NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
ORAL HISTORY TRANSCRIPT

THOMAS K. MATTINGLY II
INTERVIEWED BY REBECCA WRIGHT
COSTA MESA, CALIFORNIA – 6 NOVEMBER 2001

WRIGHT: Today is November 6, 2001. This interview is with T. K. Mattingly, and it's being conducted for the NASA Johnson Space Center Oral History Project. The interview is being conducted in Costa Mesa, California, by Rebecca Wright.

Thank you between for taking time to participate in this project. We'd like for you to start today by telling us how you became interested in aeronautics and then later space flight.

MATTINGLY: [Chuckles] I think it's in the genes. As a kid, my earliest memories that I can recall all had to do with airplanes. My dad worked for Eastern Airlines. Before I had any idea what that was, my toys were all some kind of airplane, and any picture that you could glean from when I was a child, they always had an airplane in it. I don't think there was ever anything conscious about the fascination with flight, that was just all-consuming.

As I got to be an older child, I built every model airplane that I could find, ate every box of cereal that had a cut-out paper airplane on the back, all that sort of stuff. It was just a way of life. Since Dad worked for Eastern after he transferred to Miami [Florida], and I got a little older so I could be left alone, why, if I could stay out of trouble for a while, my reward was Dad had passes on Eastern, and I would get on the airplane, and I would just fly to the end of the route and back. Never got off the airplane, just go to one place to the other.

In those days, the [Douglas] DC-3 was the only transport airplane, and so if you went up the East Coast from Miami up north and back, that was a long day. That was my big thrill, to sit there and just look out the window. Airplanes didn't fly so high in those days, so you could see a lot.

I remember on weekends, if we had time, why, we'd go drive over to the airport and just stand there and watch airplanes. It's like I've been told a generation ahead of us went out and watched trains. Well, I watched airplanes.

So when it came time to pick a career, I don't think there was ever any choice. It was just, well, I want to be in aviation. I wanted to fly. I didn't have any idea what that was or how you did it, but that was something I wanted to do. So from that point on, it was just don't get in the way of getting into aviation.

My first ride in an airplane other than a commercial airliner was when I went to Auburn [University, Auburn, Alabama]. I went on a Navy ROTC [Reserve Officer Training Corps] scholarship. One of the neighbors was a Marine colonel who was stationed out at Opa-Locka Marine Corps Station there in Miami. They had a group of [Douglas] ADs, which is a propeller-driven attack airplane. They had one version that normally they were single-seat airplanes. They were used in Korea. They had a version that had a widened fuselage so that you could have people sit side-by-side, and they used it for all kinds of utility things.

So after he got me into this program, first Christmas we were up there, why, he said, well, he'd come up and bring me back to Miami and he would fly his AD up to a field near the school and pick me up. So it was my first time to get into what I call a real airplane. I still remember that, but the idea that I would end up being able to get into aviation, I wanted to be a pilot. I wanted to be a test pilot, whatever that was. It just seemed like that was what you wanted to do, but I had no idea.

So after that, it was just anything that became related to that. It essentially was don't get in the way of getting there. A friend of mine in business kept telling me, "When you're not sure what to do, just don't get in the way of success, because you're not sure what's going to happen."

So that was the road we went down and took aeronautical engineering in college. Started in engineering physics and that was taking too much time, so I went back to aeronautical engineering and did that because, of course, that's what I wanted to do.

When I graduated from college and got my commission, I volunteered for flight training and wasn't selected. I was crushed. Other people in my class that had grades that weren't as good, were not engineers—and I could never figure it out. I ended up being sent to a precommissioning detail on a ship called the USS *Galveston*. It was in dry dock in Philadelphia.

So here I was, a brand new ensign, wanted to be in flight training, and instead I was up in this shipyard, a ship that didn't even go to sea. You walked across a gangplank, but there was no water underneath you. It was just concrete. The ship was not in commission yet. We were still finishing putting it together, checking it out.

I was pretty miserable. [Laughs] A young kid paying off his college debts, didn't have anyplace to go. So there was another guy in the same boat, two ensigns. He came from West Virginia, and I think we may have been the only two that lived on the ship. Everybody else lived ashore, but we couldn't afford that. So we got to be good friends there and found out how far you can stretch a dollar.

So one day the guy that I worked for pulled me aside and said, "You know, I understand you don't do anything but read airplane books. Why don't you go to flight training?"

I told him I tried and been rejected—or hadn't been selected.

He said, "Why is that?"

I said, "I have no idea."

"Would you still like to go?"

"Of course, but I asked my commanding officer at the NROTC unit, and he told me I had to finish my first set of orders before I could apply again."

So that didn't sound right. So this guy called the Navy Bureau of Personnel in Washington, and they said, "Well, yeah, we wondered. He had good grades. He had everything, but he never sent in an application."

The guy says, "I don't think that's what was intended." He said, "Is there any way he could—?" He said, "Of course. Tell him to drive down, and I'll give him a set of orders."

So my boss said, "Okay, if you want to go, all you've got to do is get in your car. I'll give you tomorrow off. You can drive down, and they'll send you to flight training." I said, "Okay. What do I do next?"

He said, "Everything we do in the military has to be approved on a piece of paper called a chit. So you have to take your little chit around and get everybody to sign it." The last person on the list that I had to go see was the head of our department, was the gunnery officer. He's a lieutenant commander. To me, that was probably some inch or so short of God, but to tell you, it doesn't look like such a high rank, but in those days it really was impressive to me and I was terrified of having to go in and see this fellow, and sat down and we talked. He said, "Well, I hear you've really been doing a lot of interesting things." And it was the first guided missile cruiser that we had put into operation, was to fire a Talos missile. I was in the gunnery department and learning to make this system put together. It was really, for the time, a very sophisticated weapon. It carried both nuclear and conventional things, and it was kind of awesome to be around.

He said, "I hear you've really done some good stuff." And he says, "Do you know how it works?"

I told him. He said, "Yeah, you understand it." He says, "You realize this is going to revolutionize naval warfare. Airplanes are history."

I said, "Yes, sir."

He says, "Now, this piece of paper says you want to go to flight training."

"Yes, sir."

"Well, you understand what we just said. We've revolutionized naval warfare. Aviation is history. Nobody will ever survive. Do you really want to go to flight training?"

"Yes, sir."

He said, "You are the dumbest ensign I have ever met," signs it, and says, "Out."

I left. I really didn't think anything about that for twenty-two years. The guy's name was Glenwood Clark. I did go to flight training, of course.

When I left JSC [Johnson Space Center, Houston, Texas] and went back to the Navy, I reported to a command called Naval Space and Warfare Systems Command. They were trying to reshape it into a new entity. After I'd been there about a month and was still totally lost, they passed out a little flyer that says "The Secretary of the Navy has designated our new commander. He'll be here in two weeks," or something. "His name is Vice Admiral Glenwood Clark," and it gave his bio.

Well, I'd been out of the real Navy for twenty years at this point, so I sneaked over in a corner to read this thing. I figured I won't know a thing about what's on here, but I ought to read it. So I got through it, and he's done all this and this and that and had a very distinguished career. When I got right down to the end at the bottom, towards the end of his bio it just said gunnery officer, USS *Galveston*, 1958 to '60.

I said, "Couldn't be." So I went back, dug out my papers to see who had signed, and sure enough, it's the same guy. I thought, "Oh, this is not a good start, but he won't remember me."

So when he came aboard, we went around and we had briefings, and I briefed him on all of my programs. After it was over, we went into his office and relaxed for a minute. On the way out, we were just kind of chatting. On the way out, I just couldn't resist. I said, "Admiral, do you remember me?"

He looked me right in the eye and says, "I sure do. You were the dumbest ensign I've ever known." And he had to remember it. There's no other way. I had not told that story to anybody.

I said, "This is really going to be a rough tour." [Laughs] Turns out he's been one of my closest personal friends ever since both of us retired. But that's just part of "How did you get into aviation?"

The space stuff came along after I got into flying. I still didn't know how to get there, but I wanted to get into flight test. I became interested in the engineering part of it and just didn't have any idea where I was going or what was going to happen. Turned out the squadron I was assigned to was flying that same AD that Marine colonel gave me my first ride in. It was old when he was

flying it, and it was a lot older when I got to fly it. It was carrier-based, but it wasn't the most exotic thing in the navy. They had a special place at the bar for you so you wouldn't contaminate all the jet people.

I didn't think there was really a great deal of future in this career, but I did thoroughly love flying. I was stationed at Naval Air Station Jacksonville [Florida], and that's when we were ashore and we deployed on a carrier. One day a friend of mine that I knew from the BOQ [Bachelor Officer's Quarters] said, "They're going to launch one of these Gemini rockets." And he was in a photo reconnaissance squadron and his job was to fly down and take pictures of the launch. He said, "Can you get a bird and we'll all go down and watch it?"

"Sure."

I had not been impressed with the space program at that point. I thought the pictures in the magazines of Mercury and Gemini weren't visually appealing. Airplanes are supposed to be smooth, and there's an elegance to them, and these things, I can't imagine how anybody could be interested in that. It just had no appeal.

So I got on an airplane. In those days you could do a lot things you can't do today. So I got this airplane, and my friend had given me all the radio frequencies. So I went down and orbited over the Banana River and listened in to the activities on the air-to-ground. It lifted off. This, by the way, was John's [W. Young] first flight. It was, I guess, the first manned Gemini.

So they blasted off, and I watched this thing go. I heard the voice communications and when I saw some [McDonnell-Douglas] F-4s that were trying to fly chase to take pictures of it or something, and I saw airplanes that were as good as we had in service fly up and this rocket walked away from them and just kept going.

I came back at dinner that night, Jack said, "Well, what did you think?"

I said, "You know, I think that sounds like the most exciting thing anybody could ever do." And the newspapers were filled with pictures of all these heroes and stuff.

He said, "Yeah, man. How do you get into something like that?"

I said, "Nah, we'll never get there. But if someone ever said you could, you ought to say yes."

WRIGHT: What was the next step? How did you apply for the astronaut program?

MATTINGLY: After a change in tours in the Navy, I went from my AD because I was convinced that I was never even going to get into the test pilot school with nothing but propeller experience, not in the modern Navy. I had to get out of there while I was young, because the way our rotations worked, the chances of getting assigned to a jet squadron later were much lower.

So I ended up doing all kinds of crazy things and writing letters to "Whoever gets this." I finally was able to wrangle a seat in an [Douglas] A-3 squadron, which was a twin-engine jet, went from the slowest, oldest airplane in the Navy to not the newest, but the biggest carrier airplane we had. That was quite a transition.

We made a couple of cruises there. Because I had changed types of aircraft, I had extended. So I had been on sea duty for five years at the time, and they were about to transition to a new airplane called the A-3J, which was really the most modern thing in the Navy. So I thought, "I'll just stay around and go from the bottom of the pile to the top of the pile."

They said, "You have got to get off sea duty and go back to shore duty. You have to go somewhere. You can't keep extending or you'll get out of cycle with your contemporaries, and it won't be good for you." So they said, "What do you want to do?"

I said, "Well, I want to go to Pax [Patuxent] River [Maryland] and the test pilot school." And so because of this out-of-rotation thing, we returned from our last cruise with the A-3. I think it was like in April, if I'm remember right, and the test pilot school started in March, just a month earlier.

So they said, "You can't make that date, but we'll send you to postgraduate school first. When you finish there, then you can go to the test pilot school."

I said, "What postgraduate school?"

They said, "Well, we think you ought to get a master's in aeronautical engineering."

I said, "I don't think so. I don't think that's what I want to do." I said, "I would like to go to Harvard [University, Cambridge, Massachusetts]," and they laughed at that.

So we couldn't figure out what I was going to do. I said, "Well, I've been on sea duty for five years. Right now I'm standing duty officer in a hangar. The squadron is back. We're just sitting here watching our airplanes get towed away while they bring in the new ones. I'm not going to any of the schools. I'm doing nothing. Why don't I detach early?"

"Can't do that."

So I resigned from the Navy. Before I actually got out, a fellow called and said, "How would you like to go to the Air Force test pilot school? We can't get you into Pax River, but we can get you in the Air Force school. They start a little later. They start in May, and you could still make that one."

So I said, "All right. I'll do that."

It wasn't so bad, because I remember reading in *Aviation Week*, I'd seen a little article the Air Force school at Edwards [Air Force Base, California] was designated as the source for the MOL program. That's where their Manned Orbiting Laboratory was, the Air Force program to put a reconnaissance module in what they called a "Blue Gemini" on a Titan, and it was going to be this big program. It was going to be the military man in space program. According to this article I'd read, the source of those people would be the school at Edwards. So I thought maybe that's not all bad.

So I drove out to the desert in California and spent a year at Edwards, really just an absolutely fun year. There was nothing else to do out there in the desert except fly, so it was really, really a lot of fun. At the end of it, or I guess in the middle of our session, both NASA and the MOL program announced that they were selecting another group of astronauts.

The selections were kind of in parallel. So the people in our class, Ed [Edgar D.] Mitchell was in the class with me. Bo [Karol J.] Bobko was in the class. I don't think there was anyone else in our class that came down there.

The Air Force guys all went and put their requests in, and you could check do you want to go to NASA, do you want to go to the Air Force program. The Air Force guys could check [both boxes]. The Navy says, no, just pick one. The instructors in the school, Charlie [Charles M.] Duke was one. Hank [Henry W.] Hartsfield [Jr.] was an instructor. Hank was the instructor for our class. I didn't have much to do with Charlie. [Richard H.] Truly and [Robert L.] Crippen were in MOL class that left just as we arrived there.

So, instructors, students, everybody was applying for both of these programs, and there was only a few of us Navy cats there. So Ed and I were the two Navy people that were in the program at the time. So we sat around and thought about it. Ed had just returned from MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts], and we both sort of thought neither one of us would have ever gotten here if it hadn't been for the military. Besides, you look at all those press releases and stuff, we'll never get to fly at NASA, so let's take the Navy program, take the military program. So we checked it off.

We all went down to Brooks, our Air Force base in San Antonio [Texas], for our physicals, had about a week down there for classes and things. They were going down for interviews in Houston, is when I found out that the Galveston Freeway is always under repair.

So we had done that. We came back, and we were attending—actually, I guess it was a two-week class in medicine. Fascinating class. We were doing this, but everybody was on pins and needles, believing that the selection process was going to happen soon.

One day, oh, noontime or so, someone came to the door and asked Ed Mitchell to—told him he had a telephone call. We all looked around and "What's that?" Ed came back, and he didn't say anything, but you could see he was beaming from ear to ear. And there were no more calls.

I got called that night, but the way that happened was after the initial screenings, the list came out, and Ed and I were not selected for the [MOL] program. We had volunteered for the MOL program. We were not selected by the Air Force Screening Board, and of course we didn't apply. A fellow who was in the school, his name was John Prodan, said, "You guys, I think you didn't get picked up because you're had the wrong color blue in your uniform." He said, "Would you like to go to NASA?"

We said, "Well, of course, but, you know, somebody said the date's over and the Navy said we couldn't do both."

He said, "Well, if I can get them to take your application, do you want me to do that?"

Well, of course. I think John was worried about us because Ed and I, in the class standing, we were one and two. I think Truly and Crippen had more or less dominated the MOL early class, and I think there may have had some sensitivities about "these clowns that wear navy uniforms." I think John worried about that too.

So he [interviewed us] for it, and they took us down and interviewed us. That was a fascinating little experience, my first introduction to John Young and Mike [Michael] Collins. Didn't figure John out that day and didn't do so for a long time after that either.

But I figured I was dead meat. When they finally called us back, called me late in the evening and all the rest of the class was waiting for the MOL list, and the class was really worried that if Ed got selected and I didn't—so they were all hanging around and buying me beer and trying to keep up my spirits. Finally I got this phone call and Deke [Donald K. Slayton] asked if I'd like to join.

Obviously, yes. So I came out, and they could tell that the world had changed. "Now, you can't tell anybody. The announcement will be out here one of these days before the end of the week, but you can't tell anybody."

I said, "Okay."

So you cannot tell anybody, but you can't hide that from your friends. I mean, they can look and see. So we all decided to go down to the Riverwalk [in San Antonio] and went to some Mexican place, and we were just going to go celebrate. Everybody knew we couldn't say anything, but we celebrated anyhow.

So we're sitting around this table, and the waiter comes over. He handed me a piece of paper. He said, "This lady over here would like your autograph."

Somebody recognized me? Wait a minute. How does she know? I said, "Who does she think I am?"

He said, "Aren't you Dickey Smothers?"

I said, "No, but let me give you this and just hang onto it for a week." [Laughs]

WRIGHT: How funny.

[*T. K. Mattingly included the following comments to provide a more chronologically correct sequence of events.*]

[The course at ARPS (Aerospace Research Pilot School) was scheduled for 12 months. Our class began in the spring of '65. Ed Mitchell and I were the two Navy participants. The class also included Bo Bobko who subsequently was assigned to NASA after the MOL program was cancelled. Two of the ARPS instructor pilots, Charlie Duke and Hank Hartsfield also ended up at NASA. Dick Truly and Bob Crippen had been Navy participants in the class that graduated as we arrived and both had been selected as part of the first MOL contingent.

In the summer of '65, both NASA and MOL announced that they would be selecting additional astronauts in 1966. The selection process for military applicants involved applying to the parent service which set its own criteria and convened a service selection board which forwarded applications to NASA and/or MOL for further consideration and ultimate selection.

Navy applicants were required to designate their interest in participating in either the MOL or NASA programs but not both. The USAF, on the other hand, permitted its officers to apply for MOL, NASA or both. Most Air Force pilots naturally applied for both programs. Ed Mitchell and I, faced with the choice of applying only for one or the other, chose MOL.

Most of our ARPS class and many of the instructors submitted applications and were sent to Brook AFB for physicals. Applications for those that passed their physicals were forwarded to the MOL and NASA selection boards for consideration. After initial screening, the MOL and NASA selection boards released lists of applicants that would be interviewed. When the MOL list came out, (MOL published its list in advance of NASA) Ed and I were devastated to find that we had not been selected for an interview by the MOL program although our Air Force classmates were. Since we had not been permitted to apply for both programs, we were immediately out of the running. Fortunately for us, one of the schools instructors, LCOL John Prodan, thought that we deserved another chance and arranged for the Navy to submit our applications to the NASA selection board. This time we made the interview cut along with several other from the school. It was during this visit to Houston that we learned that the Gulf Freeway was perpetually under repair and met John Young and Mike Collins who were members of the NASA interview team. I was perplexed by John, couldn't figure him out. Mike was much more approachable and asked about flying and in particular wanted to know what I thought about the F-104. I told him it was about as much fun as anything I'd ever flown but wouldn't be worth much in combat. He furrowed his brow and I knew I had blown it.

