

## ORAL HISTORY TRANSCRIPT

CHARLES M. DUKE, JR.  
INTERVIEWED BY DOUG WARD  
HOUSTON, TEXAS – 12 MARCH 1999

VOICE OFF CAMERA: And we're recording.

WARD: Well this is our oral history interview with Charles Duke, Apollo astronaut. The date is March 12, 1999. And, Charlie, one of the things that struck me in going back over some of the information on your career was the number of you guys who came into the Astronaut corps from Eagle Scout backgrounds. I think I counted—at last count there were 293 current and former astronauts. Forty of you had been Eagle Scouts, including you. Is that a cause-and-effect sort of a relationship? Or do you think it's just that people who excel in one thing tend to excel in all of them?

DUKE: I think there's probably some connection, Doug. It might be slight. Some connection. I learned in Scouts responsibility, dedication, perseverance, goal-setting, patriotism, all of those things, I think, that led me to a career in the military. And from that background in the military, then, I was starting my military career and the space program was getting started, all of those attributes and characteristics that had been foundational in my life through the Scouts, I think, certainly helped me in my military career and then focused me in the right direction for the space program.

I was in flying school in 1957, and I'd just soloed in October when they launched the Sputnik. And, you know, beginning of the space age. And 4 years later, of course, [Yuri A.] Gagarin and then [Alan B.] Shepard [Jr.] went up, and I was still a lieutenant in Germany in a fighter squadron, and began to dream at that point about, you know, "Maybe this career I'm on, if I set the right goals, I could be an astronaut one day." And so that's what happened.

WARD: Well, you kind of had the pattern of other astronauts by that time—

DUKE: Right.

WARD: —so you could see what constituted getting selected.

DUKE: Yeah. I knew I needed graduate school, which I volunteered to go back to school. And the Air Force sent me to MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts]. And then I had—

WARD: Did you do that consciously to prepare yourself as an astronaut?

DUKE: Well, not for the astronaut—I did it consciously for my career. It was a goal in my career. Back in those days, the Air Force was really seeking, you know, advanced education as a prerequisite for promotion and stuff. And so I just knew that that was really what [I really needed to do, but] I didn't want to leave the cockpit, because I loved to fly. But I knew that that was necessary for me to make a step in my career. And so that's why I really volunteered. Not specifically to focus on the space program. It was only after MIT when I realized, you know, "I got this engineering degree, but, man, I really miss flying. What should I do?" And the next logical step was [Air Force] Test Pilot School [Edwards Air Force Base, California].

And so I volunteered and went to work out—went to school out there in '64. Graduated in '65, and 2 months later there was an ad in the paper that said, "NASA's looking for more astronauts," you know, "Please apply." And so a bunch of us from Edwards applied.

WARD: Did you do that consciously as a group? I mean, did you kind of get together amongst yourselves and say, “Let’s do this?” or did you do it more individually?

DUKE: It was individually for me. There—well, there were a few of us in our Test Pilot School class. We’d just graduated, and [there] was a real decision. The MOL [Air Force Manned Orbiting Laboratory] Program was selecting astronauts.

WARD: That’s the Air Force Manned Orbiting Lab.

DUKE: That was the Air Force Manned Orbiting Lab. And then—and NASA was selecting. Well I went to my boss, a deputy commandant of the Test Pilot School—

WARD: Was that at Edwards?

DUKE: At Edwards. His name was Buck Buchanan. And said, “Sir, you know if I would like to apply. What do I do?” He said, “Well, I don’t know, but we’ll find out.” And then a couple of days later he came back and said, “You guys, if y’all apply, you can apply for NASA, you can apply for MOL, you can apply for both. But if you apply for both, I guarantee you we going to pick you for MOL and not let NASA have y’all.” And there was two or three of us in that category.

So the Air Force didn’t have very good luck with the—or history with manned flights in space. And so I decided that I’d volunteer only for NASA, which I did. And fortunately got selected. But then after I got my process started, it was sort of, you know, “Who—are you going? Are you going?” and so it—just sort of word of mouth among the test pilot corps at Edwards, and it turned out 8 or 9 of us had applied.

WARD: So you all had a pretty good idea of who among your colleagues were also your competitors?

DUKE: Right. Yeah. We did. We were hoping that we would all get selected, and a lot of us did from my Test Pilot School class. It ended up Stu [Stuart A.] Roosa and myself, Al [Alfred M.] Worden, later on Hank [Henry W.] Hartsfield [Jr.] was in our class (he came in)—

WARD: He was from the MOL.

DUKE: —from MOL. Then, gosh, Ken [Thomas K.] Mattingly [II] had got—he was a class or two behind us. Ed [Edgar D.] Mitchell. So in our group of 19, there were a lot of us that were at Edwards—either in Test Pilot School or had just graduated—that got picked. Joe [H.] Engle. He was probably the most experienced of us, of the bunch, because he was already flying X-15 and really had his astronaut wings at that point. But because he'd flown X-15 up to, I don't know, a jillion miles or whatever it was, you know.

WARD: Now you were one of—I think it may have been more common at that time than it is now, but one of the Naval Academy graduates who went into the Air Force.

DUKE: That's correct. Yeah.

WARD: How does that work?

DUKE: Well, back in those days there wasn't a Air Force Academy. Their first class was 1959, so they would allow ("they" being the Defense Department)—allowed 25% of West

Point and Annapolis to volunteer for the Air Force. So the Air Force was basically culling out their regular officer corps from West Point and Annapolis. So starting in the early '50s, you know, [Thomas P.] Stafford and (let's see) Bill [William A.] Anders and a few others—Mike [Michael] Collins was a West Pointer. But it—well, he was a West Pointer on that side. He did it on that side.

Anyway, we could volunteer. So before we graduated, we said, “Well, we'd volunteer for the Air Force.” And I'd fallen in love with airplanes at the Naval Academy rather than ships; and I knew that's what I wanted to do. The airplanes I thought were better. You could stay in the cockpit longer in those days. And so there was some number of reasons that I wanted to go in the Air Force.

WARD: How did you get hooked on airplanes?

DUKE: My first recollection of flight was back in the early '50s. I was with a friend, and he had his—we'd just gotten our driver's license. And we were driving along. He had a little old convertible. And I looked up in—one afternoon and there was a contrail going over. And—early days of jets, you didn't see many contrails back then. And I said, you know, “Gosh, it'd be nice to make a contrail. I wonder what that'd be like?” And I started dreaming about flying airplanes then. I went on to the Naval Academy. They gave me a couple of rides in an open-cockpit, bi-wing seaplane called the N3N Yellow Peril. And I was hooked from that moment on.

WARD: Didn't get sick.

DUKE: No. I got seasick, but I never got airsick. And maybe that's one—another reason that I decided to go [laughs], because I really did get seasick. But I never did get—never did get airsick.

WARD: What was the—getting back to the astronaut selection process and after you'd applied, you started moving through the process, the physicals and all of that. You get down to the final interview. Do you remember who participated in that?

DUKE: Yes, I do. I remember three, no, four. There was John [W.] Young, who I ended up, you know, on the Moon with, and Mike Collins, Deke [Donald K.] Slayton, Warren [J.] North, were the four that I remember that were on that committee. I don't remember the nature of the interview. It was more a get-to-know-you type of—kind of guy, motivation, you know: "What's your motivation?" Because they had our backgrounds. They knew—

WARD: By that time, they had pretty well ascertained that you were qualified.

DUKE: Yeah.

WARD: They just wanted to get your personality.

DUKE: Yeah.

WARD: So—

DUKE: And we'd gone through the physicals and everybody—nobody had any problem with physical. And, you know, we'd taken some preliminary test. But with a master's

degree and all, we were—you know, I knew we were in the running, those of us who had that kind of background. But I just, you know, hopefully you didn't say the wrong thing or do the wrong thing. Had to be excited. And we were. I was really getting pumped up by then. I really wanted to get picked.

WARD: Did you have the impression at that point that—to the extent to which public relations would be a prerequisite for the job?

DUKE: No, I didn't. I—

WARD: Not particularly.

DUKE: I knew that—Well, I didn't perceive that that would be part of my job. I perceived that they were certainly in the limelight, the original guys and the astronauts who'd been selected. Gemini was going on and I knew that they were in the limelight. But I never realized that there was a big part of the job, that while you weren't flying, that it was part of the job was going out and, you know, and garnering support for the space program. It turned out I ended up liking that, and I enjoyed my week in the barrel or whatever it was back in those days. And—but, I didn't realize that was going to part of it when I started.

WARD: So they really weren't as up front about as they might've been.

DUKE: No. It was something that—I'm not sure anybody would've turned it down because they had to go out and make a speech. But, you know, it just turned out some people are more comfortable doing that than others. And I love to meet people, and I love

to—well, you know, when your heart's in something, you can make a you can really talk about it and be sincere. And that's where we were.

WARD: I think it may in part because, as a group of people, the astronauts have always been very adept at meeting people, giving speeches, being spokesmen for the program. But I think the public perceives that NASA selects them with that as a prerequisite. And, I wonder what it is that makes them all so adept at that if they're not consciously selected for it?

DUKE: Well, I—again, I think it's something that is there that comes out because you really love the program. You really support—the—to me the space program is very, very important for our country. I still, you know, 20-something years later, Apollo's long gone, I've been out of the program now since 1976, but I still love the program. And I think what we're doing is important for our nation. It's—like [NASA Administrator Daniel S.] Goldin says, it's an investment in our future. And that was—that's been my line the whole time is, we're—and when you believe that then you want to profess that. And that's been something that's, I think, in most of us; and that's why we do it.

WARD: Yeah. Getting back to Slayton and Shepard. How did you perceive, at that time, the relationship between the two of them? Shepard, of course, worked for Slayton; but they were, to most of us, very close.

DUKE: I sensed it was a close relationship. Of course, I was in awe when we got here, you know. Gosh, here's Alan Shepard, and Deke Slayton, you know, and Wally [Walter M.] Schirra [Jr.], and all those famous astronauts who I just admired and looked up to for years then. And so I sensed that Shepard and Deke and that whole group were real close; and their



working relationship, which I didn't quite understand in those days, was very tight. I didn't see any competition. One was above the other. I didn't sense that—

WARD: It was a collegial—

DUKE: Yeah.

WARD: —relationship.

DUKE: It was a collegial. More of that.

WARD: Do you think that whatever criteria Deke and Al used in selecting crews was a fair and effective—? And did you ever sort out what that criteria was?

DUKE: I never sorted that out. [laughs] I've been asked that many, many times. "How did you get picked?" I said, "I don't know." Even to this day, I'm not sure how the crews were selected. I got a inkling that Deke and Al sat down and said, "Okay, who's going to be the next commander?" And, "Okay, it's John Young." And John Young gets called in. And John Young says—well, Deke says, "Well, here are the guys that we could—we think we ought to fly. But who do you think?"

