course, I left—actually I left on January 14<sup>th</sup> of ’86—

WARD: Okay. Just after the first of the year.

GRIFFIN: —and it was only 2 weeks later that the *Challenger* accident had occurred. And so I started off this thing, I was so proud of the way the Shuttle had operated. It had done superbly up till then. Then of course, right after I left, I’d been gone 2 weeks when the *Challenger* accident happened. It kind of took a lot of the fun, I guess, out of what I would say is the number one thing that sticks in my mind that we got done. In terms of problems,

you know, interestingly enough, one of the things that I had (and I never would have thought it)—that I would have had to spend as much time at it as I did: And that's with disgruntled astronauts. Astronauts who thought they should fly before the other guy.

And they would run their traps as far as they could with all of their own management, and I would always be at the end of the final appeal, if you will. And, every time I'd go in, in the morning if I—, "Betsy, what have we got on the calendar today?" And if she'd tell me that "Astronaut So-and-so," (whoever that is) "wants to see if he can set up a time to come see you," I knew what it was about before he ever came in. And I always had my pat answer, which was: "I don't make crew assignments." But I'd have to listen and cajole and commiserate with them, and so, "Yeah, yeah, yeah, I know." But I spent a lot of the time with astronauts.

WARD: Chris—

GRIFFIN: I also had some of my best remembrances—There's some astronaut friends that—and one of them that comes to mind is [Judith A.] Judy Resnik who, as you know, was killed on *Challenger*. Judy was single and so my wife and I would occasionally have her at the holiday time or something like that. And [Kathryn D.] Kathy Sullivan. And there was just some really neat people that I recall being astronauts that were fun.

WARD: One of the things that Chris Kraft mentioned was that, when he took over as center director from Bob Gilruth, he said he felt that the astronaut function was really being managed with too little input from the center director. And that was one of the things he tried to and felt he had changed, is to insert the center director into some of those crew decisions.

GRIFFIN: Right.

WARD: And I would expect that in your case, your close association with most of those astronauts in the flight operations realm made that transition a little easier.

GRIFFIN: It helped. And there's no doubt, too, that one of the things that—and I think we're—and I'm not sure what Chris meant by that, but I think—I did—I was heavily involved in the policy that said this is how crew assignments should be done. And—but even at that, you would always—you'd get to come up with all the criteria you could come up with, who flew last and there would always be two or three that you could probably flip a coin, and they probably ought to be the guy that would go or the gal that would go next. And it was those kind of things where—when it happened that they would want the final appeal. But I had—I never did undo any crew assignment or anything. Because I knew—I was always briefed on them and why and so forth. So I knew what they were doing. But it was—I never would have thought it. I just wouldn't have thought it.

Let me say something about Chris that's important here that—one of the things that made my transition into here as easy as it was: I was one of Chris's guys. When Chris decided to step down, it was really, I think, a very unique hand-over. I had followed him most of his career as—, particularly since he—or when he came to MSC and then JSC. So I knew how he thought. I knew what he had done. And there were so many things that were done exactly the way I would have done them anyway. I—and I—but I changed a few things.

One of the things I changed was the organization. I thought Chris had too many direct reports, too many people. As I recall there were 17, I think, or 17 or 18. And, I just thought that was too broad a span of control. I didn't change any of the people's functions, but if you'll recall I don't know whether you remember that.

WARD: Yes, I do.

GRIFFIN: I did some things where—in trying to group some things with some leaders that had some muscle so that I didn't have to try to integrate 17 different inputs. Now some people liked that. And I think Chris is a little more aimed that way. He likes to be that final integrator and keep all the people guessing.

But Chris was so (let me say) kind and open and helpful when I first came in here and I came back. And I'd been gone almost 10 years, so I left in '72 and came back—I left in late '72 and came back in the early—well, spring of '82. So it had been 9½ years I had been gone. So there was a lot of water under the bridge and a lot of things had changed. And—but Chris really did make it easy for me to get my feet in the stirrups and start riding the horse pretty quick. And I was very grateful for that.

WARD: You mentioned that the *Challenger* accident had occurred a couple of weeks after you had left, although you were very closely involved with the Shuttle Program up till that and I'm sure had some insights and observations as that process was unfolding, do you think that the Rogers Commission that conducted the hearings on the *Challenger* accident pretty well got the right sequence of events and causes of that accident identified?

GRIFFIN: I think so, although I—and this is based strictly on a gut feel. I think the temperature aspects were probably overdone. I have a feeling we would have lost that vehicle on a summer day.

WARD: So you don't really think that the decision to launch in the cold was as crucial as it might have appeared?

GRIFFIN: I think there was a bad seal. We knew the design was close. It was marginal, and we were working on an improved interface between the segments. But we had flown lots of things and, gosh, clear back to—in my timeframe, Gemini and Apollo, Skylab, we had flown things that we knew design was—you know, we wish it was beefier—

WARD: Yeah.