The next step in selection was to wait for the board results, due out in late winter or early spring '66. The ARPS curriculum was presented in two six month segments, aircraft and space. Space came last and included a two week aerospace physiology course at Brook AFB in San Antonio, Texas. This school was one of the most fascinating experiences imaginable but our thoughts were preoccupied by the fact that the astronaut selections were imminent. About noon one day during the second week, Ed was called out of class for a telephone call. He came back

grinning from ear to ear but said nothing. The day ended with no more calls and I was in a real funk. The rest of the class was trying to bolster my spirits and decided we should all go down to the River Walk for a drink. Just before we left, I got a call from Deke who asked if I'd like to come aboard. When I said yes, he told me I was not to tell anyone until an official announcement was made, in a few days. Obviously, I didn't have to say anything to Ed and the others so we all went out to celebrate. We were sitting at one of those outdoor places along the river having a few beers when the waiter brought me a napkin and said that a woman at another table wanted my autograph. We all looked at each other and asked, how can she know? Someone asked the waiter who he thought I was? He said, are you Dickie Smothers? When we recovered, I told him no, but tell her to hold on to this, my first autograph, for a couple of days.]

MATTINGLY: So that's how you get into space.

WRIGHT: So how soon after the announcement was made or when you learned that you were able to report for duty? Was it soon?

MATTINGLY: I don't remember what that timing was. But I do remember we got to Houston in May of '66. The class—we had not graduated. I think graduation was after we reported to Houston. I remember we had to fly back out so we could go to graduation. It was right at the end of that period. So from the time we knew about it until we departed, oh, boy, a month at the most.

WRIGHT: Once you got there, the training process began and your life changed once more.

MATTINGLY: When we got there, we learned what it means to be the "Excess Nineteen." [Laughs] "Why are you people here? What are you going to do?"

We said, "I don't know. Whatever you say." I don't think they were—obviously they did not—the feeling was they didn't need any more help, which they probably didn't. But we were there, and so we became go-fers for a lot of things. They put us in classes. It was interesting, but, you know, it wasn't like doing work.

I don't remember that, to be honest. I'm sure somebody has some calendars that shows what happened in that first year, but it wasn't a terribly memorable period. We got introduced to geology. I don't remember when that started, but I think it either started after the [Apollo 1] fire, may have been after the fire, but before that I think we were just all assigned, given assignments to go work on different little projects. With so many of us, there was kind of a scramble to find a job. I didn't know anybody that was in the program, and a number of people did, and so they kind of mentored them and steered them into "Here's where you need to be."

Ed was easy to place just because with his Ph.D. and his style, why, he captured everybody's—he was older and everybody had a great deal of admiration for him from the beginning. I didn't know anybody there, and so I just kind of—I don't remember what my initial assignment was. It was something so nondescript, I can't remember it.

But Ed [Edward G.] Givens [Jr.], who was an Air Force officer and had known a number of the people, the senior people that were already there, they had given him the job of the space suit and things like that, because I guess Ed had worked with them on the Gemini EVA [extravehicular activities] exercises as an Air Force officer. So Ed took that job. Unfortunately, Ed was in an automobile accident not too long into that year.

So nobody that had what were perceived as good jobs wanted to go do that, but I was so fascinated with these Gemini pictures of Ed [Edward H.] White [II] and people floating around, and those pictures were just indelibly engraved in my head, and I said, "You know, this is on the ground, but that stuff really looks pretty cool, and I'd like to try that." So I asked if I could take that. I think there was some skepticism. What did I know about it? And the answer was "Nothing." But it started one of the most fascinating and rewarding periods that I've had.

Because we went a long time without doing real space things, I was one of the few who actually had a job. It was just a fluke of a circumstance, and it wasn't all that glamorous to do it on the ground. Go do it in space, that's different, but all the stuff on the ground wasn't all that glamorous. So they were quite content to let me go off and do that on my own.

So I didn't know what a program manager was or anything like that, but *de facto* I sort of became one. I went over and was getting briefed on all this stuff. We were getting ready to put the Apollo suit through its initial acceptance and doing all that. I looked at this thing, and I remember they had this emergency oxygen pack that went on the back. The backpack was this thing they called a Portable Life Support System, PLSS. On the back of it was a little doughnut that was maybe six, seven inches in diameter. This was the emergency oxygen supply. It had a little wire with a wooden green apple on the end of it like an emergency oxygen bottle in an airplane, and you pulled this thing. They said this gives you thirty minutes of emergency oxygen.

I said, "Hmm. That little thing. This backpack is good for four hours, and it's this huge thing. Why is that?"

Well, after a while I found out what it had thirty minutes of oxygen for was, as you breathe, your body burns a certain amount of oxygen out of the air. So what this little bottle had was enough oxygen to make up what you would burn out of the air, but not enough to provide thirty minutes of volume, but just to make up the oxygen from it. It was there in case the oxygen supply actually was depleted, leaked or something, but it didn't affect the integrity of the space suit. It had nothing to do with the leaks in the suit or anything like that. It also meant you could breathe for thirty minutes, but you really should be quiescent, because there wasn't that much oxygen in that little bottle.

So they explained all this to me and the rationale, and I spent a very agonized weekend or so. I kept looking at it saying, you know, I can't imagine what it would feel like to be on the lunar surface and that's all the protection you've got. Here people are going to go walk away from this thing, and just the act of getting in and the depressurizing. I said, you know, I just don't think I'm really quite that brave.

These guys, I talked to some of the senior people in the office, and they said, "Aw, come on, kid. This is nothing. We do that all the time."

So I finally went to Deke and told him, I said, "I don't think this is adequate," explained it to him.

He said, "That's not what I've been told. Are you sure about that?"

"Yes."

So he had to go check it out, and he came back and says, "You're right. We're not going to send anybody out there with that," which started me off on a bad foot with some of the people in CSD [Crew Systems Division] because I had thrown mud in their punch bowl, but it also started some friendships with some people there that I treasure to this day. It was a small group of people, and it was just a really good bunch of people.

I remember that since no one else wanted to do these things, that I got to be a test subject. They had a professional test subject, Jackie [Mays]. I can't think of his name now. Jackie—big, strapping, tough guy. I was a scrawny little runt. One of the deals was, space suits were rare and expensive, and so, you know, you didn't make space suits for the test subjects. You made space suits for flight crews, and then the test subjects would try to find the one that was closest to the right size.

Nothing fit me, and so I had Frank Borman's suit. Frank Borman and I are not the same size in any dimension, and it was really miserable in there. Old Jackie would help me. He was teaching me the ropes, being a test subject. So we got to be pretty good friends. As I learned more about it, I started getting involved in writing some of the test programs, since we built this. We sort of designed the requirements and the system together, then we kind of wrote the test program. It was just, just really fascinating. That bunch of people at Crew Systems was really, really a lot of fun.

We got to work in these—had that one big chamber down in the back of the campus where they had the solar illumination panels. They built it to put in the command and service module [CSM] and the lunar module [LM] in a vacuum in a radiation environment. To show that the space

suit was going to work on the surface, we were supposed to go in there. The space suit, when it's pressurized, would hold up the backpack. The backpack weighed 150, 200 pounds. I don't know, it's pretty heavy, and it's very clumsy to walk in. If you see pictures of people walking on the surface, it looks pretty cool, but that was after the program had matured a good bit and in a sixth of a G. But in 1 G, that thing was kind of hard to push around, especially if it didn't fit you.

The deal was you went into an airlock and then they hooked you up to a weight lift that would hold the backpack in case your suit sprung a leak so this thing wouldn't fall on you. But all of this mechanism and cables and stuff was all behind you. You couldn't see back here. If it got hung up or jammed—and I kept practicing it, I could just envision myself getting stuck halfway into this thing, not able to come out, not able to turn around, can't see, I'm hung up by something, I don't know what it is. I finally convinced them that it was actually safer to let me walk in there. If I thought the suit was going to lose pressure, I would promise to fall down so it didn't fall on me. I would just roll over. Convinced them that that was probably safer.

So our last episodes in the suit testing was to go in and do that, walk in, turn on all these solar simulators that were supposed to make it hot. Then you still got to do this terribly exciting job of it had a step. To work up a metabolic load, you would step up on this thing and down. You can't believe how boring that can be when you do that for four hours. Just horrible.

But there were a couple of little vignettes I got a kick out of it. We worked hard on the gloves. The gloves were the things that you need the most tactility. We were just having real trouble. My hands are not big. I used to curl weights and squeeze rubber balls, and all I did was get tired. I didn't get any stronger, and I just wasn't going to do it.

So I figured, well, maybe somewhere in the world there's somebody that's got hands that are no stronger than mine, so might as well let that be the standard. We tried all kinds of gloves, different things, just trying to get some tactility and mobility into it. But by the time you put the thermal insulation on there so you can handle this—they had this requirement that the environment had to go—even though we weren't going to land this way, all the equipment had to be qualified to

go from sunrise or from noon until midnight. So that's means it had to go through all the cold stuff at worst and all the hot stuff. Even though we weren't going to be there that, but that's the specs [specifications] that we had to meet.

You had to be able to do certain things like pick up a rock that's been exposed to the sun on the Moon and hold it long enough to put it in a bag. So we devised a test for that. To do that, we had an iron rod that was a couple of inches in diameter, put heaters on it. In the midst of all this environment, one of the latest tests was, okay, you've got to do all this in a vacuum to make sure it's working right. So we'll crank the temperature of this rod up, and once it gets stabilized, then you go and grab it and hold it, and we'll count for two minutes, and you let go.

So, okay. So they said, "All right. Let's go."

I go out there, grab it. We did a good job. That's really—it's getting warm. It's getting very hot. I've got to let go. Then you think about the things you didn't think of. Okay, I let go of the rod, but the heat got to me by getting the glove hot. The glove is still hot. How do you get away from the glove?

That's where being in a space suit that doesn't fit saves you, because in a suit that fit, the answer was, you don't. But having one of these suits that didn't fit, I was able to pull my arm out of the suit arm, so I just left this balloon out there with what looked like a glove with my hand up in the air. In fact, I have one picture of me in the suit where I had pulled my arm all the way out of the suit arm and was scratching my nose. You're not supposed to be able to do that.

That was a really neat program. I'm trying to remember some of the people. There was a young PLSS engineer. His name, I cannot remember. I can see his face. Maurice Carson was the program manager for it, I think. Jerry [C.] Poradek was the thermal guy. Craig [A.] Castle, he was the Ham[ilton] Standard guy. There was a couple of people from that group, and we just all formed this little club. It was really, really was just a very rewarding experience. Then when we got through, why, we wrote up all the procedures and gave them to the big boys to go use.

WRIGHT: What time span was this? How long were you able to stay with them to work?

MATTINGLY: You know, I don't know what that was. Let's see. The fire was in—

WRIGHT: January '67.

MATTINGLY: '67. So we stood down for a year there. So I think I must have gotten into this job in '66, guessing. So it was over a year.

In fact, I remember that while all of the other things were standing down, I had this job to do that was kind of going on and really was the most active thing of what we were doing, because everybody else was caught up in waiting for the engineering to finish.

When we got ready to resume flying, I remember that the rumor was out that because we were behind schedule, one of the things that they were going to do to catch up was they were going to assign teams and put them in place and leave them there, and everybody would do the same jobs. They'd have three crews, I think it was, that would just keep cycling over and over until someone landed. Because in those days we really didn't think the first try would work. It just seemed too preposterous. So they were going to have a couple of crews that would keep cycling. There would be a group of people who would accept lunar modules. There would be a group of people that would accept the CSMs. Some people who work at the Cape. We'd all just go there and learn our jobs and try to be proficient at it, and then just keep turning the cranks, and we could fly as often as possible, which actually is a very sound way to operate.

Fred [W. Haise] and Jim [James B.] Irwin and [John Bull] were sent to Grumman [Aircraft Engineering Corp.]. I went to [North American Rockwell Corp.] Downey [California] with the CSM. I'm trying to think if Jack [John L.] Swigert may have been in that group. I don't remember who else was sent out there. But at that point, all of the focus was on the lunar module and the

CSM was kind of—and so there were a couple of us that were a little bit disappointed to think that we were going to get stuck here doing this for the duration.

In fact, I think that policy was probably announced. I know we believed it then. I don't remember whether it was announced or whether we just perceived it. Certainly the procedure guys who were on the flying crews didn't want to discourage you from thinking that.

So I spent half my time in Downey checking out spacecraft. I was working on the one for Frank Borman in what was to be called the E mission. The original Apollo buildup went from the—you know, to fly an Earth orbit to doing a docking and then do a high ellipse. It seemed like there may have been two of those in there, but the E mission was the high ellipse. When I heard we were working on it, I thought this isn't going to—space is space, but in this buildup of things, this doesn't seem like the most productive mission.

It was the one that Frank was assigned to command. They'd come out to Downey to run one of the last tests. They'd leave us go-fers to get it all ready, but when it came for the big integrated test, why, they went in and ran it. That test process always takes longer than you think, and so we had a little ready room there outside the floor where they did the checkouts where we could sleep. Because you'd come in at eight in the morning, but the test might be two o'clock tomorrow morning. It was always delayed thirty minutes at a time, and you never knew.

So we were all staying there, and Frank got a call to go back to Houston. So he went back to Houston. We stayed. I don't remember whether Frank flew back and told us to pack our bags or whether he called and told—it was that Bill [Anders] and Mike [Collins] to go back. It was the middle of the week sometime, because they called us all together and said we're going to have a briefing. I believe it was Saturday morning. We walked in, and that's when they revealed to us that they were going to do the Apollo 8 circumlunar mission.

I don't think I have any records that would pin down dates, so some day I'll have to figure that out, because I want to think it was in the September, October time frame, but I just don't remember. But I remember from that Saturday morning, it was twenty-four/seven [twenty-four

hours a day, seven days a week] until they got down. Of all of the events to participate in, you know, I was lucky because I could do Apollo 11 as well as 8 and then 13.

But being part of Apollo 8, it made everything else anticlimactic. You know, our purpose was to go land on the Moon, but somehow participation, the angst that went with that Apollo 8 mission was far more electrifying. I remember after the first set of briefings, I remember going home one night, and listening to these meetings, it's like no one had ever thought about going to the Moon. We've been in this program for how many years, and yet people are asking questions that are almost like, "Does anyone know where the Moon is and how to find it?" And here we're supposed to be going.

It was built into those beginnings of what they started calling data priority. There were so many questions, and every one of them needed an answer. But the difference between designing hardware and getting ready to fly a mission, this was my first exposure to how dramatically different that was. Bill [Howard W. Tindall, Jr.] came out and started having these meetings. His initial charter, as I understand it, was just see if you can figure out an order that we can answer these questions in, because we can't do it all at once. Let's do the most important ones first. So we started having these meetings.

That kind of put some sanity and sense to it. It created this thing we called Tindallgrams. Because Bill Tindall would listen. These meetings would go on sometimes two days, and they would be eight in the morning until eight in the evening, whatever it took. Room filled with people. Not always a lot of decorum. Bill was after answers. It was nowhere near as a collegial environment as you see in some organizations today.

But they were after what was right, and everybody was passionate about. Everybody was young so they were kind of brash and there wasn't a lot of patience anywhere. So some of those meetings were very, very colorful. Some of the characters were colorful. At the end of this, you were just inundated with all of this stuff you've heard. And now what?

And the next day you would get this two-, maybe three-page memorandum from Bill Tindall written in a folksy style, saying, "You know, we had this meeting yesterday. We were trying to ask this. If I heard you right, here's what I think you said and here's what I think we should do." And he could summarize these complex technical and human issues and put it down in a readable style that—I mean, people waited for the next Tindallgram. That was like waiting for the newspaper in the morning. They looked forward to it.

I just remember that I've always talked to people about this amazing skill. One day I was talking to Malcolm Johnson, who was an MIT guy and had been a very close friend of Bill Tindall's. He says, "I've got a complete set. Would you like one?"

I said, "You're kidding. Yes."

So Malcolm went and made a copy for me of the complete unexpurgated set of Tindallgrams, which I unfortunately have in storage right now, but that's one of my prize possessions. Bill was just—I don't know if—you folks probably didn't start this program in time to talk with him.

WRIGHT: No, but we hear the same comments from everybody that talks about him.

MATTINGLY: Absolutely extraordinary guy. He was so far up in the hierarchy that I knew very little about him, other than he came and used the gym with us, so I could see him periodically. He had this blue Pantera that it was his pride. You would even see it parked out at the gym a lot.

Bill left NASA before I did. I thought he went to Washington or somewhere, but I didn't know what he did. We weren't particularly close, because there was such a difference in our positions more than in age. But in those days it seemed like a lot.

When I went to Washington [DC] to go back to the Navy, I moved into a condo that was in Crystal City [Virginia] because it was five minutes to work, and I thought that, in Washington, was a good deal. It had underground parking. I got a slot assigned there. One day I walked by, and

there was this blue Pantera sitting over there, and I thought, "I'll be darned. I haven't seen one of those in a long time. It looks just like Bill's." Never gave it a thought. I saw it a couple of times. I even mentioned it to somebody once. "Hey, you know, I've only known one person that had one of those."

He said, "Well, is it theirs?"

I said, "Surely not," but I walked over and looked at it, and it still had an MSC sticker on it, and I said, "It might be. Maybe he sold it." So I went up to the desk and said, "Do you have a Bill Tindall?"

They said, "Well, we have a Howard W. Tindall."

I said, "You're kidding." Right there in the same condo, three or four floors below me. I went up and knocked on the door, and, sure enough, that was him. So we renewed our acquaintance. Unfortunately, that was towards the end of his life, and he was starting to suffer from it, but he was as extraordinary then as he was. He's just a remarkable person.

WRIGHT: Well, we've heard how he's really put the glue of keeping so many things—

MATTINGLY: Everything.