And so in some way, that process got selected and then it went up to the directorate, from there to [NASA Headquarters in] Washington [DC]. And I don't know of any time it was ever overruled. And it is a mystery to me, you know. There was no "Check out the squares," you know, "Fill this board of squares," you know, "Do this task," "Do that run," "Do this thing." And you get all these squares filled and you're going to get a flight. We didn't have any of that. It was just, "Do your job."

When we first got here, of course, we started training. Geology, which was—that was important I think. Everybody, not knowing who was going to fly—everybody did geology. And, then we did spacecraft systems for 4 or 5 months. And then everybody got assigned to some sort of little engineering oversight job. I remember Stu Roosa and I got assigned to Frank [F.] Borman, who was sort of Head of the Propulsion System, the—side of the Astronaut Office. These things were all sort of unofficial, I think, as far as organization within the Office. But that was where you concentrated your effort.

And so, on behalf of the Astronaut Office, you support—you went to design reviews on the Saturn or the engines or, you know, the guidance system or—which took us to [George C.] Marshall [Space Flight Center, Huntsville, Alabama] a lot and to [John F.] Kennedy [Space Center, Cape Canaveral, Florida] a lot. And all of those things that were involved in that. I remember we went to Ames [Research Center, Moffett Field, California] a couple of times to try to, “Can you fly the Saturn V in orbit manually?” And so they had—Ames had a program and some sort of simulator that—Stu and I went out there and we could fly the Saturn V into orbit from the pad. And—

WARD: This was using the guidance system—

DUKE: The guide—the IU [Instrument Unit], yeah. There was a program in the guidance system in the Saturn in the instrument unit; and it was connected through some software prop—way that I don’t recall to the controller in the command module. And so the commander could sit there and, with the eight ball, fly this thing into orbit like you do an instrument landing system in an airplane. And we showed that we could do that. They never implemented it. But in the program. We never had that capability, at least not in first stage. But in second and third stage, we had that ability. It was incorporated into the software. I could—

WARD: So you could override the Saturn instrument unit—

DUKE: Yeah, if it failed.

WARD: —to let the space—

DUKE: Yeah, if the guidance system failed for some reason, you could then utilize the instrument unit—the INS [Inertial Navigation System] in the command module to guide you. It would track, and then you would fly that and you could wiggle the engines back there on the—

WARD: Well, in a way that was kind of presaging the Shuttle Program, because—

DUKE: Exactly.

WARD: —that's exactly the way the Shuttle operates—

DUKE: Yeah.

WARD: —now. Of course—

DUKE: Nobody ever used it, of course. We never had to take over. But we felt like we could do it.

WARD: Well on Apollo 12, it was probably fortunate that the system didn't work that way. When they were struck by lightning.

DUKE: Well, it wouldn't have worked there because they lost their guidance—they lost everything in the command module. The instrument unit stayed—

WARD: Kept going.

DUKE: —operational, kept going, and that's what saved them of course.

WARD: Right.

DUKE: I mean, to me that Pete [Charles C.] Conrad [Jr.] didn't rotate that handle to abort that spacecraft when everything went zap is remarkable.

WARD: Right. I think they had a parallel situation in Mission Control, where the responsible flight controller didn't call for an abort either—

DUKE: Right. Yeah.

WARD: —and recognized that they might be able to salvage the situation. I think Apollo 12, sort of in my recollection, was the only launch vehicle ever to get struck by lightning that survived it.

DUKE: Yeah. It was—I mean, I watched it disappear in those clouds, you know, and then there was this flash. And it was—

WARD: Were you at the Cape?

DUKE: I was at the Cape, yeah, watching. And, you know, we didn't have any idea what had gone on. But then I listened to the tape—the transcript and Pete's just rattling off all this—all these problems we've got in this thing. And the thing's falling apart, you know! And golly! And that they got it all back on board, I believe it was so overwhelming that they—“Maybe we'd better sit here and figure out what happened.” And by the time they did that, it was—the thing was fly—still flying and—

WARD: Well the crew seemed to sense before anybody else did that lightning was the cause.

DUKE: Yeah.

WARD: I think the ground was a little incredulous that that might've been what was going on.

DUKE: Well, you sure—I know in an airplane, I've been struck by lightning in an airplane a number of times, and there's no doubt when that happens. Man, I mean, it just, zap! And it's a flash all around you. Fortunately nothing ever—usually nothing ever happens in an airplane. But—

WARD: Well, they even lost their cockpit lights—

DUKE: Yeah.

WARD: —for a time, didn't they? And went dark.

DUKE: Yeah. Apparently, and, of course, they had only one window at the time, you know. The hatch window's the only one uncovered. And so there was just that little light coming in through that hatch window. So it must've been a

WARD: What was your assignment on Apollo 12?

DUKE: I wasn't really assigned to that flight. I had been working on Apollo—by that time, I was backup on 13. So I was training on 13. So I was not involved officially in Apollo 12.

I'd been support crew for Apollo 10, and helped develop the lunar module procedures during that time for activation and checkout. So I was a Capcom [capsule communicator], — support crew during the training, and then for the flight was Capcom for the lunar orbit stuff and the activation and checkout and the rendezvous on Apollo 10. And as a result of that, I probably had the most experience of any of the astronauts that was not on a crew in the lunar module. And so I ended up on Capcom and doing the same job on Apollo 11.

WARD: Did [Neil A.] Armstrong have a vote in that?

DUKE: Apparently he did, yeah. Neil had come and said, "Charlie," (I believe it was Neil and Buzz [Edwin E. Aldrin, Jr.], and maybe just Neil), he'd come and said, "You know, we'd like you to do activation and checkout for us for the landing." And I said, "Man, that'd be a great honor. I'd love to do it." And of course, that's what I did.

WARD: That, in recent years (and I suspect was the case then), really wasn't the normal rotation. You wouldn't normally go as a Capcom from one flight right into the next, would you?

DUKE: No. That wasn't—normally, you know, support crew, then you went into maybe a backup crew and then on into a flight crew. So about every three flights, you had some progression, hopefully. And that's what happened for me. From 10 to 13 to 16, really, was that prime way it went for me; and it just turned out that I went—we didn't get really on the backup crew until after 11. I think they didn't announce that crew until after 11, so then I went on to that. So that's how I ended up at Capcom for Neil and Buzz for the landing.

Prior to that, I had, in my engineering stuff, I had taken over the lunar module engine oversight. The descent stage engine was doing really well, but the ascent engine was in trouble. This was like in the early ['70s]. They were trying to qualify it, and they were having some instability in the engine. And that's a critical engine. I mean, if it didn't work, you were going to either crash on the Moon or [be] trapped on the Moon.

WARD: It was kind of like the service module engine in the command module. It just had to work.

DUKE: It had just had to work.

WARD: Because it had to be a very simple, robust system.

DUKE: And so, George [M.] Low, who was Apollo Program Manager at the time, he organized this committee or team to decide what we were going to do. I mean, would we get this thing qualified, or should we have a parallel development? And, it was mostly the

Propulsion guys in Max [Maxime A.] Faget's division but—who was the Engineering Directorate. But then I was on the team from the—to represent the Astronaut Office. And a few others, I think.

Anyway, that—we met for a couple of months and visited with various contractors. We listened to proposals from Bell [Aerosystems Corp.] about how they were going to fix theirs, and we went to Rocketdyne [Division, North American Aviation, Inc.] and they said, “Well, we could do it.” And it ended up, after about (don't hold me to this but—about the timeline) but like 6 months later, we decided that we would—had this big meeting with Low. And there was a big vote. “What are we going to do?” And I remember everybody sort of looked at me: “What does the crew want to do?” you know. And it was, “Well, I think we ought to go with a new contractor.” And we'd been parallel this time; and so Rocketdyne was selected and just within months, they had their engine qualified. And it turned out it was a great engine for—

WARD: You changed horses in midstream. Went from Bell to Rocketdyne.

DUKE: Which was really that close to a launch, you know. We were like—it was beginning to impact the schedule because Apollo—you know, [President John F.] Kennedy said, “Land by the end of the decade,” and now we're at late '68. The first lunar—hadn't even flown a lunar module. We need to get it up with Apollo 9; it's coming up in a month or two. And so, first time we were going to fire those engines and so it was a critical time, and that was a big decision because, to change a contractor that close in and start really—and not a new development, because we were able to use the injector was really I think the problem with this engine. And anyway, we did it and I thought it was a bold move by Low. And—



WARD: Was that part of the problem that kept the lunar module from being ready for Apollo 8? Which was why Apollo 8—

DUKE: I don't remember exactly. Probably. I would imagine that was some reason. It did—but it wasn't ready to go. I we knew that. And so, it could have been other reasons, but I don't remember the details of that, Doug.

WARD: But in any event, your lunar module expertise had a lot to do with Neil and the crew—

DUKE: Yeah.

WARD: —wanting you to work their flight.

DUKE: But especially the Apollo 10 part—side of it, you know. And that—I mean, it was a great honor and a great thrill to have been in Mission Control when the landing occurred. It was a—I don't know whether you were there or not. You were probably there, too. And, the tension in Mission Control during that last minute of the descent was incredible.

WARD: Has the thought crossed your mind that you may be remembered as much in history for your role on Apollo 11 as for your own lunar landing?

DUKE: Probably more so. Yeah, it has. And that's okay. You know, I was just pleased to have been part of that team. You know, Doug, to me the Mission—I loved the Mission Control team. I thought we had the greatest bunch of guys and gals in that Mission Control that were dedicated, young, but experienced; and it was great working with them. All the

flight directors that I worked with, we all hit it off really well. And [they were] very confident, very cool, in all of the problems that we experienced.

WARD: Now that's interesting. Because it really wasn't always that way. If you go back and talk to some of the early groups, there were some almost pitched battles, as I understand it, between the astronaut representatives who were sent out to the remote sites, between, in effect, Deke's guys and Chris's [Christopher C. Kraft] guys—

DUKE: Yeah.

WARD: —as to who was going to be in charge. And it's pretty clear that, through Mercury and Gemini, all that got sorted out; and it really was a nicely functioning team by the time you guys got into Apollo.

DUKE: Yeah, I'm sure it was. And I'd heard some of those stories. But I never experienced that. By the time I got there, Apollo 10, I had done one of the trench jobs. I remember then in the Gemini, they had an astronaut and also a Capcom that was an astronaut also in the booster position. And I did that on Apollo—not Apollo but Gemini XI and XII, maybe. And you know I really didn't know what I was doing out there, but that's where I was. And—but even then, I felt a smooth-running teamwork had evolved into the Mission Control, and there wasn't any of that “I'm in charge here” dynamics. It was all really, really well. I—

WARD: It certainly gave you a lot more confidence when you had to rely on the judgments of the ground and you were the one in flight.

DUKE: Yeah. Which we did. You know, we had—on Apollo 16, an hour before we were to land on the Moon, we were on the backside of the Moon and Ken, in the command module, had to burn the SPS [Service Propulsion System] to boost his orbit up. So—

WARD: This was after the lunar module had separated?