GRIFFIN: —we wished it was—but we thought it was okay. And so I really think, you know, they had trouble making that seal at the Cape. They went through quite a lot of detail. How many times they had to make it and unmake it. And the design wasn't real easy to—you could make a mistake with it. You had to be careful. And then there was no way to really test it once you got the design—and then, you know, they added the second O-ring and a pressure port, the easy—

WARD: Yeah.

GRIFFIN: —solution to make sure that you had a seal. And I think they—that it was a bad joint. And I just have the feel—I have the feeling that we could've launched it in July and it would have still failed. So I think the temperature thing was probably overblown a bit. But that—again, that's my personal opinion and it's not based on any great fact.

WARD: Sure.

GRIFFIN: I just think it was a bad situation.

WARD: Well the solid rocket motor, in retrospect, is one of those things that a lot of people said they wish we had never had to add to the Shuttle. And that was one of those compromises that came about—

GRIFFIN: Right.

WARD: —while you were in Washington—

GRIFFIN: Yep.

WARD: —to keep cost down or cut cost. And I'm wondering how much of a factor that was, and how much did we really understand those solids until—prior to the accident?

GRIFFIN: Well, you know interestingly enough, though, the solids had had—have always had a good safety—I'm just talking about solid rockets in general—

WARD: Yeah.

GRIFFIN: —have had an excellent safety record. They've been very reliable. And when we went to the solids, I didn't think that was all such a bad deal. I thought that was probably okay. I didn't know a lot about them because we had never flown anything with them on there. And by that time, I'm up in Washington worrying about things other than propellants. But I remember thinking that, "Well, that sounds like a—probably a pretty good tradeoff." And—

WARD: Do you think, in retrospect, that that—the sense of security or confidence that people had in the solids was due to the fact that they were looking at them in a—from the standpoint of an unmanned system as opposed to a manned system?

GRIFFIN: Probably. There may've been some of that. There's also, I think, it's a little bit analogous, I think, to the 100% oxygen environment in a cabin. You get lulled by success into thinking that something is good because it's been okay in the past. And we might've taken our eye off the ball a little bit. However, I think at the time that joint design and the guys that were assembling it were probably the best we could do. It just wasn't good enough. And it was that simple. That's why I think we would've lost it even on a hot day.

WARD: Yeah. [Robert L.] Bob Crippen made the observation, I think, before the Rogers Commission that from his perspective one of the things that had happened leading up to that accident was that NASA had quit asking the question “Prove to me that this vehicle is safe to fly” and it started asking it, “Prove to me that it is not safe.”

GRIFFIN: Is not. Right.

WARD: Do you agree with that?

GRIFFIN: And I'd—you know, I was not involved in that decision, particularly on that flight. But—to go. But I can see how I think that could happen. We were trying to make the Shuttle more operational. We were trying to make it more of a “check it out and go” without this exhaustive set of things that we had done ever since Mercury. And I think we learned. It—and we weren't doing that to cut corners. We were trying to do it to make the system more like a real operational system. And I think we learned out of that process that you

can't—with these kind of systems, with these kind of energies, stored energy involved and releasing it so fast, that you really can't be that kind.

Now, if we can ever get to a horizontal takeoff and landing and some kind of engine that burns liquids all the time, you know, maybe we can get to a more operational kind of spaceflight. But with the technology that we've got in the Shuttle—which is, you know, it's early '70s stuff primarily with the boosters—we're—we can't make it any more operational than it is probably today. Which is not real operational.

WARD: Were do you suspect the technology will go in the next 20 to 30 years?

GRIFFIN: Twenty to 30 years, I think we're going to see some sort of X-33/34 kind of vehicle. Horizontal takeoff, landing. Twenty or 30 years may be a little short. It may take longer to get there than what I'm thinking for an operation—

WARD: So that would say the Shuttle really is likely to be the primary—

GRIFFIN: For another 20 years.

WARD: —manned vehicle for another 20 years?

GRIFFIN: I think so.

WARD: How do you think history's going to judge the Shuttle as a—?

GRIFFIN: I think it's going to judge it extremely well. It's—If I'm not mistaken, I think it has just passed recently the record for any launch system in terms of success rate. I may be wrong on that but I—

WARD: No, I think you're right.

GRIFFIN: —I think read somewhere that it had—it passed the Delta and it passed something else. And I think now it is the most successful of any vehicle ever—that's ever been launched. It's got the most—it's got the highest success rate. And I don't know how you can get any better than that.

WARD: I think the criticism that will probably continue to be leveled against it is that it didn't meet its promise. NASA at one point was saying, "It will fly 60 times a year and reduce the cost by an order of magnitude." And we just didn't do that.

GRIFFIN: Let me—I've got a theory on that. Because I was in the middle of that. And I remember when those claims were being made and it was mostly in Washington. And I remember kind of, "Whoa!" You know. "I wonder if they really think that's right?" Because I—by the time I got in there, '71 is when they got the first funding, I got there in April of '73, and I had not been—I had been flying Apollo, so I hadn't been worrying too much about the Shuttle. But I thought, "Boy that is a big leap!" You know, "I wonder—" I remember thinking to myself, "Can we do that?"