WRIGHT: — together. I'm sure in Apollo 8 there was so much going on trying to accomplish so much in a small amount of time. Tell us about your participation. Now, you worked as CapCom [capsule communicator] at part of 8?

MATTINGLY: [Laughs] I was supposed to be working the command service module. That was what I was supposed to be checking out. When I was assigned to the E crew, I was assigned—we were called support crew. I would call them go-fers. There would be three go-fers, and we were

assigned to go-fer for somebody. I had the extraordinary fortune to be assigned to Bill [William A.] Anders. The go-fer job was, it meant you handled the guest list, you made phone calls, you did personal errands. It was not very much like what one dreams of when they say, "I want to grow up and be an astronaut." Thank God Bill Anders never asked me to do one personal thing. Not one.

Bill was kind of—maybe that's because my perception when I got there was that Bill was, for whatever reason, maybe he was too intellectual, I don't know, but whatever it was, he was not one of the rising stars of his class. So he got thrown into this thing, and I think maybe because of that, he kept our relationship on a professional basis.

Of course, knowing how my other friends were going along, I was very appreciative of all that. The first time out, I mean, every day was there's this much to do and if we get some of it done. When I say twenty-four/seven, it was. It was like cramming for a degree, orals or something. It was twenty-four hours a day. You lived it. You grudgingly would grab a couple hours' sleep.

I remember one of the—in those days we were still trying to get our story together. So there are a lot of things that had grown up in the Johnson program that are extraordinary. One of them are these things that we call flight control schematics, big books of drawings of every system. But those were in their infancy at that point. Bill wanted a set of procedures and things, and we hadn't yet matured the process to crank out all of these procedures.

So Bill told me he needed something, a reference for the electrical power system because they were having a sim [simulation] down at the Cape [Canaveral] at the end of the week, and he needed some kind of a help. He says, "Go make me a chart that draws the electrical system and the procedures."

So I went back to my apartment and put rolls of paper on the floor and had all these books around it. It was probably in a space like this room. I was just drawing stuff from here and there in it, and then got all through and rolled it all up, the paper.

Bill calls and says, "Are you ready?"

I said, "Well, I am because the clock's run out."

He said. "Okay. Get it here."

So I roll this thing up, made a big roll of paper, three, four feet long, and rolled it up into a tube, took it out to Ellington [Air Force Base, California], got in my airplane, flew to the Cape, gave it to Bill, got back in my airplane and came home.

Bill didn't plan ahead either, and so he took this roll into the simulator with him. Then when it came time to use it, he unrolls this, which won't fit and it's running out the door. Borman was really upset at how amateurish we had been. But out of that came some little better procedures and things.

But if it hadn't been for Bill giving me that kick start, I don't know how I would have turned out. To me, all of the things we did getting ready for the mission, trying to figure out, answer all these questions, those were the fascinating things. This time spent in the control center, learning to be a CapCom, which was always confusing to me at first because I'm one of these people that I can't learn rote. I still have trouble with my Social Security number. I have to have a meaning to something, and then I never forget it. But give me a set of procedures and I'm in trouble. I think people see that, and, you know, they think I'm a pretty slow learner, which I am in terms of if that's what you want me to do, I am slow.

The first introduction to MOCR [Mission Operations Control Room] was all these procedures and do this and do that, and, boy, I didn't find that interesting. I found it threatening, just the maze of procedures. I was really concerned about that, whereas working on the flight techniques with Bill and all of the procedures and things that we were putting together based on understanding the system was right up my alley, and I just loved that. So the CapCom part on 8 was I got to know a lot of the controllers who became very close friends, but that friendship came out of when we got into their systems, not working in the control center. I'm trying to remember who the other—Jerry [Gerald P.] Carr and Vance [D.] Brand, I believe, were the other two. So we were going through this, and we had each had different phases.

I guess one other little vignette that taught me something about the world. We were sitting in a meeting in JSC and there was some circuit that had been found to be deficient or put together wrong in the pyrotechnics that deployed the parachutes on the reentry. It was a design or manufacturing flaw, I don't remember which. But it was in the backup system, and the fix was if this certain thing happened, then you should do this, and the way to fix that was to take a wire and cut it.

This was just a few days, maybe a week before launch. Nobody wanted to bother the crew. So we thought what we're going to do is go down, put tape around it and a little mark, and then we'll tell people, "Normally you don't have to touch this, but if this one bad thing happens, we'll call and tell you to open that panel and go get that."

So got all this done and they said, "Okay Ken (as I was in those days), you've got access to an airplane. Fly it down and put it in. Here's a picture of the drawings, and here's where the tape goes. You open this panel on the side, inside the cabin, take this panel off, go in there, put the tape around it, put the panel back on."

So I took a little piece of tape, and I went down and got in my airplane, I flew down the Cape. I drove from the airport up to the launch pad, went out still in my flight suit. These guys are all looking at me, and I climb in the cockpit. They said, "What are you doing?"

I said, "Well, I'm here to put a piece of tape on this, inside this panel. Could I borrow your wrench and take this thing off?"

He says, "I don't see that on this procedure."

I said, "No, this is special," and I wrapped my tape around it and put it back.

The guy says, "Are you sure you're supposed to be here?"

"Yeah."

I went back, got my airplane, flew back to Houston.

When I landed at Houston—it hadn't been very many hours—when I landed, there was notes all over aircraft ops [operations] to call Arnie [Arnold D.] Aldrich *now*. I didn't know who

Arnie was. Well, I knew who he was, but this would be my first conversation, and it was not a pleasant one as he proceeded to explain to me the procedures and protocols and all this.

I said, "But I sat right in that room with your guys. They're the ones that walked me through it. They're the ones that told me how it is."

He says, "That's got nothing to do with it. That's not how we do things. If you're going stay around here, you're going to learn how we do things."

"Okay. Yes, sir."

That also introduced one of the longest-lasting friendships. Arnie is another one of those really, really special people. I don't know if you've talked to him yet?

WRIGHT: Yes.

MATTINGLY: Okay. He is extraordinary.

WRIGHT: He is that. He is that.

Did you have the same role for Apollo 11?

MATTINGLY: [Laughs] After 8, we went through—on 8, the thing I really wanted to do is see these guys go into lunar orbit. I had had one of the periods going out, and we got all set up for a pre-LOI [lunar orbit insertion]. Jerry Carr came by to relieve me.

I said, "Jerry, I'm going to go get some sleep. Call me when you get near that in case I sleep through or something, because I really want to come over and watch that."

I woke up that afternoon or something, and they must have done it. I ran over to the control center, and, of course, they were in lunar orbit. "Jerry, what happened?"

He said, "I forgot. I was so excited, I never thought about calling." [Laughs] So I missed it. I missed the thing I really wanted to see.

But the other part of that thing was that the replacement, you know, getting this thing going, when we left that, I was then assigned to be one of the go-fers for Apollo 12. I was down at the Cape working, I think on one of the Cape vacuum chamber tests for the command service module, and that was really the first time I had run into—I knew Pete [Charles Conrad, Jr.] and Dick [Richard F.] Gordon [Jr.], but just knew who they were. There was class distinction. [Laughs]

So I was down there with them on this test. I don't know, somebody called and said, "Come back to Houston."

I said, "Well, I've got to finish this test."

"No, you don't. Come on back." And they explained to me that Bill [Anders] had decided he was not going to stay in the program and been nominated to be the president's advisor on space or whatever the title was in those days, and Apollo 8 crew was the backup crew for 11, but he was going to go take on his job because he had already been to the Moon. He was moving up to be the CMP [Command Module Pilot]. So he already knew all he had to know, so they needed someone to fill in in the simulations.

They wanted me to do that, but had no illusions that "If the backup crew flies, it's not likely to be you." That's fine. So to be on Apollo 11 after being on 8 to go to be on Apollo 11 was really—and not to do it as a support guy, but as almost like a real person, I thought I had died and gone to heaven this time.

One day I was in the simulator and Neil [Armstrong] came out. I was in there and Neil came out, and he looked. He went back inside. The crew offices outside the simulator at the Cape generally had two offices. The backup crew would take one and the prime crew had the larger one. After we were back in the office, I overheard Neil go to [James A.] Lovell [Jr.] and said, "What's Mattingly doing here?"

"I think they're right. My chances of flying aren't very good." [Laughs] Then Neil asked me what I was doing. I told him. He just looked at me with this—no expression, just, "Oh." And it was the last thing he ever said. [Laughs]

But it gave me this just absolutely fascinating insight into what that was all about.

WRIGHT: Of course, at that time you didn't know that was pre-training to training for a future role.

MATTINGLY: As a matter of fact, it was in that—when was it? It was probably after 11, I guess, and, you know, probably while I was assigned to—well, I don't remember when it was. There was a period in there before Deke used to make crew announcements in blocks. He'd wait till after a landing when the crew had come back, and he'd get everybody together, and they'd do a quick debrief, and then Deke would pull out this rumpled little notepad and say "And the crew for—will be."

I had gotten a letter from one of the families of a friend of mine who he had been shot down in [Viet]Nam, and I was trying to figure out how do you answer this letter? I said, I can't sit here and here I am living in the lap of luxury and everybody that I grew up is getting these letters, and I can't do this.

So I went in to [Alan B.] Shepard [Jr.], and told him, "I think it's time for me to go. I've had fun, and it's time for me to go back and earn my pay."

He said, "Yeah, I can understand that." He says, "Think about it for a week, ten days," I don't remember what he said, "and then come back. If you still feel the same way, tell me."

It was in that period was when Deke announced that I was going to be on 13. I presume Al knew all that, but I didn't, of course. So I went from being really, really depressed to really, really excited. I'm not sure, I think my assignment to 13 was—I think Lovell didn't know me from Adam's house cat. He might see me around. I believe he asked "Freddo" [Fred Haise]. He knew Freddo had more knowledge of the lunar module than anybody so he clearly was going to be Jim's first pick.

In those days I think the commander was allowed to pick from a slate. I don't know how big, but you had to kind of work your—I was able to glean that you had to work your way down a

list and until everybody in this group had flown, this group wasn't going to come in. But once they started the mix, then I think that Deke would pick the commander and give him some latitude in selection. I think it got to us, and they're going to have two rookies. It was obvious that Jim wanted to have Freddo. My guess is, he asked Freddo, "Who do you want to fly with?"

Fred and I had become acquainted while I was at Edwards, and we both had this unusual passion for flying. So he and I became friends at Edwards and then remained very close friends when we got to Houston. We'd go out every Saturday and Sunday and fly and nights. We always flew together, and we just really racked up the hours and developed a very, very close relationship.

Then when it's time to split and support these different groups, Freddo went to Grumman and I went to Rockwell. I'm guessing that I probably owe my chance to go fly to Freddo. We never talked about it, but I just think that was probably the case, because Jim did not know me. But so then that started a new page.

WRIGHT: Before we go there, we're going to take a break so that we can put in a fresh tape and hear about how your adventures with Apollo 13 and 16 began.

MATTINGLY: Okay.

WRIGHT: We were talking about Apollo 13, that you had been assigned to that crew. Tell me about your training and how the three of you became not as three individuals, but became the Apollo 13 crew.

MATTINGLY: Well, the training cycle was one of these things that, you know, the ideal thing, I think sometimes getting assigned to the crew was as much relief as going flying, because at that point your life did change. Your life changed. Suddenly instead of responding to a thousand other

people's schedules, your schedule was coordinated. You then had somebody who actually laid out your life for you and made sure that everything happened.

You got to do interesting things. You could go fly the simulators, which the rest of us were never allowed. We could look at them, but it was very rare that you had tests. That wasn't because it was exclusive as much as it was they didn't work that often, and when they were working, the time was precious and so you tried to keep the crews that were getting ready to fly there. You trained at Houston in a simulator, then you went to Florida and finished your training during the last couple of months there.

So this was our first chance to get away from books and drawings and all that stuff and go do things. This is where the difference in the way Fred learns and the way I learn just was really embarrassing, because we'd go over there for our first simulator training, and it was—I don't know what it was, but it was some really, really benign thing, just a normal go through the procedures of a launch or something.

Freddo, he took that checklist home, and he came in the next day, and, boy, Fred was the fastest switch-thrower button-pusher in the west. He could sit there and rattle this stuff off. It eventually became a big joke with us that Freddo had this characteristic of being very abrupt in everything he did. If he opened the door, he never used the doorknob; he explosively opened it. With Fred in the area, you always were cautious about walking by a door, because that was just his style.

So when it came time to do this training, Fred looked like he was Dr. [Robert H.] Goddard's son or something. I mean, he knew every acronym. You mentioned a procedure, and the instructors couldn't believe that Freddo knew all these things. He turned a book over, click, click, click. They were astounded.

They'd tell me to do something and [speaking slowly], "Step one, I did that. Why do you do this?" And everybody was really frustrated, and I was getting frustrated. I suspect Jim was.

It took a long time, but finally my own style of thinking caught up, and then I could leave the checklist at home and felt like I knew what I was doing with the system, and then I became comfortable with it and actually was able to step out and do things that were outside of the script. But that took a while coming.

I think even by the time I got down to Florida, I think the training people were probably a little on the apprehensive side. But fortunately the learning curve crossed in that period, so I started making headway. That was important, because by now the lunar surface mission was becoming more and more important or getting more attention. As we tried to tighten up on what we could get done with the lunar module, it just took more and more training and effort. It was concentrating on that. Freddo and Jim were in that around the clock and doing their own surface training and geology and stuff.

I was doing some orbital training, but for the most part, I was just trying to learn the spacecraft part of it. We had put together some extra activities I was going to do, but, by and large, I think the nature of the business just caused that the CMP generally embarked on his own training, and the lunar crew went about life together. We would meet for breakfast and dinner. In between, you know, you'd pass each other in the office between simulator sessions or something, but the separation was fairly distinct because there was just too much to do everything.

Compared to the stuff they were going to go do on the lunar surface practicing sucking your thumb in Zero G for four days while you coast back and forth is not a very exciting thing. It was hard to get attention on that anyhow. So we just kind of went our separate ways, which I suspect—I don't think 12 did that as much, but I think after 12, starting with 13, I think everybody kind of did go down these two parallel roads just because of the nature of the mission. So it was quite a difference, and Jim really didn't pay any attention, but he just, whatever I told him, that's what we'll do, and that was just the way it was.

So as we approached the end of our training, we'd been doing this stuff, you know, work expands to fill the time allotted. We had a lot of time, and so we filled it with a lot of work. I'm sure we could have gone on our mission just as successfully as ever in much, much less time.

But when you've got that much at stake, the last thing you want to do is you do not want to be the one that blows it. Even in those days we understood that this is—"I don't know how much money this is, but it's a lot, and I really don't want to be the cat that blows this mission."

WRIGHT: How long was your training period? Do you remember from the time that you were assigned as a crew till—

MATTINGLY: I don't know. I guess it was a year. For the most part, we had gone to a two-per-year flight program after—11 went and then 12 went at the end of '69, and then we were supposed to go in April. So I think we probably started right after 11, I think, or at least not too long in that time frame. So it was nine to twelve months, but the time on 11 kind of counted too, because Jim was in there, and Fred was kind of the go-fer for that. So I think it may have been only nine months of designated training, but with all the preceding stuff it was a little longer.

Dave [David R.] Brooks, that's his name, he was [the CSM engineer]—we had a little group that went to the Cape from the Houston office that there was a training coordinator [Lloyd Reeder] who just took care of arranging everything. There was generally a systems engineer who went down when the spacecraft arrived at the Cape and kind of was the den mother for the spacecraft and kept in touch with you.

But there weren't too many people from Houston that went down to the Cape. So you kind of shifted your friendships. People you associated now with were those that were down there for the time period. Dave Ballard did the lunar module, and Dave Brooks did the command service module, came out of what was called then the Flight Crew Support Division, Jim [James W.] Bilodeau's organization.

We had done the wet countdown demonstration for the launch vehicle. Those kinds of things, they're interesting to the launch team because they're getting to go do all the stuff they're going to do. For the crew, this is not a very thrilling exercise. It's a lot of laying in an uncomfortable position and just watching the paint dry.

So we got back. Dave Brooks came up to me after dinner or at dinner and said they had had a problem down on the spacecraft, some kind of a problem with detanking the oxygen from the service module. So our immediate thought was what you always worry about, "It's not going to delay the launch, is it?" That's question one for everything. "It's not going to hold us up?" He said he'd keep us posted and let us know.

So I would guess that episode took all night and a good bit of the next day as they tried to review. Came back and Dave briefed me. He came in and wanted to know if we wanted to know what the status was. Jim said, "Ken'll take care of it."

And so I listened to him, and he explained to me that they had this tank, and that they'd seen a problem like this before, and even though the regular drain system wasn't working, they could boil the oxygen out. We went through all the procedures, how they put the heaters on. When the pressure came up, it would open the relief valve and boil out. I remember we talked about, "Well, how do you know that you're not doing damage?" and "Well, we've got a guy watching the temperatures and it has these protective circuits in there, and we have actually done this somewhere else, and it's not a big deal, take us overnight or something to boil it out. So that's what we want to do, and that's what we're going to go do." It was really a courtesy briefing, but if we had objected, I'm sure we'd have had more discussion.

So I listened. Dave thought it was—he researched it. He's really a good guy. I said, "Okay. I'll tell Jim." So I told Jim and Freddo that this is what we've done and we're going to go ahead and boil it out. They said, "Okay, fine." And that was the sum total of thought about this stuff.

This is all down near the end. Again, I wasn't keeping records of all the chronology of these things, so sometimes the sequence of events gets jumbled. But one of the weekends when Charlie [Duke]—it was the last weekend when we were able to go home. We generally stayed in Florida, and people would fly back to Houston for the weekend with their families and come back Sunday night. This, as I recall, was the last weekend before launch, which was probably not the weekend before the launch, but probably the weekend before the week before the launch. And nobody thought anything about it.

Somewhere in there—I don't remember all the details—we found out that a family that had gone to a picnic with Charlie and his family over the weekend, one of their kids had the measles, and Charlie was considered exposed. So they said, "It's just a precaution, but it's no big deal, because we can determine your susceptibility, and so we'll just take some blood and then just kind of watch it." We were sufficiently quarantined. There weren't a lot of people around us, but it's not isolation.

Somewhere in there, they called me aside and said, "We need to take your blood again."