DUKE: Yeah, we were separated. We were a mile or two apart. And John—we were within an hour of landing. We—the next half rev around, we were going to start our descent. And on the backside, he [Mattingly] was to boost up to a 60 circular orbit so that we could have the right phasing for the rendezvous if we had to abort. Well, he reports a real problem in the engine. The reaction—not the reaction control, but the control system when he powered it up, the secondary, it wouldn't stabilize the engine and it was wiggling back there. And he thought that the thing was going to shake him apart. So John says, "Don't burn."

So, I mean, our hearts sank. If your heart can sink to the bottom of your boots in zero gravity ours did, because it was—I mean, there we were, you know, 2 years of training, 240,000 miles away, an hour before the landing on a orbit you can look down at your landing site, 8 miles beneath you, and they're about to tell you to come home. And that's what we thought was going to happen because it was, according to Mission Rules, abort. So we came around, reported no circularization burn. And they said, "Roger, stand by. Start getting back together." And so we started a slow rendezvous, thinking that that was it, you know. And—but, they said, "We'll look at it."

And I don't know all the dynamics that went up—which went on in Mission Control, but 4 hours later, after a couple of more revs, they kept briefing us and say, "Well, we think we've isolating the problem. And we think we can work around it" and this and that and the other, "but we don't know yet." And later on, I get back and the—saw a video that they'd taken at Mission Control, and I can remember Chris Kraft sitting there, scratching his hand,

and said, “Give—let them have at it.” And he said, “Go,” and so they—Jim [James B.] Irwin said, “We’re go for this attempt,” the second time around.

WARD: Jim was your Capcom.

DUKE: He was the Capcom, yeah. He’d been on 15 and was the Capcom. So they figured out, from Mission Control—we didn’t know what was wrong. But they figured it out, you know. And that’s—and then—then at that point in our flight, in Apollo, to have management say, “Yes,” to a landing I thought was really tremendous, because, you know, it would have been a lot easier to say, “Well, come on home, you guys.”

WARD: Sure.

DUKE: You know, “We don’t want to risk it.” You know, “We’ve done it before, and—” but to let us go ahead and land was really terrific, and thanks to Mission Control. And you—almost every flight, you could see that Mission Control team had a great hand in either the rescue or continue the mission or overcome some problem that we didn’t have a clue of what it was in the cockpit.

WARD: Sure. And you couldn’t possibly have the network of support that they could assemble—

DUKE: That they assembled, yeah.

WARD: —on the ground.

DUKE: I mean, all over the country, just instantly. You know, Apollo 11 with the computer alarms on the descent that we had. I mean, 1202 or whatever it was, you know, and I—, “What is that?” Well Steve Bales knew. And, man, just like that, we’re go for it.

WARD: I was going to ask you about that because there were a couple of problems on that descent that, as I recall, were pretty unnerving. One was the continual communications dropouts and telemetry dropouts with the lunar module. And of course the other was the computer alarms. At the time, do you remember which of those or other problems were uppermost in your mind?

DUKE: The computer alarms.

WARD: Was that—?

DUKE: Yeah. Communication dropouts were a nuisance more than a danger, but a computer problem was a showstopper. And we didn’t—I mean I vaguely remember seeing—reading something about twelve-oh (whatever those alarms were), 1201, 1202, I didn’t really know the consequences of those alarms. And, you know, you didn’t have time to break out your G&N [guidance and navigation] checklist to go to the emergency procedures and find out what that was. But fortunately, Steve and those guys on [the] G&N console knew. But to me that was the most critical.

WARD: Yeah.

DUKE: Then later on, the most critical was, of course, the fuel state. We didn’t quite have the tracking right, if you remember, in those days. We didn’t quite understand what the

mascons [mass concentrations]—the gravity anomalies were on the Moon, and so we were a little off in position. And so when they pitched over to look at the lunar surface, they didn't recognize anything and they were going into this big boulder field and Neil was flying a trajectory that we'd never flown in the simulator or, you know, in our integrated sims [simulations] with Mission Control; it was something we'd never seen. And, you know, we kept trying to figure out, "What was this going? What's going on?" You know, "He's just whizzing across the surface at about 400 feet," and all of a sudden he—the thing rears back and he slows it down and then comes down. And I'm sitting there, sweating out—

WARD: You could see all that from the telemetry—

DUKE: Yeah, we could see—

WARD: —if you knew how to read it.

DUKE: Yeah, we could see all of that. I had that plot on my screen, and, of course, I was watching fuel state too along with the Propulsion guys. And (I forgot who that was now), but anyway, we were getting real critical fuel-wise. And, so I remember I was sort of giving them this running commentary. We were down to, like, the last couple of minutes; and Deke Slayton is sitting to my right, you know. We were glued to that screen, and I'm just talking and talking and telling them all this stuff. And Deke, I remember, punches me in the side and says, "Charlie, shut up. Let them land." [laughs] "Yes, sir, boss." So I got real quiet, and the tension began to rise in Mission Control. And I remember giving them—we had a 60-second call and—

WARD: That was 60 seconds to abort. Is that it?

DUKE: That's right. It was—when I—when Mission Control said, “60 seconds,” it meant you had 60 seconds to get on the ground. And the problem was fuel. If you didn't—we wanted enough fuel remaining in the descent engine that when he throttled up, he would get a positive rate of climb and start up before we had to abort stage, because that was a critical deal.

WARD: You didn't want the ascent engine to have to overcome—

DUKE: A descent—

WARD: —a descent rate and also getting them going up again.

DUKE: Exactly.

WARD: You wanted the descent engine to have enough propellant to do that.

DUKE: Right. So there was a little margin. But we'd had, at some level, 60 seconds came. And then the next call was “30 seconds.” And so I called, “60,” and they were still in the air. And I called, “30,” and, “Man, it's getting close.” And then, of course, the dust was flying. And then I heard, “Contact. Engine stop,” and I knew we were on the ground.

WARD: This was after the 30-second call?

DUKE: After the 30 seconds, right, Doug. And so, later on, you look at the data and it was between 7 and 17 seconds' fuel remain. I had 17 seconds remaining on my watch.

WARD: That was 17 seconds remaining before you would have had to make that abort.

DUKE: Before I would've had to abort. Now, but Neil—

WARD: You had some more of that—more than that in reserve.

DUKE: That's right.

WARD: But you can't use that.

DUKE: You—yeah. Now whether Neil would actually have aborted or not, I don't know. Had I been the commander and I was within the dust and, you know, if somebody even called "Abort," you know, and you were 10 feet off the ground, what were you going to do? Well, I'd have probably landed. But, I mean, that—you know, he's in charge.

And, but anyway, we landed before the 30 seconds were up. And, of course, everybody erupted in Mission Control and—as you know, and then his famous lines about, "Houston. Tranquility Base here. The Eagle has landed." And so we made it, you know, and it was really a great release. People cheering, as you remember, and all.

WARD: Yeah.

DUKE: Then Chris Kraft got—I mean—Chris—Gene [Eugene F.] Kranz got us all back to work because, at that point, we had to make sure this thing was safe, that we didn't leak anything and if we had to, we could lift off again quickly in an emergency.



WARD: Your comment at that point was obviously very spontaneous.

DUKE: It was. I was so excited, I couldn't get out "Tranquility Base." It came out sort of like "Twangquility," you know. And so it was, "Roger, Houston. Twangquility Base here." Let's see, what did I say? No, it was, "Roger, Twangquility Base. We copy you down. We've got a bunch of guys about to turn blue. But we're breathing again." And I believe that's true—was a true statement. It was spontaneous, but it was true. I mean, we were—I was holding my breath, you know, because we were close.

WARD: Yeah. Getting back to the simulators on that. One of the things that I've been told is that almost invariably the commanders in landing on the Moon and in landing the lunar landing training vehicle tended to use a lot more propellant and take it down a lot closer to the wire than they did when they were in the lunar module simulator. I don't know if that was your experience—or not.

DUKE: Well, I didn't get to fly the lunar lander, the rocket one that we had out here at—or jet engine, whatever it was—

WARD: The lunar lander trainer [lunar landing training vehicle].

DUKE: —out here at Ellington [Air Force Base]. After Neil Armstrong ejected from that one that went out of control, they only let the commanders fly that thing. So, I didn't get to fly it.

WARD: I think that was generally viewed as probably one of the most dangerous parts of—

DUKE: Probably, yeah.

WARD: —training or even landing on the Moon—

DUKE: Yeah.

WARD: —was flying that training vehicle.

DUKE: Oh yeah. It was—

WARD: As I recall, that had a jet engine that took out, what? Five-sixths of the Earth's gravity—

DUKE: Right. Yeah.

WARD: —and then used lunar-like—lunar module-like thrusters to give you the rest of the one-sixth—

DUKE: Exactly.

WARD: —so it was like landing on the Moon.

DUKE: Yeah. And so, we had something that was similar to that up at Langley [Research Center, Hampton, Virginia], but it was on a wire and you slid down this wire at sort of one-sixth type stuff. And I did fly that, but it wasn't very good. I thought the simulator was a lot better. The only thing with the simulator was, [it was] bolted to the floor so it didn't give

you the motions cues that you had in flight. But other than that, it was—the simulator was really, really good. And I believe you're right. We tended to—in the simulations, you tended to be a little bit more cautious than the real world.

For some reason, when we came down to land, John just continued right straight on down and we were basically in a constant descent of some rate throughout our landing. And I remember at about 20 feet, he did level off, and we just sort of stopped. And I remember saying, "Okay, John, you've leveled off. Let her on down." And I was sort of feeding him the information that he needed for the velocity and the control and the rate of descent. And after a second or two of hover, we began to just sink down about 1 or 2 feet a second, and touched down with plenty of fuel for us. Of course, that's a function of experience, Doug.

WARD: Yeah.

DUKE: You know, we were the fifth landing. And everybody else had done it, and we knew—we just—you just—while you'd never done it yourself before, everybody else had done it, and you just—that glean that experience from the briefings and the debriefings and talking to guys and—about it. And so we felt real confident, when we were there, that we were going to have plenty of gas.

WARD: Of course by the second mission, Pete Conrad was able to set down real—very close to the planned landing site. Right next to Surveyor.

DUKE: Yeah, we'd figured out the mascon [mass concentration]—the gravity anomaly deal and so we were able to track and tell the computer accurately where it was and where it wanted to go. And so that guidance system would take you right down if you gave it the right information. It was a good system.

WARD: The mascon as I—problem, as I recall, was the fact the Moon isn't of consistent mass. It has concentrations like raisins in a cookie—

DUKE: Exactly.

WARD: —that affect the gravitational pull on a vehicle like the lunar module and affects the trajectory.

DUKE: That's right. And so as you go over one of these, it sort of pulls you down. More gravity, and you sort of start going in an orbit like this and as you go down, it slows you down and so—or speeds you up, one or the other. And anyway, you end up—you end up not being where we think we were as we project 2 to 3 revs [revolutions] later on down. So we had to figure that out.