But I even—you know, I listened to all those guys come in up there and say they—yeah, they could—But it really was, I believe, a primarily Headquarters-driven political message that—And not that they did it—they thought they really could do it. But you didn't hear the—you didn't hear the guys in the field centers standing before the American public

saying we were going to fly this thing, you know, as many times and as easy as we could. But I think everybody just assumed that we could make it a lot easier.

And it was not trying to mislead anybody that they—this system should be able to be better than the old Saturn. And, indeed, it is. But it never could—from the get-go, it was never going to get to where the people were claiming it would do.

WARD: Well the Shuttle was designed by the Apollo team, really, at the peak of that team's capabilities and accomplishments. Do you think that maybe that contributed to a sense of overconfidence in what they could do?

GRIFFIN: Probably. I think it probably did. And in the thing that is kind of the—at the footnote to that is, is that there wasn't anybody else in the country that could've done it. Those were the people that had the skill to do it. And so, I don't really fault—I think they thought they could change this thing an order of magnitude. And what they did is changed it, you know, about 10 to 20 or maybe even 50%. But they couldn't get the order of magnitude that they thought they could. And, I mean, I got eaten up with the same story. I heck, I was up there telling people on the [Capitol] Hill, "Oh yeah, we can fly the—" you know, "I guess we can. So let's do it."

WARD: Well, there were also political and legislative tradeoffs that were made that changed the ability to do that. And I'm not sure those ever got factored in.

GRIFFIN: No. That's right. And—but if—and I wasn't—in the—as I said earlier, right in the middle of that fray in Washington. I don't think anybody was trying to intentionally mislead anybody. We really thought we could do it. And it turned out—

WARD: One of the reporters that you'll remember well, Bill Hines, wrote an article at about that time pointing out that the numbers that NASA was using were "bogus," as he put it. He compared it to the supersonic transport. He said, "The supersonic transport looks great. But only if you build enough of them and fly enough flights did it get—you get the cost down." And he predicted the same thing would happen with the Shuttle.

GRIFFIN: He was right.

WARD: And unfortunately, I think he was right.

GRIFFIN: Yeah. Yeah.

WARD: I've got one other thought along those lines: Gilruth and Kraft really in a way had a kind of a paradoxical concept of returning to the Moon, as I remember it. Gilruth said that "People will never realize how difficult it was to do it the first time until they try to do it again."

GRIFFIN: Right.

WARD: Kraft has said repeatedly that "We won't do it again until it's easy." And in a way, you know, I wonder if both of those could be right.

GRIFFIN: They—I—that was my—going to be my reaction. I think, you know, in a way they're both right. I can see the point. But, it—you stop and think about what it takes to get to the Moon, and it is kind of mind-boggling. It—how much energy you have to add. If you take any—of anything of any size out there it—there's a lot of energy that has to be added in

a fairly short period of time, which is always dangerous. And then so many things can go wrong. And you're out there 250,000 miles from Earth, and what you've got is all you've got with you at the time.

And—on the other hand, I do think there are some—the technology today would probably make it no harder to do than what we did in Apollo. And it would probably make it easier. I think we can make some things lighter. We can make some things a little more capable of fault-tolerance and that sort of thing. So, I think we're going—we will go back to the Moon. And—when those curves get in the right perspective again. But it's—I don't see what's going to drive us to do it right now. That's the thing that's—I think, there's nothing to make it happen. There's nothing to push it.

And maybe we shouldn't go back. Maybe we ought to go on to Mars. Now you talk about a tough mission. I mean that's a really tough one. But if we would undertake that one and with the resolve to get it done, I'm sure we could do it.

WARD: You mentioned earlier on the psychological impact of making a fairly short burn in Earth orbit that commits you to going to the Moon.

GRIFFIN: Yeah.

WARD: Was that about a 4-minute burn?

GRIFFIN: Yeah. As I recall, I think it was about 4 minutes.

WARD: How much longer of a burn would you have to have to commit you to a 2-year trip to Mars? Not much?

GRIFFIN: Not a lot. Not a lot more energy. It just takes you longer.

WARD: Yeah.

GRIFFIN: And—

WARD: The trip.

GRIFFIN: The trip.

WARD: Yeah.

GRIFFIN: And, the last numbers I've seen, they've got that down to about a 10-month transit time each direction, with certain assumptions. And, so who knows? Maybe that—maybe that's what we'll do next.

WARD: It would be a psychological—

GRIFFIN: It would.

WARD: —effect to see the Earth diminish to a point of light.

GRIFFIN: Yeah.

WARD: Yeah.

GRIFFIN: It would take 20 minutes just to get a conversation out there.

WARD: Yeah. I think that that's enough.

GRIFFIN: Well, this is excellent.

WARD: Did you—?

GRIFFIN: I appreciate your inviting me to be a part of this.

WARD: Well, we may want to get you back. We'll look over the transcripts and think of what we should have asked and didn't.

GRIFFIN: Be glad. Be glad to do that.

[End of Interview]