"Okay. Why is this?"

"Well, your blood chemistry does not show the titer or the indication that you have had the disease and built a natural immunity."

So I said, "Well, gee, I don't know."

They said, "Do you remember having it?"

"No. I don't know." I called home. "Hey, Mom, did I have measles?"

She said, "No, I don't think so. If you did, it was awfully mild, because it was never a big deal."

So I told them that, and they said, "Oh."

I said, "Well, what does that mean?"

"Well, we'll just kind of watch you for a while," which then evolved into a series of morning and evening blood draws and comforting things like feel your forehead. "Are you sick?"

"No." And so I said, "What is this nonsense? So if Charlie was exposed and I get sick, I might be immune, it might not be bad, and I might not get sick. So what's—."

"Well, gee, the incubation period says that if you did—one scenario says if you did it on this time line, Charlie exposed you when he got back, you go through the incubation period, you'll be in lunar orbit solo, and we don't really think that's a good idea. So we're going to keep watching this, but let's start giving Jack more training time in the simulator." I had been a simulator hog, and so there was no excuse for not sharing.

So then everybody that was starting to gather for the launch, they were are all coming around saying, you know, "They're not really going to put Jack in there, are they?"

I said, "I don't know. They say they might, but they haven't decided."

They said, "Ah, no. Nobody would do that. Don't worry about it. It's just for the public, to show that we've really done everything."

I wasn't really all that sure, but I couldn't intellectualize the idea that this might happen. It was pretty obvious that because our training had gone down these two roads, you probably could not afford to split the LM crew. But there were really opportunities. This, unfortunately, was no longer a tightly integrated group. They worked together, but those were procedural things, so you had the option. So the idea of delaying at very high cost, I don't think was ever seriously considered by anybody.

For all the personal feelings about it, you know, I would only hope that as a manager I would have—it's a non-decision. You take someone with no risk or a risk. Especially in the government where you'll never be praised, but you'll always be criticized for making a mistake, I mean, that's a non-decision if there ever was one.

But we drug it out. I don't know when the decision was actually made. Deke was down there by the time, and when Deke's around, it's always good, because he is the coolest—I don't know. He and Shepard were both really cool. They just could not be rattled. But Deke was more

talkative than Al, and Deke had this extraordinary simplicity that he could just say whatever mattered and only what mattered, and he would never tell you anything that he couldn't produce.

Sometimes it would disappoint people because he would not offer hope, encouragement. Deke would just say, "If things work the way we hope, you'll get all that it takes. If they don't, why should I add to your disappointment?" And Deke was just—this whole program was filled with extraordinary people. I know it sounds silly to say that, but there really—a little moment in history because of the magnitude attracted just wonderful people, so there's reason that there's lot of extraordinary stories.

When Deke got there, I thought, all right, I don't know what the answer is. I asked him, "What's going to happen?"

He said, "I don't know."

I said, "Well, I guess that's what it means." Deke was not one of these people that has—he's not an emotional person. But anyway, we were sitting at dinner, and he said, "You must be really getting bored sitting around watching Swigert practice."

"Yep."

He says, "Go down and fly. You know, get rid of your frustrations."

I had the blood test in the morning, and it was one of these things I knew something was happening because Dr. [Charles A.] Berry showed up. I think [Dr. Charles K.] Lapinta was the flight surgeon that was with us and a guy from the Cape. Chuck Berry was not a favorite of the astronaut corps. He was one of the original people. I know Deke had a close relationship and a very professional and friendly one. For the rest of us, he was a threat. He could never say a yes, but he could always say no, and you don't like people like that. So it's just a joke that aviators and doctors don't get along anyhow. So when they said, "Berry's coming down and he's going to probably want to give you a physical himself."

So he showed up in the morning, and they did the most cursory physical I think I've ever had, and left. They took some more blood, and we look at the blood every day and there's nothing here.

So I guess that was when Deke says, "Why don't you go fly." So I got in the car, drove down to Patrick [Air Force Base, Florida], went out and flew for a while. Sure enough, felt better. Got in the car to drive back up. This is two days, I think, two days before launch, I think. I'm driving up the road, turned the radio on, and they interrupt the news announcement that this afternoon NASA has announced that they have changed and substituted Jack Swigert for me. I just kind of pulled over to the side of the road and sat there for a while. If this is a practical joke, it's really well done, but I don't think this is a joke.

I went back out there, and nobody knew what to say. I know Deke well enough to know that he never said anything about it, but he must have been ready to kill somebody for letting that happen. But Deke would not share that. I just know him. That's not going to do anybody any good.

So it wasn't that night, that must have been the day before, because the next day was the day before launch. By now everything's off and running, and Deke said, "What do you want to do tomorrow? You want to stay here? Do you want to go back?"

I said, "Deke, I don't think I can stay here. I'd rather not. I'll do whatever you want."

He said, "Well, if you want to go home, go home. If you want to watch from the MOCR, I'll call them and tell them you're going to be there."

"Okay, I'll do that."

It was, I don't know, late in the evening, I mean, nine o'clock or so. I drove down to Patrick, and I called and said I was going to come take an airplane. In the evening down there, it's really quiet. When you'd show up, you had to go to the line and wake up somebody and say, "Would you get a couple of guys to come help me start my airplane?"

The parking ramp was close to where you could park the cars, so I went there first to put my gear in the airplane before I went to get the line crew. There was three guys there. The starter was already hooked up. No one said a word. They just came out and helped me put the stuff in the airplane. So I got my flight plan and headed back for Houston.

By now it's somewhere in here it's getting near midnight. When you fly late at night, there's a lot of air traffic, radio traffic in the air up until, oh, about ten o'clock in the evening, and then the airliners and all generally end their day, so the center controllers often where they have centers across the United States that work regions of air traffic control and they go from one to the other, then late at night they'll merge so that they may pass you from Jacksonville center to New Orleans, but the voice will be the same. They're just changing radios, but it's just one guy that's now taking care of all this.

I used to love flying late at night because the chatter's gone. There's not a lot of distractions. If you're like me, I'm never tired of watching the lights on the ground. To this day I could just—that's just perfect, to do that. So I kind of like flying late at night, there's quiet, and nobody ever talked to you. You'd get two transmissions, one where you checked in with a center at this end of his geographical area and then another one when you checked out and he gave you a new frequency to go to. You just don't chatter on the traffic controls. It's just not professional. Every now and then somebody would, you know, be friendly. Some airliner would ask what's the ball score or something so he could tell his passengers, but that was the limit.

So I took off, got up, and these guys kept asking me this, asking me that, asking me this. They never stopped talking. Our call sign was NASA whatever your side number was, so they knew—not one word was ever said about the mission. They were just talking. It's totally different now. All the way back to Houston, there was not a—and when I landed in Houston, which normally you land at midnight at Ellington and you go in, you pull your airplane up, you shut it down, go over and find some chocks. Generally there's nobody there, and you put the airplane to bed and you drive home.

When I got there, there was a couple of maintenance guys. That was good, because my car was at home, not at the airport. So they gave me a ride home. I can't prove it, but we have a lot of rules about you can't fly after you've been on a workday of so long, and this violated those things in spades. I think, you know, Deke's the kind of person, I think he knew that that was the right thing to do, and he would take the hit if anyone brought up the fact that I had gotten up in the morning and here it was much beyond the normal workday, flying day, and that he probably arranged to make sure that these folks kept me awake.

WRIGHT: The next day or when it was time to launch, did you go to the MOCR and participate there?

MATTINGLY: Yes, I went over to the MOCR. Of course, they had CapComs and everything, so I was a fifth wheel. I remember sitting on the steps next to the CapCom console, just sitting on the floor because the visitors' room is full of visitors. So I was just sitting there. I really was feeling very down, very sorry for myself.

WRIGHT: I imagine everybody understood your position. I'm sure nobody could understand exactly how you felt, though.

MATTINGLY: No. It was a close group, and we'd all worked together lots. The nice thing was no one ever said anything. They knew better. They just didn't.

So I went through it, and I had put a bunch of the stuff in the flight plan on my own, pictures I was going to take and different things I was going to do that were not part of the official plan, but I put these things in and now people kind of expected it. Jack certainly understood the command service module after he worked hard on that. So I thought, I'll talk Jack through some of these

procedures he's not familiar with. So I kept thinking, you know, I'll still have something to do here. Shouldn't take very long. Jack didn't need any help.

So in early days of the program, I forget the name of the FM radio station or what the call sign was, it was classic music, but when a mission was going on, they put the entire air-to-ground on the radio. That had ended by the time we got into this part of Apollo, and you didn't get that anymore. I think they generally wired it up so the families could have an air-to-ground box that they could listen to at home. But since I wasn't supposed to be there, there wasn't anything like that.

So the only way I was going to get to see this, they were going to do this TV show when they activated the LM and checked it out. So the only way to see that was to go over to the MOCR and sit in the viewing room.

So I went back and was sitting in the viewing room to watch the TV show, and Mr. [George W. S.] Abbey came in. Then when the video was over, he says, "You look like you need a drink."

I said, "You got that right."

He said, "Okay. Let me go get my briefcase and we'll go over to the Singing Wheel." He didn't get back. Right after that is when Jim called down and said that they'd had this event. It didn't take an awful long time for me to get rid of my hostility for doctors. They have done me a really good favor. [Laughs]

After that, from that moment on, the movie of *Apollo 13,* it's a pretty good movie. The book is pretty good. I think *The Race to the Moon* book's description is probably a little better. And they all fall way short. I always thought that that was—I didn't know why, I just knew I was watching—I had seen the most extraordinary event. In substance it far outweighed anything in Apollo 8 or 11. It was a different kind of story, but it was really remarkable.

As soon as this happened, I thought, "What did he say?" I went down to the control center inside and said, "What was that?"

They said, "I don't know. He said something about he's got a problem and we got this telemetry data that's all messed up." I think Sy [Seymour A.] Liebergot was probably the EECOM

[Electrical, Environmental, and Communications Engineer], and all the mess was on his console, and the CapCom's console position in that configuration was adjacent, across the aisle from EECOM.

It was fascinating. We had trained so hard to avoid making mistakes, being tricked. Jay [F.] Honeycutt was the sim sup [simulation supervisor] in those days. At that job Jay was absolutely extraordinary. Boy, those guys, they're probably the reason that this whole program worked, because they figured out what they needed to do and they did it with extraordinary skill and ingenuity.

But we learned that we could fool ourselves with instrumentation and respond to a problem that wasn't real, and make a nonevent into something unpleasant. So we tried really hard to recognize instrumentation failures. Jay and his team worked around the clock, I think, trying to think of different kinds of failures that we didn't know about.

So when this crazy set of signatures came up, the initial reaction from everybody was "It's an instrumentation failure." We hadn't seen this, but that's the only thing that could ever explain this array of symptoms. Because all our procedures were based on two practical rules. One of them is, structural things don't break. Actually, that drove everything. Fluid lines and structural—you know, joints can leak, shorts can happen to wires, but physical structure doesn't break.

The reason we had that rule is, if you admitted to that, then the number of things that you could have to prepare for is infinite. It's big anyhow, but it was a practical matter. We had done a lot of testing of this, a lot of margin of safety in the hardware, so we never looked at those kinds of implications.

It wasn't until, well, I watched this turmoil and confusion, and it was probably the only time—certainly the only time I've ever seen it—probably the only time in NASA's history that there was confusion in the control center. But there was. I mean, it was back rooms trying to say, "Well, we've got this information," and the nature of the signature was such it affected almost every system in the command module, so everybody was into the discussion.

[Glynn S.] Lunney's team was in the building to relieve [Eugene F.] Kranz's team. Some of them were already in the floor, so you had more people in there than you would as they were going through their briefings and changeover. So more people is a help unless they decide to help and then there's more—there was this brief period and somebody could look at the tapes. I know it's discernible. I have no idea. I would have guessed ten, fifteen minutes might have transpired in this discussion about, "Well, it could be this. It could be that."

Gene would try to say, "Well, be calm. Is it this or is it that?" "Well—" He was really under the gun and totally confused, and his back room was equally confused. They could see more than he could, but they couldn't make sense of it.

Finally, somewhere in there he said, "Well, I think it's got to be instrumentation. We're looking at different symptoms to see if I can tell you how this is."

Somewhere in there, Gene says, "Sy, didn't Jim say that he looked out the window and there's stuff out in the sky and he heard something?" He says, "Does that sound like instrumentation to you?"

"Well, I'll get back to you." [Laughs] In the midst of this, they did the hand-over. Glynn stepped in, and this is where the most magnificent display of personal leadership that I've ever seen, because there was confusion, not—*chaos* is not the right word. People were confused. They were highly trained to do things, but this was out of the experience base, and it was real, and we didn't understand it.

Glynn came in, and Gene was still there, so I mean nobody left. We had these extra people, and they got into a discussion. Glynn stood up and in his quiet way—the contrast between Glynn's speech and Gene Kranz's speech is really stark. Gene's crisp and precise and sometimes loud, and Glynn is quiet and laid back. He went around and he just started asking people, and my sense was that he was asking questions that were relevant, but not particularly important, but he went to every position to the room and gave them a question to get back to him on. So all of a sudden—I've never

asked him about it, but my sense was, it didn't matter what question he asked. It was just get your mind on something constructive, and then it'll all take care of itself.

You could almost feel the room settle down. Emotions didn't go away and all that, but all of a sudden they were back to the team that had trained with a sharp focus and a procedure that they followed.

Then we went through a number of these debates. The first one was, "We don't know the condition of the service module. We don't know any of this." We hadn't yet deduced what the problem was, but we knew the implication and EECOM could tell us we had a couple hours at best, and it was going to be too late.

Somebody, don't really know who, I have a feeling it might been Jack [R.] Lousma who had come in to see what was going on, maybe he was CapCom at the time, and mentioned a thing called LM lifeboat, which this goes back to why this simulation stuff is to important. Turns out on Apollo 13 we didn't do but one thing out of the entire mission that had not been simulated in some way before. Movies and everything makes it look like we invented a lot of stuff. Well, thanks to the kind of simulation training program we had, maybe the things weren't exactly the same or in an exactly the same order, but everything we ended up doing had been done somewhere.

So somewhere in an earlier sim, there had been an occasion to do what they call LM lifeboat, which meant you had to get the crew out of the command module and into the lunar module, and they stayed there. I vaguely remember—when you have a really exciting sim, why, generally everybody knows about it. I vaguely remember that they had come up with a thing that contaminated the atmosphere in the command module, and they had to vent it, and they put the crew into the—there's some reason that instead of staying in their suits in the command module, they put them in the lunar module while they did this.

So they said, "You know, we can power it up and go do that," and went through a discussion about whether we should or not and how long it would take. There's this little corner of

the room where the flight director console is, is where there's always this crowd standing around talking, and so now that crowd is getting to be pretty large, and everybody has got an opinion.

They said, "Well, okay. Doesn't look like there's any harm in doing it. Go ahead and start them on that." I think Jim asked something about how long it would take. The procedure for powering up the lunar module, the way we normally did it was complex. It took three or four hours, something like that.

Freddo is one of these people that could do anything by rote, and all you had to do was say, "Freddo, do LM lifeboat," and he's gone, and it's done. He would scare me at times; he would throw switches without thinking about it. But this time it was really the right thing to do. So they ended up doing that.

It was important that they get in there in a hurry because the command module only had limited batteries for reentry, and you really didn't want to drain those batteries. So you wanted to remove the requirement for electrical power from the command module as fast as you could, assuming you're going to come home. One of the many lessons out of all this is starting on day one it was from the very first moment, assume you're going to succeed and don't do anything that gets in the way.

So, preserving the command module batteries became a religion, because they need that to get back in. There's no batteries in the service module. You just have a fuel cell, so when that's gone, it's gone. We had to get it shut down before we get into the batteries.

So Jack's job in the CSM was to get that done, and it was Fred's job to get the lunar module up fast enough to beat the decay of fuel cells. So that process is going on.

Then we got into a discussion of, "Well, we don't need to do the whole procedure." We got into a debate about this inertial reference we call the IMU [inertial measurement unit]. It's just the device, the platform that you navigate with it. It maintains a reference that lets you know where the whole universe is in terms of attitude so you can find stars and planets and stuff. Each spacecraft has one of these.

The one in the lunar module, the platforms were the same, but the way you aligned it in the command module is, there was special thing we called a sextant. It was just a telescope in the side of the spacecraft, and you could steer it around and aim it at stars and take marks on it, and the computer would say, okay, you're pointing here, and it would align the platform.

In the lunar module you had the same problem except they didn't have a telescope, they had this spiral thing up on the top. You look out, and you took marks in there because you didn't rotate a telescope and measure where it's pointing; you looked through a spiral grid and put the star there, and then you read out the coordinates. It had a little cursor so you could lay it over and say it's this number of degrees and it's that far out, and you marked that down and put it in computer. You did that on a number of stars. That would give you the line of sight to the stars so you could align a platform.

Doing that through that optical device, that was one of the things that at least in the simulator took a lot of training to get to do. Freddo and I used to go over and play with it and try to find some simpler way of doing it. We really didn't come up with anything that was very clever.

Normally you make the transfer by reading the angle. The two spacecraft are tied together at the nose, so if you know the attitudes of what's in the command module, you therefore know what the physical alignment is so you can tell the platform and the lunar module how to position itself to replicate this. They're in different engineering coordinate systems, so you had to write down all the numbers in the command module, put them on a list, and then do some math, and then punch the numbers into the lunar module computer.

But if you held the spacecraft steady when you did this, why, you could get a very good alignment so that now you could go in with the lunar module and make a little tweak to tighten up the alignment. But you didn't have to go through this. One of the beauties is when you look out at all these stars, you know, they go to great lengths to that teach you how to recognize constellations so you could find this star.

What they don't teach you, all planetariums and things are showing you the sky the way you and I see it from the Earth. What they don't tell you, when you get out in space, that all those black spots in between the stars are filled with stars, and those constellations are nowhere near as obvious as they were. If it was an obscure constellation in a planetarium, you can bet it's hopeless out there in the real world.

So since you couldn't always be sure, these obscure stars that were picked because they gave us the right technical geometry, they were in the right part of the sky, they were good for navigation, but really a bear if you had to figure—but if you could tell your computer to point at that star, and then you look and there's a star and it's not right on, but it's not very far off and there's only one star there, you can be pretty sure that that's it, and all you're doing is being a vernier adjustment, even though you couldn't recognize that star from Adam's house cat.