WARD: Yeah. And that got worked out—

DUKE: Yeah.

WARD: —pretty well after Apollo 11.

DUKE: Yeah, after 11.

WARD: One of the things that struck me, I don't know if you remember it as clearly, is the reaction at Mission Control during the simulations for the lunar landing, when they finally got all of the final guidance software in from MIT and had the actual program that was going

to be used for landing on the Moon. Do you remember that first landing simulation with Buzz and Neil in the simulator and the actual team in Mission Control that was going to do it? And the emotion and the reaction when you actually simulated a highly realistic first landing with the actual software?

DUKE: I was there, but I don't remember the details of it, no. I'm sorry.

WARD: It's one of those things that gets away after 27—

DUKE: Yeah.

WARD: —26, 27 years. On your mission, of course on all the lunar missions, one of the things in the lunar module simulator that people today would probably find a little incredulous is that you didn't use computers to generate the television views out the window. You had a big plot board—a big board adjacent to the simulator, where the lunar surface itself was actually mocked up in all the detail that the scientists could give.

DUKE: That's correct. Yeah. Our landing site was selected by the site selection committee of scientists in various disciplines; and it had been selected from photographs taken on Apollo 14. Stu Roosa had—as he orbited, he had a mapping camera. And their orbit took them over the Descartes highlands. And so, it was decided that we would go land there. And so they took some of his photographs and made a mockup of our landing site, once they selected which it—where it was. And it turned out that the photographs had a resolution of about 15 meters. In other words, anything less than 45 feet in diameter, you couldn't see in the photograph. But the major features, you could see. And so they modeled that into—they built that into the model. And they put this model on this big board, and there was a TV

camera that ran a—ran on a track above here, and so that was the view you had in your window, was this TV—

WARD: As you were simulating a landing.

DUKE: —picture. Yeah. As you simulated a landing. And so, I mean, thousands of times John and I, you know, came in for landing and we'd pitch over and recognize—one crater we called—had called "Gator," one was called "Lone Star." I could look out the right window of the simulator, my right side, to the north and see North Ray Crater up there and John could look out his side and see the Stone Mountain down to the left. Names that we had give these prominent features in our landing site. And when we really did it for the first time, I mean for real, in flight, as you recall the lunar module trajectory was such you came down—our attitude was such you came down—the first 7 or 8 minutes of the descent was with the window pointed out at space. And you couldn't see the lunar surface.

WARD: So you'd keep the engine in front of you, slowing down.

DUKE: Yeah. So you were slowing down. Now you could've rolled over 180 degrees to put the windows down, but that was a problem with communications. So we chose to land—or start down with the windows pointed out to space and just depend on the landing radar to update us and to bring us in. So at 7000 feet, the guidance program maneuvered the vehicle to windows forward down, and (Excuse me)—and so out the window for the very first time, at 7000 feet, you saw the lunar surface. Well, I mean it looked exactly like the mockup.

I mean, there we were. "John, there it is!" you know, "There's Gator. There's Lone Star." And we'd had some debate about getting up to this objective, North Ray Crater, during the training because, in the photographs, it looked really rough. And so, I looked

out the window and looked north, and I said, “John, I can see North Ray. It’s smooth up there. We’re going to be able to make it.” And about that, I’m just out the window, and John says, “Give me some information, Charlie.” And so I get back in and start helping him land, because we’ve got to pick out a landing spot.

Before the mission, 4 or 5 (let’s see), about 3 months before the mission, I’d had this dream about John and I driving the rover up to the North Ray Crater and we came over one of the little ridges, and there’s a set of tracks in front of us. And it’s rover tracks! Well, gosh, you know, we reported—this was all in the dream. And, you know, we reported to Mission Control. We started following these tracks. Well that dream was so real that one of the things, when I wanted to look north, was to see if I could see that set of tracks.

WARD: Well yeah. [laughs]

DUKE: Well of course there wasn’t any set of tracks. But, anyway, I did figure out, as I looked north, that the surface wasn’t as rough as we expected. So we ended up maneuvering, and John was—by the time we were like 300 feet above the surface, he was fully in—fully manual.

Now a lunar module had dual controls like an airplane. The commander was on the left side, like the captain of the airplane. I was on the right side, like the copilot. And I had my throttle and control stick.

WARD: Of course you’re not seated. You’re standing.

DUKE: We’re standing. We were anchored to the floor by a set of cables. The—as you stood there, you—in front of your position, there was a window here. I had a little abort guidance computer with some other switches. The main instrument panel was in between us

in the center and the computer—main computer was in this point. And so I'm standing, and we have these cables that pull up, and they're bungee-type things. And you could hook on and anchor you on the floor. And that was necessary because, if something went wrong and the thing started rolling rapidly, you wanted to be anchored—

WARD: I guess you couldn't afford the weight of seats.

DUKE: No. And there was no room, really, for seats. You really didn't need any in weightlessness or in zero—in one-sixth gravity. So anyway, we had trained that John would land and I would provide him all this information, help him down to land it. And if we had any emergencies during the final stages of descent, I would handle that because I could reach over behind him and pull circuit breakers, and I could reach all the switches that was necessary to overcome any emergency. And so we did that. That was the way we had trained. But if he had a problem with his control stick or throttle, I'd take over and he'd perform the secondary role.

Well, it turned out everything worked right, and so I fed him the information he needed to make this landing and kept everything running right. And so he did the actual landing, and it—a great job. A great Navy landing. We hit solid and stable. And we'd picked out a great spot. It was—the lunar module would land on a 10-degree slope; but if you did, it was tough working around on a 10-degree slope because if it was like this, the experiments were around at the back of the lunar module, and that meant it was above my reach. Because I was standing downhill trying to reach up. And I—we couldn't have done some of the experiments. But it turned out we were within 1 degree of level, and so we were able to work around the lunar module.

WARD: Did you kick up the amount of dust that Neil and Buzz did on the first landing?



DUKE: It's hard to say how—we did have a lot of dust. In a comparative sense, I don't—I would imagine it was about the same, even though our landing site was considerably higher in elevation than theirs and in a different textural context of the Moon as far as the geology went. The dust was probably the same. I remember we almost had the surface obscured at about 20 feet. When we leveled off at 20 feet, I remember looking out and I—you really couldn't see through the dust that was being blasted away.

But we had selected what we thought was a good landing spot. No major craters, and so we landed. And it turned out, though, that when we got out the next day for our first EVA [extravehicular activity] and we went around—and I went around to retrieve the Apollo lunar surface experiments package, which was called the ALSEP, there was a big crater about 2 meters behind us that we hadn't even seen. And if we'd have landed like 3 meters back to the east, we'd have been—had one—the back leg in that crater. And—

WARD: Was it deep enough to have tipped you over?

DUKE: It would have been very—probably not. But—at least on that part of it. I mean, if you'd gone back another 6 meters—I mean, this was a pretty big crater and it tapered out maybe 15 feet deep or so, if I remember. On the edge of it, you'd have—it would have just been hard to work because I'd have been standing downhill in the crater trying to get this ALSEP out. It turned out we'd missed it by just—but we hadn't seen it. It was amazing how things like that were sort of camouflaged. Without the right lighting conditions, you missed—you could miss some of these subtle features.

WARD: Well, the Moon's surface had some unusual reflectivity characteristics that I guess accounted for why you wanted to land with the Sun relatively low—

DUKE: Exactly.

WARD: —on the horizon.

DUKE: We felt like with the Sun low on the horizon, it would give us long shadows. And generally that was—was very helpful. You realized if you were landing on a slope that was very bright, it meant it was tilted towards you. If it was very dark, it was tilted away from you because you were in the shadows—getting into the shadow side. And so we tried to pick a spot that was sort of an average brightness. (That's not the right term.) But—

WARD: But not really bright. Not really dark.

DUKE: Yeah. Sort of average. And without any major rocks, boulders there. And so—and also, you used the shadow of the lunar module to judge altitude. For instance, if you lost the landing radar at the last 200 feet, the shadow is—as you got closer, the shadow came in and you could use the shadow to give you some sense of altitude; and so it was very important that we land with a very low Sun angle. Not only because of the temperature of the lunar surface, but also of this landing aid that we needed.

WARD: How are you guys doing on the tape?

VOICE OFF CAMERA: We're almost done. We need to stop it.

DUKE: Okay.

WARD: Do you want to take a little break?

DUKE: Yeah. Let's do.

VOICE OFF CAMERA: And you're recording.

WARD: Charlie, one of the things we haven't touched on in detail is—before we continue on with Apollo 16 (your mission) is your role on Apollo 13. One of my favorite political cartoons from that era (I think it was a Bill Mauldin cartoon), where it showed three very glum Apollo 13 astronauts sitting in their suits, getting ready for launch, with their helmets off, covered with the measles.

DUKE: Measles. [laughs]

WARD: And one of them looked at the others and said, "Well, at least, on the bright side—at least none of us is pregnant."

DUKE: Yeah. [laughs]

WARD: Of course you had a pretty direct role in that episode.

DUKE: Oh, the infamous measles.

WARD: I wanted to get your recollections of how all that came to pass.

DUKE: Well, you know, it's—I was backup for the—on Apollo 13. I was the lunar module backup to Fred [W.] Haise [Jr.]. John Young and Jack [John L.] Swigert and I were the backup crew. And of course in those days, you had two crews for each mission and you trained in parallel so that the backup crew could take your place if something happened to the prime crew. And the thought was that, you know, they might have an accident or they could get sick or something like that, and then you'd have a replacement for them. You wouldn't have to abort the mission.

So about, I guess, 2 weeks or 3 weeks before flight, our son Tom was (let's see now, that would be 1970)—he was 3. And he had a little friend named Paul House and—who was the son of some good friends of ours down in Houston. An architect. And so we were off for the weekend with the Houses. And sure enough, we came back a week later and Suzanne House called and said, “Paul has got the measles.” I said, “Oh Lord.” And anyway, I caught the measles from Paul, this little 3 year old.

And so I'm in—and I'm down there training in all this time, and then, so I break out with the measles down there and, of course, go to the doctor because I'm pretty sick. And they get all excited, of course. (I forgot who the flight surgeon was down there.) But anyway, he gets all excited and starts testing everybody, you know, a couple of weeks before the flight. And maybe it was 10 days before. Well, everybody had had the measles except for Mattingly. So [James A.] Lovell [Jr.] and Haise were immune, but Mattingly wasn't. So there was the big debate, you know: “What are we going to do?” And so finally the decision was made, “Take Mattingly off. Put in Jack Swigert.” And they could launch if they thought they were able to do that.

WARD: This was only about a week before flight.

DUKE: A week before launch, yeah. So I guess they had maybe 2 or 3 days of training. And the movie [*Apollo*] 13 seemed to imply that Swigert wasn't ready, you know. He was sort of a fill-in and really wasn't qualified. But that wasn't true. Jack was a real good command module [pilot]. We were ready to go as a crew. And it showed the—to me, that showed the beauty of the synergy of all of our training, that we could—you could take somebody, a week before liftoff, stick him in, and everybody felt comfortable. And that was the training was so (what's the word I'm searching for?)—everybody did the same thing. In other words—

WARD: Yeah.