There are a lot of technical reasons why we got into this. Our optics just weren't that good. But this technique really worked well, and so if I can get the platform in the lunar module close, then you could take it up and say "Point at this," and then even though I really couldn't see what that star was, you could then tweak it up.

So we said, "We're ready to do that," and then somebody, they said, "No, it's going to take electrical power," and by then the guys doing the trajectory calculations, [Jerry C.] Bostick and company, had already determined that "Here's how many hours it takes to do things." The guys in the lunar module electrical system had calculated how much time we had, and the two numbers didn't match. So bringing on this platform is probably the biggest energy user in the spacecraft. Didn't want to do it. I remember very emotional voices about "You've got to do it." "You can't afford to do it."

Finally somebody mentioned that Jim said there's millions of stars out there with this stuff that was coming out. So with that, we were able to persuade Deke and Glynn that "If you don't get this platform aligned now, before the command module dies, next chance you're going to have to

align it is when you're behind the Moon, and that's just not a good risk. Do it now, and then we'll buy time, and we can think about it. If you don't need it, you can turn it off."

But they went back to the idea that, "Well, we certainly need to have the ability to maneuver the spacecraft accurately to come home, and we probably ought to do that before we worry about how long it takes." So we brought up the platform the way—all this was done and within, what, an hour, hour and a half, a little more. Freddo had the lunar module completely up and running, and Jack was secured. I think we nicked the command module batteries just a tad, shut down.

So now they had overcome one of the big things. They had a capability to maneuver, and they knew where they were, and now they could figure out what to do. Went through a big debate about what to do next, as I recall, the books and the movies and all don't really capture. That debate of what to do next was also rather charged because there was one group of people that said, "You know, this has really been a bad day. We don't know the condition of any piece of hardware we've got. We don't want to do anything. Don't touch anything. Let's just figure this out."

There's others that said, "There's only this much electricity and water in the lunar module. We need to turn around and come home as fast as possible. It looks like we could do this, but to get back before the batteries run out, we will have to either jettison the service module and get rid of it to make the vehicle light enough or we'll have to burn the [CSM's SPS (service propulsion system)] engine."

Well, you can't burn the [SPS] engine because we had no electrical control. We could jettison the module, but now that we've figured out that something explosive occurred, we don't really know whether the heat shield is intact, and we don't know anything about the thermal environment on the command module when you take the service module off for a day or two. So we went through this big debate. I have no recollection about who made the choices. There were a lot of people involved in this.

By then we had done the other clever thing of having Kranz took his team to the deck below to work problems. Gene and—who was the other flight director? I guess Jerry, I think. And

[Milton L.] Windler may have had a shift. I don't remember. But the four teams, so three of them were going to work the real-time stuff and Gene was going to take his team and go do all of the troubleshooting to solve the problems.

So they came up with the strategy in one of back rooms that we would maneuver—the flight path we were on initially was what they call a non-free return. To get to the landing site, you had to have a trajectory that said if you did nothing more and went around the Moon, you would not hit the entry corridor back at Earth without making another maneuver.

The first burn we made after bringing the lunar module up was a very small one designed just to put us on this free return. They said, whatever we do after this, you're going to reenter the atmosphere on the Earth. That trajectory went out and went around the Moon and came back and entered the Earth's atmosphere in the Atlantic. Recovery forces are out in the Pacific, but, you know, it's home. It's kind of a good place to be.

So they worked this problem, and they decided that what they would do, after a lot of this debate, they would go around the Moon. As soon as they came out from the back side of the Moon, they would do this maneuver which would move their trajectory just enough so that they were on a landing in the Pacific near the recovery forces. As I recall, it speeded up the return trip by a matter of a couple of hours. It really didn't matter.

So the question that occupied our time after making that strategy choice, the question was, how do you conserve your resources for the time you're going to be there? That's where—I don't know when John [W.] Aaron was brought in and sort of set up as the resource czar to go figure out how to get this stuff to work, but John ended up doing all of that.

The first thing was, how do we make this stuff last? As soon as you have done your maneuver, it's done precisely, and by then we had probably overreacted to being nervous about not taking a chance with the platforms. We did that maneuver, and then it was pull the plug, and the only thing left on was the radio and the light bulb. We turned all the instrumentation off, dumped all the platforms. So even though the command module had been probably below freezing by this

point, now the LM was headed that way too, and the only heaters in there were three bodies, because we built the spacecraft by design to radiate heat so that we didn't have to spend energy getting rid of the heat. We wanted the heat to escape naturally. Well, normally that's because it's got a lot of heat input. Now the heat input was three bodies, and all this stuff radiates.

The fascinating thing was that we talked incessantly about the temperature of the spacecraft and its effect on the hardware. I may have had some kind of a Freudian slip, but I do not remember ever participating in a conversation about the temperature of the crew. They never complained, because they weren't going to complain. They fully understood the magnitude of what was going on. For all the things we did, for the life of me, in that whole period I do not remember ever—because the first thing I would have done was tell them, "Put your stupid space suits on. If nothing else, they're miserably hot, and you won't radiate any heat." I asked Freddo later why they hadn't done it, and he said, "You know, by then we were so cold and tired, we didn't have the initiative to do all those things or to think about them."

So we started to come back. Now the shift changes are starting to go on, but Gene and his crew, they were staying in the control center and we had a "boys town," bunks where you could take a nap. So Gene and his crowd just stayed there. The other shifts continued to work.

Gene's job was to go figure out, we've never powered up a command module from scratch. Obviously you had to do that before launch, but it was done with a procedure and a book that was probably several feet thick and lots of people and deliberate things and ground support equipment, and now we had two little batteries that we didn't want to use very much of and had to do it in a spacecraft that had no instrumentation and nobody could look. It didn't take long to figure out we could not afford to bring the instrumentation on so the controllers could see, because if we let them see, then it would be kind of futile, because it would use up the battery that was supposed to bring them home, and that's what poor old John Aaron had to deal with, was try to find the right balance between do we know enough and the inevitability that the spacecraft is going to enter the

atmosphere whether you're ready or not. So John really—he was always an extraordinarily talented engineer, but he really shone in that one.

So the guys coming through on the way back, not too long after they did their return burn and shut down everything some in the spacecraft—I don't remember how long that next sequence was, because now they're coming back to Earth and they're going to land in the right ocean. Water was still a concern, and the battery power without powering down was insufficient.

Powering down meant that you could get there, but we had another consumable that—I don't remember anybody forecasting that we would have a CO_2 problem, but as soon as the light came on, we recognized it. In the movie, Ed [Robert E.] Smylie's—there's this really neat scene where they've got a tableful of stuff and he dumps a bag on the table, and he says, "Figure something out." Well, the real world is better than that. The real world is that we had had a simulation, and I think it was on Apollo 8, I believe, where the sim sup had jammed one of the cabin fans with a screw that floated loose. I think they had broken some electrical connections or done something of that ilk. The conclusion, you know, the simulations were done with the rule that the simulation may be four hours, but it's not over until everything is under control. So sometimes those things got to be rather lengthy simulations.

The solution that they came up with was that they could make a way to use the vacuum cleaner in the command module with some plastic bags cut up and taped to the lithium hydroxide cartridges and blow through it with a vacuum cleaner. So, having discovered it, they said, "Okay, it's time for beer."

Well, on 13, someone says, "You remember what we did on that sim? Who did that?" So in nothing short, Joe [Joseph P.] Kerwin showed up, and we talked about "How did you build that bag and what did you do?"

Oh, it was easy. Solving that problem took an hour, maybe two. Because it's real now, they made him build a demonstration model, so that took another thirty minutes. Then "How are we going to tell these guys in the cockpit?" And the answer was, if you just said go tape your lithium

canisters to the suit hose, that's probably all they had to say, but they proved it all out and had to show it to all the management that it would work. Of course it worked like a gem.

That's where both the LM lifeboat, the alignment procedures, the CO_2, all those things had been practiced somewhere in a simulation. This powering-up had not been, and that was the problem that John Aaron had to take.

The way back, the spacecraft started drifting off its trajectory, and now they had to make their midcourse corrections to get back, just looking out the window at stars, because there's no attitude reference in the spacecraft anymore. It turns out that, too, we had practiced in some simulation somewhere. It's not very accurate, but it doesn't have to be.

We're used to doing things and you've got to have three decimal points of accuracy. It was hard to get people to recognize that we do that, but you don't need to be the nearest five degrees. It doesn't matter. I think Tindall was the one that was—he was always the silent guy. He just kind of said, "If you're kind of in the same quadrant, it's okay for this."

Okay. So we did those things. John Aaron finally got this procedure coming together. As far as I recall, he and Arnie kind of worked all of the system stuff to build this into one big coherent procedure to power up the command module. One of the rooms downstairs was kind of a war room, and it was the place for the master copy and blackboards filled with "These are the problems we're working and this is what we're doing and whose doing it." Several people would just kind of bounce around from one place to the other, little working groups working on things.

Got it all done, read through it, and somebody said, "You know, yeah, I think this is here, but we're all so tired, don't have any idea if this thing works. We're going to have to read this up on the radio." Jack's [Swigert] never seen it.

So we said, "Let's get somebody cold to go run the procedures." So I think it was [Thomas P.] Stafford, [Joe H.] Engle — I don't know who was the third person, might have been [Stuart A.] Roosa. But anyhow, they went to the simulator there at JSC, and we handed them these big written procedures and said, "Here. We're going to call these out to you, and we want you to go through,

just like Jack will. We'll read it up to you. See if there are nomenclatures that we have made confusing or whatever. Just wring it out. See if there's anything in the process that doesn't work."

While they were doing that, we said, "You know, I think it's time to go home and shave and wake up." So, contrary to the movie and all of those things, we didn't solve any problems in the simulator. You don't do things that way. It was good way of conveying the story to the public that we have to work on it, but the public could never have followed the real magnificence of having this group of people laying around doing all these things pieces at a time.

So they actually ran those procedures, verified them, made some red lines, I think, brought them back over. Jim [Lovell] was become apprehensive about "Where are my procedures?" and he kept getting told, "They're coming. Stand by." I think Jim probably was really very much apprehensive, because they didn't have any idea what to do at all.

So we read all this stuff up to him. Jack, bless his heart, I don't know how he ever did—because they didn't have a notepad or paper. They had to take their flight plan and turn it over and tear out pages and write on the back of it. The only thing they had were pencils and ball pens. They had no idea. They don't even have a preview that says "We're going to give you the next twelve feet of paper, so be prepared to write it down". All they knew was, "Here comes a lot, and you can't afford to make a mistake. Don't mess up, but go ahead."

Got it all up to him, and, as you know, it all worked. One of the last things we did in the procedure was we, by then, had noticed that we actually had extra electrical power in the lunar module batteries and—gosh, I don't remember who did it. I want to say Richard Brown. Somebody came in and found a way to do a jumper cord and take battery power out of the lunar module and top off the command module and to use that power to help get the command module stuff started so we didn't use all the power from the batteries. So we ended up with a good margin on the batteries.

One of the last things they were going to do after they got it all closed out and got rid of the service module and the lunar module, they wanted some way of checking the alignment on the

command module, because since we didn't have the lunar module to tell the service module or the command module the orientation because they'd shut it down, so now they had to do that, but with the optics taking a lot of power, and presumably covered with condensation, we figured we couldn't see anything.

So, based on another simulation, we said, you know, we know how to go and you take your—a thing we call a COAS [crewman optical alignment sight], an optical alignment, just a crosshair that goes in the window, essentially—point it at the Moon and at the Sun and at the Earth. That's three bodies, and you have an alignment, and it takes no identification.

So we had to wait. Then the last time that he couldn't maneuver this thing while the lunar module was on, wait till all the command module's buttoned up. They don't have anything as alignment yet. They're going to go grab one out the window, but it's something that we've played with, and they got it done, and it all worked.

So, you know, the extraordinary role of the simulation program that put all of those tools in people's toolbox would never have happened if it hadn't been for things like Jay and his guys using their initiative to think of what could you do, what kind of failures there might be, and making people hold to it, and the whole system of debriefing and forcing people to learn to communicate and be totally objective. You know, all of that stuff is what played out in the Apollo 13 story.

A couple of vignettes that go along with that is while I never got to go to the Singing Wheel and have my beer, sometime during the early part of the morning, like two or three in the morning, I walked out of the MOCR to get some fresh air. Picture the—you can't forget, because the parking lot was filled. There wasn't an empty spot. You looked around at the buildings on the campus, and I'd swear there was a light in every office and the shadow of a head.

At this time we didn't have a recall bill or any of those things. Those were things that came after we said, "Oh, my goodness, look what we've just done." These people just heard that something had happened, and they showed up on site. They had the discipline to go to their office, just check in and say, "I'm here if you need something," and went to work.

Same thing happened at Downey, at Rockwell, and at Bethpage [New York] and Grumman. The story I really enjoy was while we were debating what to do with this inertial unit in the command module we had to bring up from scratch, these units are very, very delicate. To get the precision we needed, they were allowed to run at a temperature of like 70 plus or minus one. They were tested to see that they would work at plus or minus 10. We did that because their accuracy was very, very sensitive to the temperature of all the components and just the mechanical design.

Well, now we had one that we don't know what its temperature is, but we know it's below freezing, which is a long ways from 70. Wonder if it'll work at all. We had some debates about that and made lots of phone calls.

The story that came back to us was, "We didn't do any testing at those kind of temperatures but it's okay, we have reason to believe."

There was some challenge, "Are you really sure?"

"Yes. We have some unusual data that confirms that it works."

The semi-apocryphal story is that one of the employees at the company that put those together heard about the debate, said, "Boss, you remember we had a snowstorm, ice storm, last winter and you secured the plant? I had an IMU in the back of the station wagon. When you told us to go home early, I parked the wagon outside. I got in my car and drove home. Next day when I came back, I realized I had left it in the station wagon. I took it inside and set it on the bench. I've talked to the folks that hooked it up and ran it, and they didn't have any trouble."

And that was the kind of thing that you saw throughout the program, of people who—that's not the kind of story you like to go and tell your boss, especially when everything is going up on national news, but the beauty of the program was that everybody knew Apollo was so hard, that there was no room for any distraction, no room for politics. There's no personalities getting in. I don't care who's got the right answer, just get it right, and it's okay. It didn't matter if it's the new kid on the block or the guy who's retired. Anyone who's got an answer to our problems is sought after and appreciated. And you don't get to work in that climate very often. That's one of the

things that you really saw in this era. You have to have a contrast with something else to realize how much you should appreciate that kind of environment and the people who created it. That's all there is to Apollo 13.

WRIGHT: Well, we're going to stop right there then. Okay. We were finishing about 13. Are there any other things that you would like to add before we move on?

MATTINGLY: I think just to tie it all together, the oxygen tank that we discussed prior to launch was, in fact, the culprit in the explosion. It was damaged in the process that we used in ways that we didn't anticipate, obviously, for a whole lot of different reasons. So after the fact, you find out that you had at least had a vote in making a decision that turned out to have some bad consequences is something today we laugh about it, but it seemed a little bit interesting at the time.

The other aspect of this thing that I thought was, you know, during this thing, you see the world in parochial points of view. The idea of having been removed from flight or being threatened to be removed was obviously a severe disappointment. It was even more so because the flight program was being curtailed. A lot of us thought we were out exploring space and looking for "Ferengi" [reference to *Star Trek* aliens] traders and doing all kinds of exotic things, when, in fact, we were an instrument of political policy. Most of us just didn't even think about that.

So the fact that once we had succeeded and taken enormous risks to do this, we were out there ready to start popping these things to the Moon just as fast as we could, and we had, what, nineteen of them. I guess it was twenty. We just thought that it was going to fly on. It turned out that budgetary pressures hit us as soon as we succeeded in landing. We had already lost, gave up [Apollo] 20 for something. We needed the hardware. Then 19 was gone, and we were starting to see the end of this program. If you did a rotation, you could see that we had selected crews far enough down the road that it wasn't clear with our normal rotation that if you missed 13 that you were going to have another a number come up that was real.

It hadn't been canceled, but the fear was that each time we had a congressional appropriation, it had fewer flights in it. So the apprehension was quite a bit greater. It's like one of those things you don't talk about at the time. There's a mission to go fly, and fortunately, with somebody like Deke you have absolute confidence that if there's a fair treatment, you'll get it. So you don't need to spend a lot of time worrying about those things.

But nevertheless, it's one of those agonizing things, and even though I'm—terribly important that I did not go on that mission, but not for the reasons that people like to talk about, it was I have a personal thermostat that's set right around 70 degrees, like the IMU. When my body gets below 60 degrees, it doesn't function. If I had been stuck up there, I would have absolutely been a disaster. You can go so far on mental activities, but I know me and I know how my body behaves, and it would have shut down. So it would have been more than just unpleasant for me. Those guys were really in a terrible, terrible environment. I saw Freddo afterwards, he said he just had never been so miserable in his whole life.

So the other thing is that I guess I would like to go on the record here about what was my role on the ground. I mentioned that I did not have an assignment because I was supposed to be in flight instead of on the ground. Backup crews generally did not have assignments during the mission. So now that I was a full-fledged backup crew, I didn't have anything to do, didn't have an assignment, nor did I throughout this enterprise.

What I had was a ringside seat that nobody could ever imagine, with the authority to walk into anywhere and listen and kibitz, but I had no particular role. As a result, the magnificent accomplishment of what the ops team did on this has really stayed with me. It's the one thing I really enjoy talking to people about, because there's a lesson in Apollo 13 for you, whether you're a manager, an engineer, whatever it is. There are lessons in there that are really important, and they were done so well. It's just, you know, being part of that mission was probably the most exceptional education you could ever get.

WRIGHT: How long after Apollo 13 was it before you found out you were going to fly with the Apollo 16 crew?

MATTINGLY: I don't know. I would guess it was not long. I do remember Deke asked me if I wanted to be the lunar module pilot on 18 or a CMP on 16.

I said, "Well, I'd sure like to go down to the surface."

He said, "Well, I'll give you your choice, but I would always take a bird in the hand."

I said, "Well, you know, there won't be a chance to go back as a CDR [commander] if I go on 16."