DUKE: —consistent, I guess, is the best word. So anyway, Lovell seemed to think that they were ready to go, and so they launched. And by this time, I'm—I think I'd gone back to—I'd gone back home. Because I remember, I was back in Houston (I think) for the launch, and then when the explosion occurred, I was home in bed. And John called or—said, “Hey, they had this explosion and [there's] a real problem. Come into Mission Control.” So Ken and I and John showed up at Mission Control with some of the other guys, and that started, if I recall, 35 hours of work—either in Mission Control or the simulator as John and I were—and others were figuring out the procedures to power up the lunar module, to get them back on a free return trajectory, and to recover them.

WARD: Just to set the stage a little for that, the spacecraft-combined lunar module/command module were about (what?) two-thirds of the way to the Moon when that oxygen tank exploded.

DUKE: It was 55 hours out. Yeah.

WARD: And so, that disabled the command module. And I know that one of the things that people were really greatly concerned about at that time was that procedures and step-by-step checklists that had been worked out months and months in advance suddenly were out the window.

DUKE: Exactly.

WARD: And you guys had to then figure out, “All right, how do you run this new spacecraft arrangement to keep from getting in any more trouble?”

DUKE: Yeah. And also we had to not only figure out how to power up, to get it back, to get them back on trajectory, how to do that burn. We practiced, developed those procedures in the simulator, did it. We felt like we had a good handle on it. But then the problem came: “How are you going to make this thing last for 99 hours?”

WARD: The lunar—

DUKE: The lunar module.

WARD: —module, which was designed for (what?) 3 days.

DUKE: It was designed—in those days, it was designed for 3 days. It was designed for two people, not three people. And so we had electrical power; we had oxygen concerns; we had, you know, water. All the consumables that were necessary for life were—had to be

shepherded, if you will, very carefully. And to be honest, for the first 25 hours, Doug, I didn't think we were going to make it. And I—something was going to run out.

But by the time they did the burn to put them back on free return, which was, if I recall, something in the 70-hour timeframe, when we started—whipped them around the Moon and started back, you know, it started looking better and better to me. And my thought changed to, “If we don't screw this up, either in here or in Mission Control or onboard, we got it made.” And sure enough, everybody did a great job; and, I mean, the miraculous things that, you know, [Crew Systems Division Chief] Dick [Richard S.] Johnston's guys did to get the lithium hydroxide working and—

WARD: That was to get the carbon dioxide to go back on.

DUKE: To get the carbon dioxide working so we could use the command module system. Thank God for gray tape. You know, every flight had two rolls of gray tape; and then the Electrical guys figured out how to take power from the lunar module and go back into the command module and keep those batteries charged—

WARD: That's right. Because you had—regardless of whether the lunar module got you back, you had to have the command module to reenter.

DUKE: To reenter. That's correct. And so, you know, it was a tense time and—during the whole procedure and—of the recovery and 99 hours of drama, or thereabouts, till they separated and reentered. John Young and I were talking last night about that, as a matter of fact; and I remember we had figured out, in the simulator, that they had a series of maneuvers to do right before reentry to—because we were—we had never separated this whole stack of

the command module, service module, lunar module for reentry. It had never been designed for that.

WARD: You were going 25,000 miles an hour at that point.

DUKE: Right. And accelerating, and how—one's going to be reentering at the wrong speed, and the dynamics and the aerodynamics of it. Could we crash them together? And so, we had to figure out what was the best attitude and we'd done that, but it required a number of maneuvers to get it in the right position. And the more we thought about that, the more concerned I became, because, I mean, we could still be maneuvering and (Excuse me)—and we'd reenter and not get it all done, or we'd get to gimbal lock if we have a problem with a jet. We'd lose our attitude.

And so it was a real moment of decision, if you will. If I—as I recall it, John and I went to (I think it was Gene Kranz) and said “Gene,” you know, “why don't we just take what we got and just separate and let's just go?” And we did one or two little maneuvers, but we cut out some of them and that's what we agreed to do. And sure enough, everything came back in; and we didn't have any problems at all with collisions and things like that.

WARD: Did Mattingly ever thank you?

DUKE: Ken, you know, when I caught the measles and he was off the mission, he was really, I think, sad.

WARD: Oh sure.



DUKE: And I mean, and especially after that explosion. You know, he had that sense of duty and—that that's where he should be.

WARD: Yeah.

DUKE: But after the recovery and you know all it—his responsibilities in the command module and during the recovery and return, after that was over and it was announced that we would go on into Apollo 16 together, he never—I don't ever remember us talking about it. It was never a moment of, "Charlie, how could you do that?" Or—

WARD: Yeah.

DUKE: —you know, it was just one of those things that happen.

WARD: Yeah. I understand.

DUKE: By the way, after the measles, it turned out on Apollo 16, Fred Haise was the backup commander for us. And so, I got into the—we were up climbing into the command module on the launch pad and Guenter Wendt and the team were up there. And so John gets in, and I'm the next in on the right side. And as I—as I start to climb in, I reach in and I look over and on the—taped to the back of my seat was a big thing, "Typhoid Mary suit—seat." [laughs] So, we had a—

WARD: They weren't going to let you forget.

DUKE: —a laugh over that. Yeah, Fred would never let me forget that.

WARD: Getting back to 16, as you and Young prepared for your landing on 16, what kind of advice did you get from the prior crews, from 11 through 14 and 15?

DUKE: Well, on every mission after it was over, we had a day of debriefing that was basically just the Astronaut Office. Of course 11, 12, [and] 14 were in quarantine after the missions, and so after the missions were over—while they were still in quarantine, the whole Astronaut Office went over and we spent a day just talking about procedures and attitudes, feelings, all of the things that you want to know about as a—after the flight's over. And sort of cull all this information out of everyone. And so you sort of get more of a feeling and a sense of what it's like, rather than just the technical procedures of it.

A lot of suggestions came out of those debriefings. For instance, I remember on Apollo 15, which was the first rover flight, John and I were scheduled to be the first flight with the rover. But you remember they canceled Apollo 18 and 19, and so they moved what was called the "J" missions from 16, 17, 18, they moved them up to 15, 16, 17. And so instead of being the first flight with the rover, we were the second. Well John and I had been in the development of—had monitored the development of the rover. And one of the concerns we had about the rover was the seatbelt and all of that.

And sure enough, the seatbelt was very difficult to buckle and get cinched in on the lunar surface. Because in the suit, you're looking—you can't see down into this part where it was connected on a special bar, down on the side of the rover. And so, it was sort of a blind connection. And it turned out, they had a real difficult time on 15. So when they got back, well, that's what we discussed; and as a result of that, we went into a redesign for 16. It was simple, but it was a redesign; and so we got that. So John and I didn't have any trouble. We just could reach over and hook it in, and then flip it over and lock ourselves into the seat. So the debriefings really were important, I thought. As we came up with systems and

modification of procedures, different stowage ideas and concepts, that all evolved over the life of the program.

And so those moments of—or day of debriefing was excellent. So we knew when we landed on the Moon that, you know, we weren't going to sink out of sight. So when we hit the footpad, there wasn't any tentative step. It was just: Jump off and—

WARD: Yeah.

DUKE: —start work. And so, that was a, you know—a lot of growth and maturity in the program as we went along.

WARD: Yeah. It really was amazing, if you look at the amount of—number of scientific instruments, the weight that you carried on Apollo 11 versus how much you guys had. You had about twice as much—

DUKE: Yeah.

WARD: —scientific equipment on your flight. And the lunar rover was an amazing little—

DUKE: An incredible machine.

WARD: —invention all by itself.

DUKE: Yeah. It was an incredible machine. Of course [it] revolutionized lunar surface exploration. Instead of 400 yards, you could go 4 miles in any direction. And so, our objective, of course, was the Descartes highlands of the Moon. And it was a valley 8 to 10

miles across, and the objective was to explore the—to the south to a place we called Stone Mountain and then to the north, 3 or 4 miles, to a place called North Ray Crater, which was at the base of the Smoky Mountains, you know, after the names that we had selected. And so, with a rover, you could do that.

You know, we took us 40/50 minutes to drive down south; and I was the navigator. We had trained, so I was the navigator; and John was the—was the lunar module—I mean was the driver of the rover. And since the TV camera couldn't be on during our drive across the Moon (the antenna had to be pointed right at the Earth to get a TV picture), and so as we drove, the antenna was whipping with the lunar module and it would never stay pointed. And it wasn't gyro-stabilized, so we never had TV back in Mission Control while we were under way.

So to cover that gap, which might be as much as 2 kilometers or whatever, I was taking pictures and describing the terrain we were going over. So I was sort of the travel guide for Mission Control; the eyes of Mission Control during that time. And I had a set of maps that would take us from lunar module to Point A, or whatever, Stop One. And these maps were the same photographs that had been taken on Apollo 14 of our landing area, and so it was like you were looking down. Now unfortunately, once you get on the surface, some of the features just disappear. You know, it's not like looking down from altitude. And so you could see the major features, like Stone Mountain. But if you were looking for a spot like Plum Crater—Plum Crater was 1.7 kilometers in—to the west of us, and directly west. So we had to navigate out to this place, and, you know, you were looking around. It was like you couldn't see the objective for the trees type deal.

WARD: Yeah.

DUKE: You were just too close. But the maps were really good. We landed within a couple of hundred meters of where we thought we were going to land. So we, you know, basically recognized the major landing mark—spots. And I remember as John started off, I said, “Okay, John. Steer 120 degrees for 1.2 kilometers, and then turn left to 090 degrees and go another 2 kilometers” or whatever it was. And so, that’s the way we navigated. The lunar rover had a little directional gyro. There was no magnetic field on the Moon, so a magnetic compass wouldn’t work.

So we had a little gyroscope that was mounted in the instrument panel of the rover, and so we pointed it down-Sun and it was the old Navy lubber’s line: You had a bar came down across it, cast a shadow on the gyroscope compass card. And so we assumed that that shadow was west, and so we just turned the card till 270 was up underneath that shadow; and that was our direction. And then we had a little odometer on the wheel that counted out in kilometers, and so that was our distance. And so, that’s how we navigated up on the lunar surface.

Generally our trajectory—not our trajectory, but our traverses were sort of a egg shape, elliptical maneuver. We’d start out one direction and we’d make a big loop and come back to the lunar module 6/7 hours later. That was the plan. And, you never really worried about getting lost up there because the everywhere you drove, you left your tracks. And so, if you really were unsure of your position, it was easy just to turn around and follow your tracks back.

WARD: Those tracks are probably still there.

DUKE: If—unless—I’m convinced they are, unless there was a meteorite impact nearby that, you know—

WARD: Yeah.

DUKE: —created a big explosion. And it turned out really good. The car was amazing. It was electric, four-wheel drive, and it would climb a 25-degree slope. And so going up Stone Mountain, it felt like we were going out the back of the seat, because it was a pretty steep hill.

And we got up to our objective, which was a place called Cincos Craters, and we turned around and sort of started back downhill and, golly! It felt like—then you really saw how steep it was, because it felt like you were going to fall out the front of the rover. Well fortunately, we found a little bench, level area, and we parked the car and then we did—started our experiments up there on it. But that was probably the most spectacular view that we had on the lunar surface.

We were three-and-a-half/four miles to the south. We were several hundred feet above the valley floor. And you could look—from this advantage, you could look out all the way across the Cayley Plains and the valley that we had landed in. You could see, in the distance, [Smokey] Mountain and North Ray Crater. And there was—right out in the middle there was a our little lunar module that was the Mylar was orange, and you could see that. And then looking off to the northwest over this way was—as far as the eye could see—was just the rolling terrain of lunar surface, you know, shades of gray. It was really an impressive sight. My only regret, I think, of the whole mission was that we didn't take enough pictures with people in them.

WARD: Oh yeah.

DUKE: We took a lot of rock pictures. But now looking back, you pictures with people in them, was really, I think, important.

WARD: Well at least you improved on Apollo 11, where they got no pictures of Neil—

DUKE: Yeah.

WARD: —on the Moon because Buzz had the camera.

DUKE: [laughs] The only picture I believe we have is the TV camera as he steps off of the lunar—the footpad.

WARD: And a 16mm film camera shooting out the window. Otherwise—there's been some speculation that there may at some point have been an exchange of cameras and that one of the shots over by the lunar module was Neil. But of course, the other—one of the other changes, you'll remember, was the identifying stripes on the suits—

DUKE: Yeah.

WARD: —because you couldn't tell who was who because there was no way to tell—

DUKE: Exactly.

WARD: —one suit—one spacesuit from another.

DUKE: Yeah. So we ended up—that's a good point. We ended up that John, the commander, had red stripes; a broad red stripe around each arm and around each leg. And

generally, that was a good identifying mark. But after 3 days, falling down on the Moon and we lost—remember, we lost a fender on our rover, and it was like raining—

WARD: Oh that's right.

DUKE: —Moon dust on us. And instead of a Mr. Clean-looking white suit, we ended up gray.

WARD: Yeah.

DUKE: And so this lunar dust sort of smudged us into the red stripes instead of—so it was sort of difficult towards the end to recognize—

WARD: I'll bet.

DUKE: —one another. At least, in the pictures.

WARD: What scientifically were you looking for at Descartes?

DUKE: Well, the major objective, of course, was the geology. And the photo-geology interpretation of our landing site, there were two major volcanic-type rock: a very viscous rock that bulged up and caused the Stone Mountain topographical relief, and then down in the Cayley Plain, the valley was another kind of more viscous, less viscous rock that flowed out. And so we were looking at a contact between those two geologic features to see if there was any. It turned out that our landing site produced very little volcanic rock.



The major rock was breccias and igneous rock, so we had very little volcanics. And, when we started describing this, I kind of suspect that our geology team back in the Mission Control back room was thoughts like, “We wasted our time on these guys,” you know, “They’re not looking at what they’re doing,” you know. But as we did more and more, they realized that this really was a unique landing site and was not like the mare, that it was really different. And so we—the rocks we collected were a unique suite of lunar materials.

The other objectives, of course: We had the Apollo science package, which included a heat flow experiment. It included a—which was to measure the heat coming out of the Moon. It included a magnetic magnetometer, which was to measure any residual magnetism on the Moon. It included a spectrometer, which was to measure the gases escaping from the lunar surface. And two seismic experiments: one active, one passive. And maybe one or two others that I don’t recall. But that was the basic science package.

That was one of the first things we did. Once we got the rover off the lunar module, put the TV on. I pulled out the science package. I fuelled it with the RTG, which was a radioactive thermal generator (a little plutonium source). And I put that into the cast that would then generate the electrical power for the experiments. And I bolted the—(not bolted but, hooked the) packages onto the edge of a bar and I remember throwing it up in the air and hooking it in my elbows, in here like this, and I started jogging out to the deployment site, which was a couple of hundred meters to the east—no, to the west of where we landed.

Well, on the way out there (I’m jogging out), and one of these packages falls off the bar and just sort of bounces across the Moon. “Oh my Lord,” you know, was my thought. I’d blown the whole deal, you know, and broken all these experiments. And, well, it turned out that the thing was pretty robust, and so when I hooked it back. I looked around real quick to make sure that nobody had seen that. But unfortunately the TV camera—

WARD: Right on you.

DUKE: —was pointed right at me, and so everybody had seen this. But I recovered, and we went on out and deployed everything. [Everything] worked. The only problem we had was during the deployment of—I was drilling some holes into the Moon for the heat-flow experiment when John was putting up the central station and the data area. And, unfortunately, it was a spaghetti bowl full of cables around this thing, with all of the experiments attached, and—like a spiderweb. And unfortunately, he had a—he got one wrapped around his foot, which we had warned the guys about. We said, “You know, this is spaghetti; and up on the Moon, one-sixth gravity, these things are going to coil up like spaghetti.” And sure enough, that’s what happened.

And John ran off and, unfortunately, pulled a cable loose for us. And that was the data source and collector and power source for the experiment. So we lost the heat flow experiment, which was tragic because I had worked hard on it, and the principal investigator was a real great guy, and, you know, we wanted to do a good job.

WARD: Yeah.

DUKE: And—but it—we lost it. But that was the only real major problem we had, I think, as far as experiments goes, Doug. Everything else worked right.

WARD: In fact, those stations—some of the aspects of those stations—at some locations are still working. The retroreflectors.

DUKE: Well, you know, it was designed, I think—designed for a year (power source-wise). And the RTG kept working; and, if I recall, 4 or 5 years later NASA was still getting data from this thing. And finally budgets ran out, and they sent a signal to shut it down.

WARD: Yeah. Yeah. A bunch of guys went into people's garages a few years ago and got the activation data that people had hung on to. And they tried to reactive—

DUKE: Really?

WARD: —one of the sites to see if it would come back to life and used an antenna, I think, in South America to try and communicate with it. But it wouldn't— .

DUKE: Yeah, it wouldn't work.

WARD: —wouldn't respond.

DUKE: Well, I keep—I still make a lot of talks around the country. And I said, "Anybody want an \$8M car with a dead battery? You can go get ours." Yeah, it's still there.

WARD: Still there. Let's see: House Rock was one of the features that you guys encountered. What was—that was a very spectacular sight on the television because it loomed on the horizon, it looked so big. What was your first sensation when you saw that?

DUKE: Well, my first sensation was that it wasn't very far away. And John's sensation was, "That's a big rock!" I said, "Oh no, John. Come on. It's just right out there. And let's go down there." Well, there's a problem on the Moon. Your—with depth perception because you're looking at objects you've never seen before, so a big object far away looks very similar to a smaller object close in. You don't have any pole—telephone poles or houses or trees or cars to sit and judge scale like we—did down—down here on Earth. And

so, in my mind this rock was sort of average size and was just out there and “Let’s go do it.” And John was a little hesitant, but I said—they finally Mission Control said, “Well, have at it.” And so we started jogging, and then I realized, “This is a big rock!”

We kept jogging and jogging, and the rock kept getting bigger and bigger and bigger. And we were going slightly downhill, that we didn’t sense at first, and so we get down to this thing and we called it “House Rock.” You know, it must’ve been 90 feet across and 45 feet tall. It was humongous. And we walked around to the front side or the east side, which was in the sunlight, and, you know, it was towering over us. And you had this little hammer in our hand, you know, “What are we going to do with this rock?” And later on I— for Mission Control, saw some of the videos; and Mulberger and those guys in the back, they were cheering us on, you know, as we were going down. And actually, you could see that little dot; that rock was in the photograph. And I hadn’t realized this—

WARD: You didn’t realize what it was.

DUKE: —what it was. It was just a little black dot. And so when we got down there—this humongous rock towering over us—and John and I hit with a hammer, and a chunk came off, and we were able to collect a piece of House Rock. But—then we had to hike back. It was uphill, and it was a struggle getting back up.

But, we had some nuisance things, you know, that happened. Sample bags falling off. And clips not working. And little nuisance things like that, that we used—that we had to collect samples. But it all and all, everything worked right.

WARD: Astronauts, even to this day, will talk about how difficult it is to work in a full pressure suit.

DUKE: Yeah.

WARD: And you guys were out 3 days in a row, (what?) about 7 hours a day, working in those suits. How did you find that?

DUKE: Well, you didn't really sense a problem. I mean, you're so pumped up out there on the lunar surface, you didn't really sense any, you know—any problems. We had a good cooling system that kept us, temperature wise inside; it was very comfortable. We had a hot water—bottle of water Velcroed to the inside of the suit that we could drink out, because we were outside 7—I think 7 hours and 40-something minutes was the longest for us. And so we had a gallon of water in there that we could drink, you know. A little high-energy food bar that was Velcroed, that came up inside the helmet, that you could snack on. And that—so that kept you nourished.

WARD: But you couldn't scratch your nose.

DUKE: But you couldn't scratch your nose. But you could reach over and, you know,—and hit the side of the helmet and things like that. Or if you had to, you could sort of rub your back against the suit if you know, you could do that. And, the suit you had to learn how to operate. You couldn't bend over at the waist without great difficulty. You couldn't really bend at the knee totally. So you had to learn how to operate the suit to make it work for you. It turned out that when we got back inside and you took everything off, you were exhausted. I mean, it was hard work. I mean, you're squeezing that glove for 7/8 hours was like, you know, a hard rubber ball in your hand for—if you can imagine squeezing a ball for 7/8 hours. And doing the curls and stuff in the suit, and trying to make it work for you. It was real work.

A couple of times, I remember, the flight surgeon said, “Slow down. Your heartbeat’s up to 140 a minute or so. We want you to rest.” And so, generally, we rested in the car when we drove from point to point. But a couple of times they had to make me just slow down and rest. The suit was—it was tough work. I mean, it was I liken it to being in a gym for, you know, a light workout for 7/8 hours.

I remember my arms were cramping in here, and the end of the—some of the fingernails—fingers were, you know, sort of black-and-blue from blood bruises and those kind of things we had that were as a result of the Apollo pressure suit. It kept you alive, though. It was very secure. You—only one time did I have a feeling that, “I’m in trouble” in the suit, and that was the final part of our stay on the Moon.

We were going to do the Moon Olympics, and—but John said, “Houston, we were going to do the Moon Olympics but we’re running out of time, so we won’t do that.” And I said, “Yeah, Houston, I was going to bounce and set the high jump record.” And I started just kidding around and bouncing, and when I jumped the last time, I went over backwards and disappeared behind the lunar rover, and the TV camera’s pointed at me and—that was a moment of panic, Doug. I really—you know, I was in trouble. You could watch me scrambling like that, trying to get my balance. I ended up landing on my right side, and bouncing on to my back. And my heart was just pounding, you know.