Deke wouldn't say [unclear]. "It's your call. Just think about a bird in the hand."

So I concluded that I really wanted to go to the surface, but it probably was better to get near it than not go at all, so, knowing Deke, I said, "There's no emotion here, but there is a message. I'd better do this." [Laughs] Of course, 18 was canceled. I did get to go.

When that time took place, though, it wasn't too long. I didn't have a lot of time to sit around and feel sorry for myself at that point, but by then you've kind of learned to change your priorities and you don't feel quite so sorry for yourself.

WRIGHT: Well, once you said yes, you must have started right to train again, so another two years of training with another crew?

MATTINGLY: Well, you know, I really can't remember that transition, because, you know, it's a ways off, because we inserted Al's [Shepard's] crew into the normal rotational sequence so that Al and Ed [Mitchell] and Stu [Roosa] got in there. So the 13 backup crew would have gone to 15. So we didn't start training right away.

Well, after 13, the world came to a halt for a while, and we found out that there was a lot of stuff that each of us knew or thought we knew and that no one else knew. So Freddo and I were put

on the job of compiling what we called a contingency checklist of hip-pocket procedures and things that various people had compiled that would to be used in an unusual circumstance.

As I remember, that was a pretty lengthy job writing all that down and then try to prove it. It put some discipline in our program that we lacked before that. Didn't realize it, we just—everybody thought they had these taken clever little things that they tried one place or another and if ever needed, why, we'd tell somebody, but it's not proven. So these things started to show up during Apollo 13. So we were sent off to do that.

Then starting with 15, we had what we called the J-series of service modules, which added a bay in the service module that was empty. It filled it with some science experiments, and we put in cameras and science instruments and stuff. The best part of it was that we had film cameras instead of digital cameras in those days, so to bring the pictures back, you had to go get the film. The only way to do that was to open the door and walk outside and go pick it up and bring it back. So that meant that on 15, 16, 17, we had a chance for the command module pilot to put on a suit and use it for a change.

So, building and qualifying the service module modifications was a job that I had, which gave me another one of those little interesting vignettes. While we were putting this design together, Rockwell had designed all this stuff. The outer skin of the service module is made up of four bays, and one of these was filled with the instruments, and the outer cover of this had to be removed in flight. But to withstand the stress of launch, the cover had to be on there as an integral part of the service module to hold the command module on top.

So the way that the engineers had chosen to remove it was they put a shaped charge, pyrotechnic charge that went around the door. We used pyrotechnic charges like this in lots of applications, not an unusual thing. So it was just another application on here. After you got headed to the Moon and all the big thrusting was over, you would fire this pyrotechnic, and that would take this door off.

In the discussions they said, "Well, you cut this thing with a shaped charge, will it just sit there or does it go away? Where does it go?"

So they devised a system and said, "Well, we're not really sure. Testing is probably more expensive than just making sure you know what it does." So the engineers had a design that had two little pins in it, just take a door and put two little pins out here and then stick it on something that will act as a hinge down here. Put the charge all away around here and anchor this in this way, and we'll put a little lanyard on the front end. So when this thing fires, if there's any pressure, which there should be, it will start to rotate about this hinge. After it's rotated, this lanyard will be fully extended, pull a pin out that will fire another pyrotechnic charge, which is going to push the door away from the spacecraft.

So this thing fires, and it rotates until it's pointing like 60 degrees up from the side of the spacecraft. The lanyard pulls out. It fires one more charge, pushes this thing off. That was how it worked. Looked and sounded good to everybody. So I at some point—must have been a slow day, and I say, "How do we test this?"

"You don't need to test that."

"Well, you know, gosh, with all the testing we've already done, it doesn't seem right to not test this." So after we had a debate and probably ended up taking it probably up to the CCB [Change Control Board] to get it done, they agree to do it.

One of the old vacuum chambers, the small one down in back forty there, was rigged up as a place to test this thing. They took a cable from the ceiling and hung the service module on it with the door out to the side, and had a wire mesh screen out here to catch the door. Part of this was to put it in a vacuum condition and everything.

So I was all set up. The engineers were really miffed that we were going to do this. So finally, test day came, and I called up a couple of friends and said, "Okay, now, I'll swing by in front where we'll put out a watch."

"Nah, I don't want to go."

"Don't want to go? Come on. You've got on see this." I didn't get very many people to go. I got a couple. We went down there, and everybody is still really kind of irritated that I had been such a pain in the neck.

In this, because it's a vacuum chamber, there's only one little window that's about so big that you could look into the chamber. Everything else you had to do on TV cameras. So this thing's hanging in the middle of the chamber, and the cameras are all looking at it. They go through the countdown, and it comes to zero, and you hear a little "poof." You look out there, and the service module is hanging there, not moving, a hole in the side where the door is. The wire mesh is sitting here, and it's not shaking, and there's no door. [Laughs]

Everyone looked at each other and said, "Well, where's the door?"

We looked around, and it happened so fast, you couldn't see it. There's this little smoke, and this thing comes out. Finally someone said, "We've looked everywhere else. Can you turn the camera up at the ceiling?" And there it is impaled in the ceiling.

When this charge fired, this little lanyard had enough mass that the shock of the charge pulled the pin, fired the charge that was supposed to push the door this way, fired it like here, and if it had been a real service module, it would have taken the RCS [reaction control system] thruster and module right off, because it just went right straight out front, and would have had some really interesting consequences.

The looks on people's faces when that happened were priceless. Those are the kinds of things you do to fill your time when you're bored between doing other things.

When it came time for 16, one of the things I remember, as we started getting ready in training, every command module pilot envies the people that go to the surface. In fact, we built a tape on 13 that had Jim, Fred, and me holding a conversation. The idea was, Freddo took it with him and when they landed, they were going to start playing this tape on the lunar circuit, and I was going to stop answering. We thought we'd see if we could shake up the MOCR. We obviously

didn't get to play that thing, but the command module pilot really wants to do something important and feels like you're just a truck driver.

It turns out that I wanted to do something. I don't know who arranged for me to do some orbital geology things. Maybe Stu even started it, I'm not sure. But anyhow I got this message to meet Farouk el-Baz at seven o'clock one night. Farouk el-Baz. Somebody is really pulling my chain. I don't know what kind of game this is, but I'm going to see it out.

Turns out there is a Farouk el-Baz. He was late, as almost always. One of the most intriguing characters. He's Egyptian. He had the patience and the enthusiasm to talk about what you could see from a distance. He just made looking at the Moon a meaningful thing. He spent untold hours with me trying to help me understand and look for things, and posed a series of questions, not to go look for the answer for this, but he was trying to teach me how to approach a problem with some curiosity that would lead me to see things that I would otherwise miss. He'd take me out in the field on a geology trip and say, "What do you see?"

Dirt. Rock here and there. You'd get a Lee [Leon T.] Silver or [William R.] Bill Muehlberger or somebody out there and they'd say, "No, look," and they'd just describe the entire universe to you, and it's compelling. Those two guys, Lee Silver in particular, he could hold you spellbound for hours as he unfolded his story. I don't know how old he was at the time, but he was not a spring chicken. But he was out ahead of anybody in our group. That guy, he may look like he's a senior citizen until he hits the field, and then he goes into overdrive and you can't keep up. He never loses enthusiasm, and he's just a remarkable guy. I think he did as much for Charlie [Duke] and John [Young] as Farouk did for me.

So, Farouk talked to me about all these things, and we got to spending a lot of time as I tried to understand what to look for. It really enriched the opportunity to go see things.

Now, the other thing that kind of dominated, since I'd been through this training cycle and worked on all this stuff, it was really getting to be hard to find things to train on other than just

proficiency, and yet work expands to fill the time allotted, so we had allotted a lot of time, so we had to do things.

One of the stories people told about space flight from the days I went to my first debriefing was a continual comment made that "I trained for this thing, I did this, I had this time line down, and yet, boy, you get out in orbit and time goes twice as fast as it does in the real world." People have flown X-15 and some other of those kind of short-duration missions, always said the same thing. They tried to practice everything at a clock that was running twice real time. And the guys talked about how "I don't know what happened, I was following this procedure, then I started falling behind, and I couldn't catch up, and it was just terrible."

So I got to worrying that here I am just looking for all of these nifty things that I can do, but what if all that turns out to be true and I fall behind and I blow not only the extra stuff, but I don't do the things I'm supposed to do? So I got to worrying and thinking and said, you know what? I sit in the simulator and they say, "Do this," and I go tick, tick, tick. Then at X time—and everything in space flight is done on a clock, so at 10:32, turn this thing on. Okay. Well, it's 10:05. How much time am I going to spend watching my clock waiting for 10:32 because it's not supposed to go on at some other time? I said, you know, I'm convinced a lot of our time is spent wasting time so we don't miss this event.

We had a little mechanical timer that you could wind up like a kitchen clock and buzz, buzz, buzz, and ding. You could do that, but I guess that was just—so one of the neat things that happened to us after 13 was the MOL program, where I had envied all the people that went there, and the MOL program was canceled, so a number of their people came to NASA. The first group had Truly and Crippen and Hank Hartsfield, Don [Donald H.] Peterson, Bo Bobko came later; he went to school first. Bob [Robert F.] Overmeyer. I think that's probably it. They popped in, and doggone if they didn't assign Hank to Apollo 16 as the go-fer. [Laughs] I really couldn't quite imagine that this was the guy that gave me so much trouble when he was the instructor is now in a

role reversal here. But he'd always treated me nicely, and he's really a funny guy once you get to know him.

So he had all the enthusiasm that you ever asked for, and he was willing to do anything. So we split it up and said, "Look. I've got this theory that it is all this time we spend trying to stay on the time line that gets us behind the time line." So in lunar orbit, the orbit period is about two hours, and you're out of communication with the Earth for about thirty minutes of that, maybe forty, I don't remember. It isn't exact, but you're in communication more than you're out of communication.

So I said, "I tell you what, you run the flight plan whenever we're in communications. You tell me you want me to go turn a switch on, change attitude, whatever it is, you just take the flight plan and you're responsible for it. That's yours. I'm your extension. You just tell me what to do, because I'm going to look out the window."

Then I gave Hank a meaningful role. I said, "When we get ready to go out of communications, then I'll pick up the flight plan and I'll do my thing on the back side."

So we started working that, and that really, really worked like a gem. It paid off, because I was able to—Farouk had one of these questions that he showed me pictures that showed places where there are little mountains, and at the base of mountains, you find that the rocks on the side of the hill tend to slide down, and they fall into a pile they call talus at the bottom of the hill. As a matter of fact, you can look at the amount of this stuff that makes this little faring at the bottom of the pile, and you can pretty much estimate the slope of the hill.

But Farouk showed me some pictures that had been taken by the lunar orbiter that showed that little hills in some of these mare areas that had talused and went halfway up the side of the hill and is all the same height, and it just didn't make sense. There are all kinds of convoluted explanations. Said, "That's the kind of problem that it would be interesting if somebody could explain that."

So on one of the passes over the front, I came across the area where this phenomenon was observed, and looked out there. It was not even a question. One look out the window, and you said, "It's a bathtub ring." Because you could, in one view, instead of looking at this little piece but looking at a bigger piece you could see that this what we call debris was solidified lava that at one point had been at this level, and it receded either because it gave off gasses and collapsed or it was pushed up and then drained back down some. You see that in volcanoes often.

But you could see it, and it was as clear as you could imagine. Just one look out there says, "Got it." So there was a whole lot of stuff that I was able to do that may not have meant anything to Farouk, but at least it gave me a sense of this isn't all just for practice. So that gave us a lot better head start on this thing.

The split between the lunar module and the command module activities widened as the surface stay was extended. They took on more and more activities so that John and Charlie lived in their own world. We just kind of got together periodically for meals and so forth. But that gave me, from a personal point of view, a sense of being a bit more involved and necessary. At least without me, you're not going anywhere. So I went and did all of that.

There's a couple of other little things that came along the way as we got ready that—one story I like to tell people is that staying out at the Cape got to be a real drag when you're in the quarantine period and you're on the Cape. They don't even have a candy machine. You can watch just so much TV and videotapes.

So I would make a habit of going out every night after dinner. I'd drive out to the pad. We'd spent years learning about the spacecraft and didn't know anything about the rocket. Wasn't necessary. You're not doing anything except sit there, but it was kind of a cool thing that I just wanted to see.

So I started each night, and I'd go up a little further and look around. I tell this story, and people, I think, think I make it up, but it really happened that at one stage we got to the instrument unit [IU], which is the event that it's a section on the top of the rocket that houses the guidance and

electronics for the Saturn V, and it's nondescript. From the outside, there's nothing here. From the inside, there's not much in it. There's boxes around.

I got up there one night, and there was a light showing. You could see the light shining out, so you knew somebody was inside. I went in to see this—kind of startled this technician and introduced myself and told him I was curious what he was doing. So he was thrilled to show me around, you know, "Here's this thing and this thing," and pointed out what the boxes were and what he was going to do that night.

He made the statement to me after some discussion about he was in awe of this mission and he did say things like, "I really don't know how you're going to get back. It seems like a long ways off." But he made the statement that says, "You know, I don't understand that, but you can bet it won't fail because of me."

I've used that illustration with people. I call it the spirit of Apollo. But it really was. It was thousands of people who said, "This is over my pay grade. I don't understand all this. But this is such a cool thing. My piece will go work, and hope the rest of you do as good." That really was the characteristic of the entire program. That was a real event that happened, and I didn't forget it then and haven't since.

So as we move up to flight, is there anything else that was unusual? I mentioned Hank and his role.

WRIGHT: Didn't the doctors talk to you once again about your health?

MATTINGLY: [Laughs] Yes. This time it was bilirubin. Who's he and what's that? I couldn't believe it. I would have thought they would be terrified of even suggesting another medical protocol, but doctors go where others fear to tread. Sure enough, we went back to drawing blood. This was about as antagonistic a relationship as you could create.

They never could figure out what it meant. They finally admitted to me they didn't know what it meant. They just knew it was an abnormal number. And that really didn't sit well. So people talk about how you've got to get yourself in the right mental frame and you want launch rested and all that. Well, these clowns had me going through this medical—I call it medical harassment. They're just doing their job. Then they had an experiment, and I don't remember the name of it, but the idea was that they'd put electrodes on your head and they would measure your normal—the idea was these little things would get stuck here, and they'd put a little cap on to keep them in place, and they'd measure your wave patterns while you're sleeping and waking up. It was partly to get a baseline so that they wanted to be able to prescribe sedatives. They wanted to see the change in these behaviors. So I was supposed to sleep with this thing.

Well, you put marbles and tape them to the back of your head and lay down and try to sleep, you know, this is not in the spirit of a good night's rest. So we had a number of differences of opinion about how to get ready for flight.

I don't remember—Ross? Who was it? Somebody was sent down to give me a sedative and then come in and see if he could wake me up. So I throw them by making a ceremony out of taking the sedative with a cup of coffee and walked in and went to sleep, immediately went to sleep. [Laughs] So then they were convinced that the sedative was *way* too strong. Then they made some noise, and I got up. So we all agreed that "I won't take medication, you don't test it. We'll go on our merry ways." So we did have a little fun getting off the ground.

WRIGHT: But you did, and you were able to launch.

MATTINGLY: Yeah, that was—boy, I tell you that—actually, if you were going to devise a program for personal enjoyment, the only thing you'd change in the way things worked out for me is I would have had another flight to go land on the Moon. Nothing can take the place of being there. But you wouldn't want to skip the lunar part to go to the surface. You need both, because the lunar piece,

especially solo, was probably more sense of exhilaration. I can't explain it. But it was really, really something.

Having come at the end of the line and having heard people talk about things they saw and going way back to some Gemini briefings, I had filled the flight plan with annotations of "Look here. Look at this." I'd heard people back at Gemini talking about seeing the fires in Africa from nomads, so I'd write that down. "Look at this and look at thunderstorms here and do this." So I had really captured all this, because I figured this was going to be my only flight, and I really didn't want to miss anything.

I worried—like I heard so much about people getting sick in space, and, oh, I thought wouldn't that be terrible. After all this, what if I get sick and what if I get—and over and over it. As soon as, you know, once that thing started to go—in fact, the magic started when we climbed up the side of the Saturn. When I'd gone out there and visited it before, it's an industrial area. There's cables everywhere. People wear hardhats because somebody's always dropping things, and it's noisy. There's machinery. It's just an industrial site. The launch day you're in your little suit, which cuts out a lot of noise. The only thing you hear is this little ventilator that's trying to blow air through so you don't get so hot. There's no communications. If somebody wants to talk to you, they get up close to your helmet. You're buttoned up because you're living in an oxygen environment, so you're trying not to get the bends when they reduce pressure.

So when they load the command module, the lunar module pilot and the commander get in first because they've got to go to the outside and the CMP sits in the middle. We went through that routine, and I had a chance to just stand on the outside and wait while they strapped John and Charlie in. And even that was magical, because you could see this thing, and it was like you see vapors coming out with no sounds. There's no apparent noise that you can pick up. You see ice forming on the sides of the tanks. Every now and then—it was in the morning when the sun would shine on it, the sun would heat up a section, and the structure would bend a little bit, and it would pop off a chunk of this white ice. It would go float down, kind of like in slow motion, and shatter at

the bottom of launch pad with no sound. So there's this really surreal environment that starts to take over as you see this live thing. It was amazing.

There was a sensation of "I've been here all my life" that started with climbing. It's like climbing into an airplane. No matter what's going on around you, once you strap in, the world goes to normal. That's the way climbing in the spacecraft was. It just went normal. At that point it was just one thing after another. I was really in a playful mood and looked—the CMP has the only window that's useful on launch, because this launch cover comes down from the escape tower comes down over the command module, and there's a hole where the hatch is, and there's a window, and the hatch is right behind your head, and there's a pole there. While you're strapped in, you can't see out of it, but it's there, and it kind of points—you can get your head over, you can see straight forward.

I looked out there, and the one thing I had not put in the flight plan, never thought to ask, where will the Moon be on launch. And the Moon was right straight overhead. That has nothing—I mean, that's a coincidence of orbital mechanics that we just happened to be there. But I remember telling Skip [Chauvin], called him and said, "You know, you must have it right because you're pointing right at the target." He didn't understand what I was talking about. If you aimed right straight at it, you would obviously never hit it, so it was just an artifact. But it was kind of one of those, "Wow! This is really a neat simulation" kind of days.