WARD: What was your concern? That you’d damaged the suit?

DUKE: That I’d have damaged the suit. You know, the backpack is very fragile. I thought the suit would hold, but the backpack, with the plumbing and connections and all, if that broke, it was just like having a puncture in the suit.

WARD: Yeah.

DUKE: And so that was my real concern. And, you know, falling over backwards on the Moon, you—hardly ever did we think about, you know, “We’re in a vacuum. This thing’s got to work.” I don’t hardly ever remember thinking about that or worrying about that. But this time, as I started over backwards, the thought occurred to me, you know, “I’m in trouble.”

WARD: Yeah.

DUKE: Because I was—so I was able to spin right and—before I hit, and my right foot and right hand hit, and I bounced on to my back. And John came over and helped me up. But, I mean, I got real quiet, and you could hear the pumps running in the backpack. And I checked my pressure. It was okay. And so this fear began to subside.

And then I realized the TV camera was pointed at me and then embarrassment came. You know, “The stupid stunt.” And I forgot what Mission Control said. I think Tony [Anthony W.] England was our Capcom, and it was, “That’s enough of that, guys,” or something, you know. And anyway, that ended our Moon Olympics. But other than that moment, there was not a moment where I didn’t feel secure in our suits.

WARD: Did you find that you adapted very quickly to the—to moving in one-sixth g—

DUKE: Yeah.

WARD: —and to doing the hop.

DUKE: Yeah, we did. I found that either the hop or the skip was the best for me. John was more of a jogger-type thing. But I found the hop—generally, the skip was—it was—for some reason it seemed like, I have to remember, I put my right foot out front and I just sort of skipped along like that, with one foot out front. But—a lot. But then again, if the ground was level, you would start a little jog and then it was sort of effortless as you went across. You fell on your—we fell down a lot and—at least I did. And I found when you did fall down (Excuse me) on your front, then you could just do a series of push-ups and you'd sort of rock yourself back up and then eventually you'd pop up. On your back was another problem.

So it was a—you know, great fun. You know, John and I really had a ball. We [were] joking and just having a tremendous sense of enjoyment and adventure. It was a real adventure for me and John. And it built a friendship that is, you know—is real solid now, 27 years later. And it's a fun experience. I'd love to do it again.

WARD: I suspect you had no inkling at that time that it would be—that 20/27 years later, we would still not have gone back to the Moon.

DUKE: No. I was—[it was] a disappointment to me that we canceled the last couple of flights. I can understand the management's reasoning behind that, that we, you know, go on to the Space Shuttle. And I think we will eventually get back to the Moon with some sort of Moon base, but, of course, now effort is focused on the International Space Station. A big project with lots of money. And, basically, consuming all the manned flight budgets for the next 10 or 15 years; and it's—(what?) designed for 10 or 15 years of use. So it'll be after that, unless that thing doesn't make it. Then we're in trouble, I think, as far as manned flight goes.



But if it works like we hope it will, and all of that data is collected, then we'll—I think we'll see a Moon base with crews cycling back and forth on a 3-month basis, 2 months maybe, maybe even longer. And eventually, my great-grandkids or grandkids will—somebody will say, "Here we are on Mars." I really believe we'll do that.

WARD: But you think we'll go back to the Moon before we go to Mars?

DUKE: I—probably. I think it'd be easiest to do that. It's something a lot closer, and we can build on that experience. And it's a—scientifically good reasons to do it. It's not just another stunt to the Moon. It's a lot of stuff we can learn from a base on the Moon. So—but I think it's in the human spirit to go out and explore. I would say most of us or all of us, as astronauts, that volunteered did it for two reasons: It was the thrill of adventure and a desire to explore, you know, what's out there. And that's why I did it anyway.

WARD: Chris Kraft has said a couple of times that he doesn't think we'll go back to the Moon until it's easy to do it again. Do you tend to agree with that, that as long as it's as difficult to do as it was in Apollo, we're not likely to mount that kind of an effort again?

DUKE: Probably he's right, yeah. I mean, that might be a degree. What's easy is, you know—is—means different things to different folks. With a potential of water—ice up at the North Pole region or wherever that, you know, Clementine—wherever he found that stuff, I think it was the North Pole. Then those—that sort of is an impetus, you know. Maybe it won't be so hard to establish a base where we could extract some of this—these consumables that would help us out. I believe we have the technology. My big regret, I guess, looking back, was that we didn't continue the heavy-lift vehicles like what we had in Apollo.

WARD: Like the Saturn V?

DUKE: Like the Saturn V, you know. I mean, we could put up the Space Station with three or four Saturns at the maximum. Now we're (what?) 70-something missions and dependent on the Proton and supply vehicles like that.

WARD: Yeah, yeah.

DUKE: So there was—there's a lot of good reasons for heavy-lift vehicles that were man-rated, and we could maybe eventually start building something on the Moon. But Chris is right. He's a great prophet and a great manager, and it was great working for him. Hopefully we'll have some propulsion breakthroughs that will eventually take us on to Mars and we'll have a successful flight.

WARD: If you had a chance to go back to Descartes, what do you think you'd find? Do you think your lunar module and your flag and all that would still be there?

DUKE: Well, without a nearby meteorite impact, yeah. I believe it'd still be there.

WARD: You don't think the flag blew down when you took off?

DUKE: Well, that it look like it. We had some—you know, I was running a camera out of the window, and as we pitched over—I mean, it wiggled a lot. And we had the—but I think it stayed upright, as near as I could tell from the video. I didn't analyze it completely. But of

course the rover's still there. Dead—battery dead. Experiments there. Power source gone. But unless a meteorite's hit there, I—those old footprints are still there.

WARD: I remember some of the scientists at the time said the footprints would probably last longer than cities—

DUKE: Yeah.

WARD: —on Earth, and that the lunar module would last longer than the Rocky Mountains.

DUKE: Yeah. [laughs] Well, we'll see about that, you know.

WARD: I understand.

DUKE: You know, that's—you know, I don't know—you know, the frequency of meteorite impacts in that area. And it'd be easy for, you know, a couple of them to hit that were football size. It would—

WARD: Yeah.

DUKE: —create a pretty good crater.

WARD: Make a big change. One of the things that changed on your mission from the previous one was a reaction, I wonder if you think perhaps it was an overreaction, to the exhaustion and the irregular heart rate that Jim Irwin experienced on 15 because of the heavy workload. And as a result, they really loaded you guys down with the potassium.

DUKE: Yeah.

WARD: What was—?

DUKE: Well, I'm glad they did that. You know, we had—they changed our medical kit. They gave us some sort of injection that we could take if we did see heart problems developing. That was an experience that was (looking back at the time) humorous. It was—looking back, it's humorous. At the time it was sort of, we turned white. We were in Mission—not Mission Control but Flight Medicine, and we were getting a briefing on this new medical kit with this thing that was to—heart medication. It wasn't oral, but it was an injection. And one of the flight surgeons was telling us, "Well, you count down so many ribs" and this was going to be injected right into the heart muscle. And you'd press it. (It was like those battlefield syringes that would fire this needle in and inject the stuff.)

And so he said, "Well, let me demonstrate this." And he took a Styrofoam ball about the size of a grapefruit and he pressed this thing. And when it went off, the Styrofoam ball exploded. And I almost passed out, you know. I said, "Man, I—" I knew at that moment, "that thing is never going into my heart. And I don't care how sick I am." And, so we never had to use it, of course. But they did put the potassium in to try to regulate the heartbeats.

But that refreshed my memory. It also generated that hard workload on the Moon helped us to develop some tools that would help us to overcome that hard workload. For instance, the core that we had to drill (10 feet deep), [Apollo] 15 could hardly get the thing back out of the surface. I mean, he and Jim (Dave [David R.] Scott was a gorilla and was strong as he could be), and he—you know, they had a tough time.

WARD: Yeah, I remember.

DUKE: So we developed this little jack. They did it over in the—here on base, the Lunar Surface Tools guy and the—and so, it was a collar that went around the stem that was sticking out of the surface and by—I could just sort of—like a car jack, just keep jacking it and this would slowly jack this thing out of the surface. And it was easy to do, and—so those kind of things came about in debriefing, that we'd talked about earlier, and those were the modifications that we made. So the workload that we had was less than they had on 15.

The one thing that potassium did, we didn't have any heart problems. But we found that potassium did work as a little laxative, and we had our problems with, you know—with our BMs [bowel movements?]. At least I did. And it turned out that it wasn't very pleasant. You know, the Apollo system wasn't the most high-tech system in the world to use; and so, while we didn't have any real serious accidents, it was just, you know, to have that frequency of BMs was really a problem.

WARD: Yeah. A bit inconvenient—

DUKE: Yeah.

WARD: —under the circumstances. You mentioned that at the end of the day, you get back into the lunar module, get the suits off, and you're in an environment one-sixth gravity. No place to lie down. Really jammed in. How do you—how were you able to sleep between the EVAs, between the excursions?

DUKE: Well, you know, you're tight, but I wouldn't call it "jammed in." We had—once we got off the suits, there was a place behind—between us, behind us over the ascent engine cover where we could drape the suits over, and they were sort of out of the way. And so now we're, you know, one-sixth gravity and, yeah, you could just sort of lean back. For me, I

could lean back and sort of semi-sit on the environmental control unit. And it—we just felt—it was comfortable, really, without any actually sitting down.

And when we got ready to—for our rest period, we each had a little beta-cloth hammock. Mine attached across the ship. If this was the front, I was this way. And down—just a few inches off the floor. And there were some hooks on the left side, and two hooks on the right side. And I just took a—so I hooked up this little hammock, cinched it up, so it was about 6 inches off the floor, and got—I rolled up one of the liquid-cooled garments for a pillow and used that as a pillow. John's was—his was up above the ascent engine cover, and his was this way, fore-to-aft in the lunar module. And he hooked on to the sides of the instrument panel and the back bulkhead, and so we were sort of in a cross, like this. And he would climb up and get in his hammock. He went right to sleep. Amazingly.

I—the first night—we had changed our flight plan due to this late landing that required us to go sleep before we went outside for the first time. Well I mean, I'm on the Moon and, you know, 6 hours after landing: "Go to sleep," you know. Well, my mind's just racing like crazy and, even though we were tired, I couldn't get to sleep. So I asked the guys if I could take a sleeping pill, and I—which I did, and then I drifted off to rest. And the sleep was very comfortable in the little hammocks, once you got to sleep. I mean, they're not comfortable but restful, I should say.

I remember that first sleep period. We had been warned that, some time during the night, we would have a master caution would go off and—due to a reaction control regulator problem that we had had during—prior to descent. That was also a problem that we overcame, thanks to John. When we powered up the system, we lost the pressurization controller; the regulators both failed. And we were overpressurizing, but John quickly vented the pressure into the ascent engine tank and so we were able to save the mission.