The ride was—I'd listened to the Saturn V take off, and from a distance, you know, there is nothing—some of today's speaker systems can begin to sound like it, but they don't feel like it. There's nothing like 7 million pounds of rocket energy that's going to shake the ground like 7 million pounds of rocket. It moves off, compared to the Shuttle, it moves very slowly, so it stays down close to the ground a lot longer.

The amazing thing was, it feels exactly like it sounds. You feel the same staccato shake and rattle and bang and it's just like it sounds, is the best way of describing it. As it accelerates, again thanks to having had all these people come ahead of us and talk about things, I'd heard, I think it

was Borman's crew, that the first time they rode the Saturn V they pointed out that at staging between the first and second stages that there was a period of negative G in the cockpit. This large tin can is pushing you up as it accelerates, and just before the first stage burns out, you're about five and a half Gs, and that's pushing, you know, millions of pounds of stuff.

So this can that represents the tank of the first stage is being compressed a bit. Once you're off the ground, then all reactions of this vehicle take place around the CG [center of gravity], which is up here. The cockpit's up above, and here's the bottom. You burn all this stuff out. So when the engines stop down here and this metal is uncompressed and snaps back, that expansion takes place around the CG, so the cockpit at the front, instead of where you've been pushed down all this time with the CG down here when this metal expands, it goes the other direction, and it throws you forward instead of pushing you back when the engine shuts off. I thought that was a cool thing, so we looked for that. Sure enough, there it was. I said, "Oh, man, this is really neat."

Got to orbit, and I was worried that I'm supposed to get an alignment from the optics as soon as we get out of orbit, because that's the requirement to go for TLI [translunar injection]. Oh, man, what if I get out of my couch and get sick? What if the optics are clouded? Or what if I can't recognize the stars? Oh.

Pull the lap belt off, and you float out, and you say, "I've been here forever. This is perfectly natural." All the things that I worried about in zero G, if I was going to throw something would I miss the target because I—no. It takes no time, and it's perfectly normal and natural, and you do just exact. It's exhilarating as, even in that confined space, you go and float around.

So then I got my star sighting. It didn't take any time. I pulled out my little list and started looking for things. It's about time to look for the fires. It's time to look or this and that. I was off on this magic campaign to see everything that anyone had ever mentioned.

We had procedures, these contingency procedures I mentioned after 13. They weren't all finished, and we kept thinking of new ones. Since work expands to fill the time allotted, and as we trained, I started getting more and more exotic with my own contingency procedures for everything

I could imagine. One of them was that when you're on the S-IV, which is the upper stage, there's an attitude control system. One of these contingency procedures we had was for the command module pilot to be able to fly through the command module and send signals to the computer in the launch vehicle so that it would hold attitudes. Okay, so you can do that. But why? Well, if one of these control modules fails, you know, you might need to do that to save the mission. John was not big on making problems for things when there weren't any. He took zero interest in this sort of stuff. I worked out a whole bunch of things that were kind of peculiar to my way of filling time on these things.

So sure enough, on orbit the APS module failed. We floated around, and it was a nonevent. Well, this, this, that. We went on our way. Looking out the window, as soon as we got out of orbit, the commander and the CMP would change seats. So now I had two windows. I thought this was really—man, I just couldn't get enough of that. In fact, I was worried that I would not concentrate on what I was supposed to do.

As the S-IVB started again and sent us out TLI, I had been impressed with the colors of sunrise, sunset. I remember going around the Earth saying, "I really would like to come back and do this some more," because you just can't see it all in one lap, and we only got to spend about one and a half revs. I know I'm missing stuff here, but I'll go on.

After TLI, we coasted for a while. As we went out, we were supposed to separate and go back and get the lunar module. One of the CMP's little tricks to measure your professionalism: John gets to land the LM; well, what do I do? I'm going to find the cheapest way, least expensive fuel requirement to get off of here, turn around and get the lunar module and start up this thing we call PTC [passive thermal control], which was a way of keeping the spacecraft thermally conditioned. These were the little games that CMPs played amongst themselves, who is the pro.

So I was bound and determined I was going to set a record for minimal amount of fuel and all of these other things. But I also had little notes in the book, and as we went out, got to a place where it said, "Okay, look out the window now." You can tell that you're further away from the

Earth than you were in low Earth orbit, but a couple hours later there's another entry that says, "Take a look now." I had calculated when the Earth's size should be small enough to fit in the window. Initially you're going fast enough that these things happen quickly, so after a couple of hours I looked out, and it was in the window. "Look at this!" Then they would push me out of the way so they could see. [Laughs] It's really beautiful.

I looked at that, and I had this terrible sensation that I was seeing so many things that were out of this world, unbelievable. I'm afraid to look again, because I feel like I have an erasable memory and if I see one more thing, it's going to write over something I just saw and I'll forget it. I know that's preposterous, but I had this very palpable fear that if I saw too much, I couldn't remember. It was just so impressive. And these things kept coming for the next ten days. They never stopped.

So we got on our way, got our little spacecraft. John was concerned because the lunar module, when we got it, showed the paint on the surface was all peeling off, and he was all apprehensive about what that meant. So we debated that for a while. We had done some other things that would kill time that we could do on the way out. But generally on the way to the Moon it was mostly getting ready and getting used to it, but getting used to [unclear] was like seconds.

One picture I had put in my flight plan, as we got close to the Moon—probably Farouk suggested it, I don't remember for sure—but, see, the Moon in Earthshine ought to be as spectacular as Earth in Moonshine. That's not true. Much more spectacular. So on the way out, you're sitting in this little attitude floating around, and you open the window and look out, and sometimes the sun's in your face and sometimes there's a gazillion stars. There's so many stars, you really lose sight of what the patterns are that you're familiar with. Every now and then the Earth goes by, but you get over the novelty that it's not so big any more. The Moon, because of the phasing, generally isn't illuminated very much. You don't see it very often. You don't get any relative sizes between Earth over here and Moon over here. You can't really tell. So we kind of watch that stuff going around.

First night, I think it was, John and Charlie were trying to sack out, and the idea of shutting my eyes was just not one of those things to think about. I was looking out at the telescope. "I wonder if I can see if I can find the planets or something here." So when this alarm came on, the end result was that the inertial platform—we'd lost our reference and didn't know why. But since I was right there at the panel when the alarm came on, I just punched it off and it didn't even wake John up.

So I looked around and, you know, the platform has lost its reference. So, well, do an alignment like we've always done and got it back, talked to the ground and said, "I did this."

They said, "Yeah, okay, it's back up.

I said, "I don't know what happened."

They said, "We don't either. We'll look at the data."

So I said, "Okay, well, I guess I'll go to sleep." So I tore a page out of the flight plan and put a note up. John's really going to be—probably going to be irritated. There's nothing he can do, so I made a little note and taped it. He was laying in the left couch. I taped this little note over. I said, "John, the platform tumbled, but it's up and running now, and it's okay. Just don't touch anything." [Laughs] I don't think John liked that too much.

But as we got close to the Moon, we had made this note that Earthshine should illuminate part of the—when you look up at the Moon face what's over on your left side, and there's a huge crater that's partially visible if you know where to look, called Orientale. It's not one of ones you can you normally see. It's one of multi-ring craters, and you see just little edges of it. It looks more like mountain range from the Earth, but when you see pictures, it's a big, big basin.

Well, I thought, I wonder if we could see that in Earthshine. So we put in a little note in the book. We had some low-light-level photography scheduled, and I knew where that film was. If there was anything to see, I'd sure like to take a picture. So I told John, I said, "We're coming up on it. I'm going to open up to take the shades off the window so we could see, and I'm going to adjust the attitude just a little bit to take a look."

John was typically not enthusiastic about doing things that weren't required. Looked out there, and it was the most fantastic sight. If you fly over mountainous terrain on a moonlit night, you see the relief and it's—well, what we failed to think about until you see it is the Earth's albedo is so much greater than the Moon's and the Earth is so much larger, that even though the Moon is a dark surface, not with the snow, but the reflection off the clouds and the Earth is so bright that it's much brighter to see the Moon in Earthshine than it is the Earth in Moonshine.

Here was this giant crater with all these rings around it, and it was a crescent because you can't see anything illuminated by the Earth that you can't see from Earth, so you only see part of it. But it was the first time we'd seen the Moon in a day or so, and now it went from down here to up there. It was "Look at this!" And here we're all pawing to get to the window. "Give me that camera!" We said, "Earth, Houston, you've got to give me a setting for this. Don't let me miss this. Give me settings for this film and here's what it is."

They said, "Well, we'll calculate that," and I'm taking pictures and I'm trying. They gave me some numbers, and I plugged them in for settings, and we took it, and then we went back to work. All the time we flew the mission, we couldn't get over this sight and said, "You know, when we get back, we have just made the cover of every magazine in the world. This is the most spectacular picture."

When we got back, the picture was black. The settings that they had calculated were nowhere near long enough. The ones I guessed at were even worse. You could just tell the film had been exposed. So someone's got to go back and take that picture, because you just cannot believe the emotional impact that has.

Went around and got into lunar orbit. I was fascinated with the Earth, and you see the sunrise and sunset every ninety minutes, and that's pretty cool because it has such vivid colors, and it's just magic. You never tire of looking at it. Figured sunrise and the Moon would be kind of bland in a monochrome picture. It's just black and white. That's wrong. I wanted to see my first

sunrise, because I didn't want to miss seeing Earthrise. So looking out there watching, and there's nothing below you, you kind of know where the Moon is.

It's really, really eerie, because it's so black. When you're out of the sight of the Earth and the sun, it's really black. The only thing you can tell is the Moon must be there because there aren't any stars over there and there's stars over here, so somewhere between those two is where the limb of the Moon is.

So I kind of figured out where the star patterns seemed to stop and said that's got to be the limb, so it's presumably somewhere around there where the sunrise will come. When it hit, I expected it to be just—the sun really is small when you look at it directly and it's just bright. It's actually the same—optically when you look at the sun, it is about the same physical apparent size as looking at the Moon from here. If you asked somebody, well, when you look up in the sky and see the Moon, how big is it? Most of us would say, probably about like that. Well, that eraser will cover it, if you take it out and hold it up, but it doesn't look that way. The sun's the same size. So we know intellectually the sun is this giant ball, but when you look at it at this distance, the Moon and Earth are the same distance, so it's this little dot. Just happens to be a very bright dot.

When this sucker comes up, it all of a sudden, totally unexpected to me, there was this flash, brilliant white flash that outlined the arc of the Moon. It was just there for an instant with this little star in the center of it, kind of a little sparkly thing, and this flash that outlines. Then here comes the Moon the way we see it.

Turned out that the reason that flash phenomenon is there is that the sunlight hits the sides of hills and then bounces back and forth across them so that there is this little arc that shows up. Something nobody had ever bothered to mention. It was just you say, "Wow! Is this going to be a cool place."

Back side of the Moon, it looks like a kid's sandbox. It's really pummeled. Whereas the front side of the Moon has features that look sharp and they look like mountains, they look like craters, there's something to look at everywhere, the back side, you've got to know where you are to

know where you are, because with the exception of the crater Tsiolkovsky, there is nothing on the back side that just jumps out at you, which in itself is very interesting.

So I spent a lot of time trying to look at it to see what could you see that was different or alike. It give a fascinating problem in trying to see—I know it looks different on the back than it does on the front. Can I figure out—what can I tell Farouk quantitatively that would explain that? Well, I don't think I did too well on that little chore, but we did pretty well on the bathtub ring, so I didn't feel so bad about that one.

We also were flying this mission so that in order to get more performance from the lunar module, we took and inserted the spacecraft in an orbit so that instead of the lunar module having to descend from sixty miles down to the surface as they did on 11 and 12, and 13 would have done the same thing, we were coming down so that we put the whole stack in an orbit that came down to within eight miles of the surface over the landing site, and then sixty miles in.

So we got into this orbit using the command module fuel. The lunar module would separate there, and then the command module would circularize before they would descend, but they didn't have to take as much energy out of their orbit because of this maneuver. We tried to get a precision of our landing, so we also had worked out a technique where the spacecraft stack could set itself up. We were going to land right after sunrise on the surface of the Moon so the features in the landing area would be shadowed and easily recognized.

We set the spacecraft up with our optics, and while John and Charlie are activating their stuff in the lunar module, I'm setting the spacecraft up, and I look out with the optics until I can see the landing site and a feature. Then as I come across it, we'll start to track this, and the guys in Houston will read these tracking angles, and they'll use that to refine our position. They know where the command module is, and with these measurements, they can connect where the command module is to where the landing site is, and we can improve the navigation knowledge of the landing site so that when we put that stuff in the lunar module's computer, it has a real good chance of landing there. So this is a way of refining our precision.

To do this, it turns out that at eight miles this thing goes by faster than the optics can slew. So you have to set the spacecraft up so that you start with it looking out here—I'm sorry, I got that backward. You start with it looking down this way, and then you start rotating the spacecraft on an autopilot at a given point. So you track this thing down, then this thing, and then the combination of the spacecraft rotation and the optics will work. As you come over here, you start to catch it again, so you can get a long tracking arc.

So all that's done while John and Charlie are next door. How do you do this? So I got one of your tape recorders. First I was going to synchronize it with a clock and I'd read the events with a tape recorder, after I'd practiced with that so that I could keep my mind on the optics and moving stuff and I could work switches and things without looking and the tape would call cadence and take me through it.

Well, after we practiced that a little bit, we can do better than this. So went down to the Mousetrap and recorded tinkling glasses and noises, and then got one of the secretaries to read the script for me. So we had this little orbiting bar to go with this picture. We tried that at sim and it wasn't—we received comments from Houston that that was probably not a good idea.

So I went back, and then I did something even better. I already started recording music, because music is one of those things that, to me, music and aviation go together. There's nothing like flying and listening to music that you like.

So there was a movie that had come out the year before, it was called *Grand Prix*, had a soundtrack in it. I recall "Laura's Theme" was the name of the theme song. It was a very popular song, but the thing that was really cool about it was as the theme song to the movie, in fact, the movie opened with a picture of the driver walking around the track, and you hear the sounds of race cars coming from behind and roaring by as he walks around the track. That's the opening scene for this movie, and this soundtrack is playing all this. So it's got the sound of the engines. I'd grown up around engines, and I loved the sounds of race cars and boats and airplanes. That is music to me.

So here is this soundtrack that I just about wore it out playing it. So here we had this thing, I took this clip, and I recorded the steps for this tracking exercise on top of this clip of *Grand Prix* and synchronized it, set it all up, said goodbye to John and Charlie, closed the hatch, went back to my little cocoon, turned on my recorder, it starts playing this. Then it comes up, and it starts calling the cadence.

Talk about something mystical. You're looking out there and for the first time instead of crummy sketches or films of things, this is real Moon that's going by here now. It just looks different. You can see there's the landing site. There's the little landmark I'm supposed to track. Boy, you're right, this stuff is really going fast. Here come these race cars, roar, right by you.

You know, it would bring tears to your eyes. I mean, there's nothing that can describe that sensation of this out-of-the-world view with these sounds, and the sounds match the fact that you're working hard to keep the tracking going, because as you go over the zenith, it maximizes the rates, and so it's all consistent with—and, wow. It is really cool.

So then from that we went up. John and Charlie separated. My job was to go circularize the command module. As soon as I did that, then they were going to get their clearance for landing.

I guess I've got to go back to prelaunch. Not only were the doctors harassing me, but I was always getting kind of worried and bored. By then we had collected so many rules about how the mission is run. I mean, the rule book is as big as—and I thought, well, you know, most of these are here or there, but I ought to take all the rules that I'm supposed to invoke on the back side of the Moon and write them down. I know them, but I'll write them down anyhow.

So I wrote them down throughout the flight plan in the places—just for the ones on the back side when there's no one to cross-check me. One of those just so happened to be rules of—in order for me to do the circularization burn, you had to satisfy criteria A, B, C, and D. Most of that stuff you get done way out. The only thing left on it was you have to have two completely functional SPS [service propulsion system] motor gimbal systems. It's a little automatic sequence. You have to check it out. You have to have electrical power to make them run and run from different battery

buses. You have to have different signals that go down in different command paths. There's a primary and a secondary that keeps these things going.

So you start the little computer program, and it just automatically swings the gimbal up, swings it downs, left, right, puts it back in the center, switches over to the other system, and does the same thing, and you just watch it. It's a little thing that you do, kind of a ritual, happens about twenty seconds before the burn, I think, you get this program. You don't do it earlier because it takes electrical power, and you don't want to start burning that electrical power of keeping these motors running. Everything we did was to be stingy.

So John and Charlie said, "Well, we're all set. Are you in position?"

"Yep, I'm here." CMP's practiced this stuff so much, it's absolutely just a part of—this is like knowing your name. We go through this thing. Gimbal swings. Now it goes to the secondary. The spacecraft swings.

We had already done this a couple of times on our way out, so it's not like the first time we'd done this test, only this time the spacecraft was doing this. I stopped. "Oh, God. I've done this a thousand times. How could I screw it up now? I've got to do this again." Did the same thing. I said, "I think you're not supposed to do this."

At this point, it never occurs to me there's anything wrong with the spacecraft. It's "I have done something. Somewhere I've forgotten something." There's a circuit breaker out there, or something, because it worked when we came into lunar orbit, it was good.

John says, "You all set?"

I said, "No, John, not yet." I looked and found the rule, and it says you've got to have two of these. I thought, "Thank God I wrote it down." Because if I hadn't, I can't imagine the pressure from memory. More than likely I would have gone ahead, but you're going to leave them stranded if this thing's broken?

So I told John. John and Charlie were not happy. Now, the next step of this thing is, he says, "You're not going to burn—." He wanted me to burn too.

I said, "The rule says no."

"Grrrrr," as only John can say.

So, all right. Well, one of the things I'd been practicing was we trained on how to do rendezvous so the command module could rescue the LM from any conceivable situation. One of the things in rendezvous that's really hard is when you're in close, orbital mechanics overrides everything. If you try to brute force, you can, but you use a lot of gas. Somewhere in one of the simulations, it set up a case where I needed to re-rendezvous with the lunar module right after I separated, and so it was a matter of finding a way to get there and recognizing that I could use up so much gas that we'd abort the mission anyhow.