But as we rested, it began to heat up and overpressurize again. And we knew when we got to a certain level, this warning would go off. And sure enough, I've just dozed off and

“Bong, bong, bong!” I got the headset on and this master alarm went off. And I mean, I almost went through the top of the lunar module. And it was—got my attention. And I cycled whatever I had to cycle to vent the pressure, and then went back to sleep.

WARD: It was all right for the rest of the time?

DUKE: It was all right the rest of the time, yeah. We didn’t—never had any other problem. And then after that, then we started our EVAs. We had one and we slept. And then I didn’t need any sleeping pill anymore. Like we said earlier, it was an exhausting—you were physically tired when you got off the lunar surface. And I was able to get right to sleep. And I’d say we averaged, maybe, 6 hours’ (on the lunar surface) sleep. The best rest I got was on the way home, you know. You started home and your attitude was, “Mission complete. We’ve done it,” you know, “We’re on our way back. Let Mattingly handle this thing from now on.”

And I remember later on, I was on the monitor, and so the flight surgeon was watching me sleep on the way home. And I think my heartbeat got down to, like, 28. I mean, I was dead to the world, and it [was] just really refreshing. And they were, you know—woke—when I woke up, they said, “Man, we thought you were dying,” you know. “It was—it just kept getting slower and slower.” But it was very—once you get used to sleeping out there, it’s very refreshing, Doug. You don’t wake up with any, you know, cricks in your back or neck or—there’s no pressure like [there is] down here.

WARD: While you were on the Moon, it was Tony England, your Capcom at Mission Control, relayed the news to you that the House of Representatives had passed the NASA budget with funding to go ahead and design and build the Space Shuttle.

DUKE: Right. Yeah. That was exciting.

WARD: Was it?

DUKE: In fact we had just saluted the flag—John had just saluted the flag and give that little jump for joy and saluted. And when we were changing positions, if I remember, right after that Tony sent up the word that they had just received word that they had funded the Space Shuttle. And John and I were excited. John made some comment about, “Yeah, we really need that Shuttle;” and it was great. Then we were on to work.

Another event that I thought was memorable to me—two other things—I was the only Air Force officer on the Moon during 1972. We had two missions, 16 and 17. And it was the 25<sup>th</sup> anniversary of the Air Force in 1972. And so, they had some special medals struck, little, like, silver dollar-size that had the Air Force seal on one side and Apollo on the other. And so, I had took two to the Moon with me, with the approval of NASA, and left one on the Moon (took a picture of it) and brought the other back. And so I was able to say “Happy birthday, Air Force,” while we were on the lunar surface. I also had a flag—Air Force flag that I had taken, and they—with NASA, gave them a piece of Moon rock. And they’re in a museum now up at Wright-[Patterson Air Force Base, Dayton, Ohio].

The other was: I took a picture of my family. Our kids were 5 and 7. And a little picture that had been taken in the backyard by one of the NASA guys, Ludy Benjamin, and we had that encased in Velcro (not Velcro) but—shrink-wrapped. And on the back of this photograph, you know, we’d written: “This is the family of Astronaut Duke from Planet Earth. Landed on the Moon, April 1972.” And the kids had signed it, you know, to sort of get them involved with the flight. So I left that on the Moon and took a picture of the picture, and that’s one of our neatest possessions now.



WARD: A nice memento.

DUKE: Yeah.

WARD: John Young, of course, stayed on with NASA and extended his flight career into flying the Shuttle. You left in '76, before the Shuttle really became operational. Do you regret not having—

DUKE: I do.

WARD: —been through that?

DUKE: I look back now and I wish I had stayed. The Shuttle turned out to be a tremendous flying machine. Not as cheap as we expected it to be, but certainly a good machine. And I look back now and I wish I could've flown some of the experimental flights on it and maybe a few of the operational missions. It—my 10 years was a great part of my life. Wonderful memories. Wonderful friends, Doug. I left and—but I do have some regrets as I look back now. Why did I do that? Why didn't I stay?

I worked on Shuttle for 3 years after Apollo was over. I guess I had some conflicting goals in my life at—in those days that just led me to leave. I look back and wished I'd have stayed on for a while.

The engineering and the development of the Shuttle in the mid-'70s was iffy, you know. Would we really get it going? Would we really get it funded? Would we really—would it really fly? And I had worked on cockpit layouts, airlocks, MMUs [manned maneuvering unit], things like that. But I'd left it, basically, was out of the Astronaut Office,

was in Operations Management over in Building 1; and I don't know. I just got frustrated with—

WARD: Yeah.

DUKE: —the pace of the program, I guess, and so I decided to leave. I had a business opportunity, which was, I thought—was lucrative and maybe I ought to do that. So we left. But now, looking back, I really missed it, and—

WARD: You're really, really more the norm than the exception. So many of the astronauts—

VOICE OFF CAMERA: We need to stop tape real quick. We're running out of tape.

WARD: Oh my goodness. Okay.

VOICE OFF CAMERA: And recording.

VOICE OFF CAMERA: Go ahead.

WARD: Charlie, we were talking about your decision to leave NASA in '76. And one of the things that I've observed over the years is that, that was probably more the norm. In fact, it definitely was the norm with astronauts departing, going to very attractive business opportunities. Many people have gone on to become chief executive officers of big corporations, done very well in investments, and in the outside world. And you begin to—

you begin to wonder if perhaps NASA had offered this very talented group of people better executive career opportunities, if more of them might have stayed on with the Agency?

DUKE: Well, I don't blame NASA really, Doug. They did offer me a great job. I—they offered me a job as the Associate Administrator for Legislative Affairs, which was a, you know, General officer job really and—at that level. And—but our marriage was in tough shape at that point, and I hardly knew my kids. And I decided that I'd better not do that because, you know, that was going to be 14-/15-hour days, and I needed (in [the] '73/'74 timeframe)—I needed some time. I'd better spend some time with my kids. And so I turned it down, primarily for that reason. Secondarily was I wanted to stay in the cockpit and I love flying. And so, T-38s are here. And so I sort of moved laterally over to Shuttle, became a technical assistant in the Shuttle Project Office, and some things like that.

Probably for me career-wise, I think NASA offered me a good opportunity. It just—it wasn't what was in the best interest of our family at the time to accept. Looking back, I think probably staying in the Astronaut Office would've been the right thing for me, because things did begin to pick up right after I left and started flying, you know, mockups and hardware were getting built, and that—all that excitement, like in the early days of Apollo. So—but the frustrations, I think, that were occurring in the mid-'70s, a lot of—you know, a lot of the Moonwalkers did leave, and—

WARD: It was a difficult time for everybody.

DUKE: And there was no real planned progression for us. There was just sort of what you could get. But I don't blame NASA, because they did offer me a real nice job up at Headquarters.

WARD: We've begun to see second-generation flight controllers, engineers, the children of the people who were here during Apollo coming back into jobs. But one of the things that we haven't seen is the children of astronauts coming back as astronauts. Do you have any explanations [as] to why that may be the case?

DUKE: No, I don't. But I—my son, Tom, when he was in his early 20s, just graduated from college, that's what he wanted to do. He got a Master's degree in—he was pre-med at Baylor [University, Waco, Texas], but like his dad, fell in love with airplanes when he was in college. So he decided he wanted to be a medical doctor and a fighter pilot, and I said, "Well, you can't do that on active duty, but you can do it in the [National] Guard." So he joined the Guard. Then after he graduated, he got a Master's degree, go to Guard—they went to flight school, and became an F-16 pilot. And he—we even made some inquiries into Test Pilot School. Could he get into Test Pilot School? Because he was really—wanted to be an astronaut.

But it turned out, Guard—getting into Test Pilot School from the Guard was almost impossible. So he'd have had to gone on active duty, and there was no guarantee that he would've made it. And he was really enjoying his Guard duty. He was full time at Kelly [Air Force Base] in San Antonio. And so it—that faded away. Now he's a Delta [Airlines] pilot and still flying F-16s on the side.

And why—you know, Fred Gregory's got a guy. And Joe [H.] Engle. Let's see, there a few others that—I don't know whether Joe's got a son. But there's a few others that are out there, F-15 pilots. Stu Roosa has a son that's—would—might be qualified. But I don't know why nobody's really sort of applied. But I'd like it—I was hoping Tom would be one of the first father/son combinations.

WARD: Well, it sounds like there are some out there who are candidates—

DUKE: Yeah there may be.

WARD: —and we may see it.

DUKE: Yeah. I hope so.

WARD: Who were some of the people, when you look back on your career with NASA, who had the greatest influence on you, both within the astronaut corps and in management, public positions?

DUKE: Well in the Astronaut Office, of course, Alan Shepard and Deke Slayton, I really respected. John Young, probably one of the most brilliant engineering minds that the space program has. Probably—certainly the most—one of the most dedicated to the program. Still there. Tom Stafford originally was a big help to me. And then, I'd say Neil Armstrong. I really appreciated him asking me to be the Capcom, because to be involved with that mission was a real thrill.

As a contemporaries Stu Roosa and I were real close. We'd been classmates at Test Pilot School, and we had worked early days in Propulsion with Borman, and then we were—ended up backup on Apollo 17 together; and so we were real close. And he was a very talented guy.

Management-wise, I really respected the flight directors, you know: Gerry [Gerald D.] Griffin and Gene [sic] Lunney and—Glynn [S.] Lunney and Gene Kranz. Management-wise, I thought Dr. [Robert R.] Gilruth was a wonderful guy. And then Chris Kraft, of course. Down around on the lower level, you know, I could name the whole Mission Control guys in the trenches were really super.

And then in the Training area, the guys that really, you know—really were our team to help us in the simulators: Mike Hernandez, Mike Wash, Charlie Floyd, and many others. Dave Ballard, who was on our team, was basically in charge of the team for procedures and checklist development. And all those guys that had responsibility for the checklist; and the suit guys, Troy [M.] Stewart and others who were our suit techs, you know.

Those friendships are all still there. Some have died and gone on, but the ones that are still around, we get together every once in a while and it's just—you know, it's a real fraternity, Doug. And it was something that indeed lifelong friendships were developed there.

WARD: I guess those kinds of things don't come along more than once in a person's lifetime.

DUKE: Probably. You know, I look back now on my career in the Air Force. There were some guys that I [met], you know, 40 years ago and when I went to Germany in 1959. Some of those guys are still real good friends, the ones that are—didn't get killed in Vietnam and other places. But those that are still there, you know, we—occasionally our paths cross and it's still great friendships.

So it's been a—looking back on it all now, it was a great moment. And a lot of folks say, "Would you like to go again?" I said, "Yeah, but I'm not old enough right now."

WARD: [laughs] That's right.

DUKE: Got a few more years before I get to John's [John H. Glenn, Jr.] age.

WARD: That's right.

DUKE: So I don't think I'll ever get to go again, but [I'm]—still physically qualified. So, Dan, if you're watching, I'm ready.

WARD: Hang on. You never know.

DUKE: You never know. Yeah.

WARD: Charlie, thanks a lot.

DUKE: Sure. It was wonderful. Thank you.

[End of Interview]