So I developed these close-in rendezvous techniques, and I'd written them all down. I sent memos to make sure that I wasn't keeping secrets. I had written these things and passed them out to people. This was the little mini football rendezvous technique and sent that out. Of course, John didn't read these things, because that's not part of the mission.

WRIGHT: Stop right there.

MATTINGLY: So now we're out there, and I thought well, fortunately I've written down the rules, so I'm sure I did that right. I have this little procedure here for how I can rendezvous with John without wasting gas. It requires you to be very deliberate. After a while John says, "What are you doing? Come on up here."

I said, "Well, no. I've started this thing. I'll be there, but it's going to take a while."

John sort of says, "Get over here."

"Okay, but I don't want to waste gas. All right, here I come."

But by now I'm starting to use fuel for things that—a lot of it. What's more, I'm no longer confident of what orbit I'm going, because I'm making maneuvers that I'm not measuring. It's all outside of the coverage by the ground. So when we come around the corner and I call [CapCom]

Hank [Hartsfield] and tell him that we didn't burn, but we're maneuvering, and I would like to have somebody give us an orbital check, eight miles is really quite a ways off the surface, but it looks close. I really didn't want to get that much closer without landing gear, and I didn't want to say, "I'm worried about where we are." I just—you look and see.

John's worried that he's not going to land. I can imagine the gloom and doom in the LM must have been terrible, because to come all this way and wave off for something that maybe was a human error anyhow. So at the end of that first round, they told me to just fly formation on the lunar module.

So we're getting ready to go into the dark, and the command module has a thing they call—on the charts it's called a floodlight. I think of a floodlight as something that floods a room with light. Well, this little thing goes out on a little pole. It's got a light on it. I've got a light on my keychain that has more illuminating power than this appears to have.

So after I got up next to the lunar module, you know, I realize that I can't let go of these guys. If I take my eyes off of them, they'll disappear and I'll never know where we are. The lunar module had little lights and command module had little lights, because that's aviation's tradition, but they were absolutely worthless.

So I started watching it, and then I got pretty comfortable. The nice thing about floating around in zero G is the forces, once you're in zero G, the tiniest little force is effective and you can see it. All your physics knowledge works exactly the way you think. It's not masked by a lot of other things.

So I got out there, and I had them—they were just a couple of feet off the probe with their door, and I looking at the window. Sitting there I said, okay. I could see their face, John and Charlie looking out the window. So, okay, this is working pretty good. Trying to be Mr. Super Smooth Pilot, I would get it all set so I could take my hands off the controls, not fire any thrusters, and we'd just drift there.

Well, since we'd gotten out of alignment in our time line, it got to the place where the next thing I was supposed to do was I was supposed to dump water from our storage tank on the command module. The significance of that is fuel cells make water, we store it in a potable water tank. Some water we use for cooling. Some water we use for drinking. And if you don't use it faster than you produce it, you need to dump it, because otherwise it'll back up the storage tank, and when it backs up, the fuel cells will flood, and bad things happen. So don't miss dumping water.

So the handle to dump water in the command module, it's down below the couch, up in the equipment bay. It's as far away from the windows as you can get, but it's easy to get to, and it takes a little wrench, and you just turn a knob. The gauge to tell you how much water is in there is up on the instrument panel, not next to the—so I tell John, "I'm going to go do the water dump now. We're all stable here. Nothing going on."

He said, "Okay."

So I float down to the equipment bay, and I open this little thing, and I float back up. Couldn't have taken fifteen seconds. I don't know. I mean, couldn't have taken very—I come up, and there's no lunar module out the window.

WRIGHT: Oh, no.

MATTINGLY: I said, "John, you still there?"

"Yeah."

"Can you see me?"

"Yes, you're drifting off to the right."

Okay. So I finally move over a little bit and look and find him, get back in position. I think, how could that happen? I was so careful. So I got in position and I got it all settled down. I let go, and as soon as I did, this thing started moving. The lunar module just slipped right out of the

window. I went back and got it, let go again, and as soon as I stopped thrusting, this thing would go away.

The only thing I have done is I started the water dump. The water dump goes out a little hole in the side of the spacecraft. Turns out the diameter of that hole is thirty thousandths. The pressure in the tank is only 35 psi. This vehicle weighs at this point about 25,000 pounds-plus—yes, about 25,000 to 30,000 pounds. So it's clear that's—but life tells you that if things change after you've done nothing that you don't like, undo it and see if that fixes it.

So I went back over, and it parked and no drift. The beauty of physics, F=MA. This water with thirty-five pounds of pressure going out of a thirty thousandths hole, which is about the size of that lead, moved the spacecraft away.

WRIGHT: Wow.

MATTINGLY: You say, isn't this fascinating? There are things that you could see and do in this environment that we read about, but you don't ever observe in practice. So we got that.

As a matter of fact, before I forget that observing, when we went up to get the lunar module out right after TLI was approaching very slowly, because doing things slow is the way you save gas, approaching very slowly. Before we docked with the lunar module, I heard this "blink, blink."

John looked at me and he says, "What's that?"

"That's our RCS."

"Oh."

Then we looked at each other and said, "How could we hear it? We're not docked." Well, we'll go back to that. Docked. After we docked, it got a little louder. When we were operating the CSM by itself, you didn't hear the RCS fire. This was clearly the firing of the RCS exhaust hitting the light aluminum foil covering of the lunar module. But how did we hear it?

When we talked to some of the physicists back at home afterwards, they said, well, you know, there could be just enough local atmosphere created when this thing fires its little thruster that some of that stuff hits the lunar module and bounces back, and you're able to hear it because it's essentially all quiet. So we kind of got used to these little weak things that have these really fascinating events.

So after we got back into this rendezvous situation, we got there and came around, and the ground called and said that, by golly, the guys at Rockwell had reproduced the problem, knew that we had an open feedback in the secondary gimbal, and that it was okay, because even if that happened and we had to use the gimbal, once the thrusting was going on, that would add enough friction to the system to stabilize it, so go ahead and do your thing, and we'll go land [unclear].

I remember thinking at the time that while I was out working on command modules we'd had a problem with the cable that took the electrical signals to and from the gimbals. The gimbal package for each, for pitch and for yaw, each of those packages had a wire bundle that's probably the size of this antenna and a connector that went into it. So there's one connector that carried signals to the gimbal, power to it, signals back, and carried it for both the primary and the backup system in one cable. We had had some trouble where the cables that had been fabricated indicated were too short when the gimbal extended its full travel, and we thought we had replaced them all. But what it did was, it would pull the pins out within this little connector.

I said, oh, jeez. That sounds like—but if it happens, it affects both gimbals and—"Oh, what the heck. They said we could go land. That's what we came for. And I'm not going to tell John. I'm not going to say anything. I'm not going to ask any questions. We'll just do it." Of course, it all worked fine. We got our burn off, and they went down and landed, and everybody lived happily ever after.

Hank coached me through the front side, but I played my music. I had [Hector] Berlioz's "Symphonie Fantastique" and some other things that I really liked that just matched the mood of seeing this unbelievable scene of things floating by.

There was another sequence where you had to use the tape where we had some kind of a dim light experiment. There was a scientist, his name was Dunkleman [phonetic], and he took low-light-level photography. We called him "Dim Light" Dunkleman. Every mission carried some thing. Look at these stars or look at something else. It was one of these things you've got to get the cockpit completely dark. This film is so sensitive—it wasn't sensitive enough to see the Moon, but it's supposed to be sensitive enough for these things with long exposure times. So you have to turn all the lights out. It was okay when there was—well, actually even when there's more than one person there, it's supposedly so sensitive, you can't afford to have a flashlight or anything.

So I went back to the tape recorder and recorded these things that says on my mark, open this, close it now, whatever, advance the film. You do all that sitting in the dark. I had set that up. So I was doing one of these series as we went around and just Hank saying—when I came around the other side and we lost radio com [communication] and I'm pointing in the right direction. Like I said before, the world is black. Where there's no stars is where there must be Moon, and where there's stars—but they're both the same color black.

So I was just sitting there waiting. The tape recorder was counting along and saying, hey, you're coming up now, do this, when all of a sudden there was this white flash out just right over there. Hmm. There's no stars over there, that must be Moon. What is this? Never did figure out whether it was a meteor or, it'd be my guess, some very, very small particle that hit it. But it was a spectacular thing out in the in middle of nowhere, and I think people still are somewhat skeptical of whether or not I saw it.

So we finish our stuff. We do our rendezvous. The coordination with Hank and letting him run the show just really, really made things productive or us. On the way after John and Charlie came back, they [Mission Control] wanted us to leave lunar orbit early, rather than stay the full mission, because by then I think somebody told McDivitt how that cable was really wired up, and he didn't want to wait any longer. So we were a bit miffed about having to come back.

So on the way back, one of the things that happens after you do the transearth ejection, you know, you never tire of seeing sunsets around the Earth. You never tire of seeing Earth rise over the Moon. The picture, the only evidence of real speed that you ever see in this kind of space flight is when we were down at eight miles doing the tracking, you had a sensation of speed, right after we burn to leave the Moon and head for Earth. We turned around so that the window was pointing at the Moon. For the first thirty minutes, you could tell there was a relatively high velocity. It was like moving pictures. You could feel you're leaving the Moon. It was visibly receding. When you left the Earth, you never had that sensation. You had to look periodically and say, yes, it's a little smaller.

But the Moon, because the relative velocities are lower there and the fact that we were closer to it when we started, it just sort of said all of a sudden this thing, you could sense that you're leaving it. It's really a powerful sensation of motion.

Coming along, working our way back, we were supposed to go retrieve the film from the SIM [scientific instrument module] bay. We had an experiment, I can't remember what they call it, but it was people had talked about seeing star flashes in their eyes on lunar missions, and nobody really knew what they were about. Maybe it's cosmic rays and this. So they devised a box you put over your head that had a photo motion on four sides, and then had another set of plates that were driven while the experiment was going so that these two photo plates were moved. The idea was that if a cosmic particle or something comes through here, it will show up in the photo plate but just as a dot. But if we have two of these plates that are separated by some distance and they're moving, we can get the angle that it goes through by seeing where it is on this plate and this plate, those two, and knowing the time. So we can find out, did they hit this part of your brain or your eye? Is it an optical phenomenon? Is it a cortex problem? What is it?

So it was, "We need to give him something to do, so, here, you wear this thing." So I had this thing, and I put it on. Before I put it on, I mean, people were talking about—Charlie would say, "Look at that!"

"At what?"

"John, do you see that?"

"Well, no."

Charlie just seemed to be seeing these things with great regularity. I didn't see anything at all. I remembered that I had really bad night vision. I always have, and it gets me in trouble sometimes, and I can't see my way around in dim light very well. I said, "You know, maybe this is really a low-light-level phenomenon and I'm not going to see it, so let's let Charlie do this." So we gave it to him, and he did this stuff.

We came back, and when we did our debriefing on that, I never saw any data from the experiment that indicated that they had made any great discoveries, but I became convinced that my lack of sensitivity to low-light-level signals, I wasn't sure if it was due to the retina of my eye or the processing that goes on in the brain, but it had something to do with this low-light-level signal, I was convinced.

When I saw on the first official report, mission report, I was astounded to find that they said we had both seen these flashes and for unknown reasons I had had Charlie run the experiment. "What do you mean we both saw them?"

He said, "We know you did. You just won't tell us." [Laughs] He didn't stay long. [Laughs]

I was so convinced that it had to be, because it was a bright flash. It reported as a bright flash. Well, it's all relative if your eyes are closed in the dark. So I never saw the bright flash that I kept looking for, and we didn't do that.

But it came time to go. The one last thing of it before getting home was to go outside and get the film. Like other things, I had planned this thing with nauseating detail, and John didn't look at it at all. So I knew we were going to put our suits on and we were going to go dump trash, throw it outside. John got more and more nervous about, "You turn that and you're going to vent the cabin to a vacuum."

"Right. That's why you've got your suit on."

Then, "Do you know what you are doing?"

"Yes, I think so."

John was really, really nervous. It didn't match his philosophy of if you don't have to do it, don't, which no one can argue with that philosophy, especially when you're that far from home. So I really didn't know if John was going to let me do it or not, but he finally—okay. So we got the hatch out.

One of the things that they did was they gave me—the space suits were the same for command module pilots as for others except we didn't have so many fittings and we didn't have a need for this gold-plated visor because we're not supposed to be out in the sun. Well, I'm going to go outside now, and so they had me take—I don't know whether it was John or Charlie's visor, one of them, and put it on. So I had this gold-plated covering.

So the two experiments to do was to go outside, open the hatch, take a pole with a box on the top that had some microbes and stuff that they wanted to expose, mount that on the hatch, open the thing. John would watch his watch, tell me when it's time to close the box, pass it back in. The other thing was to go out and get the film out of the SIM bay.

Well, prior to opening the—well, somewhere, I don't know where in the mission, I lost my wedding ring. It came off, and I couldn't find it. Normally I found I could find things after a long period of time, they'd collect on the air filters, but it never showed up. I had given up and said, "Well, guess I lost it."

So we open the hatch, Charlie's handing me all the trash and I'm throwing that out. We put this thing up on top of the hatch, and I opened the little box and it was little harder than it had within in the water tank, and Charlie would kind of hold my legs and use me like a pole and send me there so I could open this thing. John told us the time was up, and I went to close it, and I couldn't get it closed because there was a little rubber seal in there that had expanded in the vacuum. There wasn't any way I was going to get it. So we finally, trying to protect these little bugs or whatever they

were, I gave them to John. I said, "John, see if you can sit on this or do something to close it." He wrapped tape around it or something and supposed to protect it.

So I started to go back to the service module when Charlie said, "Look at that." And there was my wedding ring floating out the door. I grabbed it, and we put it in the pocket. We had the chances of a gazillion to one. So I said, "That's pretty cool stuff, Charlie."

We went back. So we go back. We had done this thing in the water simulation a hundred times. Go work your way down the handrail. Go back to where the film is. You're just sitting there looking at this silvery side of the service module, and you're holding on so that the handrail is maybe eight to ten inches from your nose and you're kind of looking at the surface of the thing.

Everything you're doing is kind of—well, why don't I stop and look around. And with this big helmet on, look around means you've got to change your whole body and move. I looked at Charlie and said, "That's really a neat picture." He was standing up in the hatch looking out at me, and he was tethered to the inside. I've got the umbilical. I looked up here, and where I've told you about all the thousands and thousands of stars, looked out there and there wasn't a single star anywhere. There was this deep black picture with this silver thing that only went from there to here. If you turned and looked, you could find the Moon over there. I couldn't see the Earth anywhere. And that's all there was in this whole picture.

For some reason, the absence of stars was really startling. I don't know why, but it really hit. Where is the world? This is unreal. I know they're there. The only thing that's different is this visor is perhaps—so they say it really hurts your eyes if you—I'll take a look. Ah, the stars are back. Whew. Okay.

That's the only time that I had a sensation of being away. I don't know why, but around the Moon, inside the spacecraft, in and out, the radio, whatever it was gave a—even though you knew that these scenes and all pictures were totally different thinking you've ever experienced, I didn't ever have a sense ever being that far away until I looked out there when there were no stars and the

entire world was within fifteen feet. And there was nothing else. That was really a powerful sensation. Never seen anything like it.

WRIGHT: Did that time go fast while you were outside?

MATTINGLY: Yes. Much too fast. But there's really not much you can do in your fifteen-foot sandbox. [Laughs] And there's not a lot of things to look at. So other than, you know, it's really kind of cool to float around. John's getting nervous, so let's get this thing buttoned up and get home, and we did. It was about the right length of time. I don't regret that so much as I do missing the times of seeing things around the Earth.

But entry had no unusual things except I had was not prepared for a night entry. It was night when we penetrate the atmosphere. It was daylight where we were going to land. Looking out the window was one of those sensational sights where you've been floating around in zero G for ten days now, and you're all set up in your little spacecraft, hopefully with the blunt end of it aimed at where you're going.

There's a big Earth out there somewhere, and I don't know where it is because it's in the dark. We had a little technique which we always did that you'd put your sight on the Moon. If you're on the right trajectory, it will disappear. If you're in this attitude and looking at the Moon, the Moon will become eclipsed at this time. So it's an excellent check.

What no one ever told us was, if it doesn't disappear on time what are you going to do about it. [Laughs] But we dutifully went through this little ritual because we always do that. So we did that, and it worked. I said, well, that's really good because I was not that curious about what happened if it didn't work.

Then after floating around and you realize that you've gotten so used to things, just set them out there. They'll be there. You don't need anything. All of a sudden there was a preference that

things kind of disappeared that way. Then the spacecraft would just kind of rock a little bit. You're not feeling any Gs, but the spacecraft would rock, and you'd hear the jets try to fight it.

So then they would come back in further, and then you started finding that, yes, indeed, you were laying against the couch now. As the G forces built up, you're looking aft from the direction you're going. Looking out the window, you started to see little color, light blue wisp, like a gas stove. It's coming from around the side, and you see it as it goes off, because the gas is being ionized on a heat shield back here, and it's flowing around. As the Gs build up, this little wisp becomes a light until it gets so bright that I was tempted to put my hand up over the window so I could read the instruments. The instruments aren't really well lit, but I was really putting my hand up here over the window so that I could see. It was this bright white light, and as the G forces eased off as you penetrate the atmosphere, the light went to dim until it kind of all went away.

Then we got out in the daylight, and the parachutes came out. The most amazing thing was once the big chutes came out, looked out the window, right there was a helicopter. He was right there. You could wave at him and see him. It was just this never-ending series of unbelievable scenes and sensations.

Hit the water, rolled over. The procedure to get it right-side-up worked. One of my least favorite things was the emergency procedure for getting out upside-down. So, man, the swimmers were there, and they put the collar around the spacecraft. You're really feeling just a sensation of elation.

The swimmer had a beard, standing on his little raft outside the hatch. We opened the hatch, and I had gotten us there because I was "Mr. Hatch." I opened this hatch, and I didn't know what he was going to say, but something, and the next thing I know, this thing goes "Wham!" and it's right back in my face.

"Why did you do that?"

I opened it again, and the guy said, "Sorry." Okay. So we got out, put us in the chopper. We got back. They brought the spacecraft aboard and set it on the flight deck, went in and got cleaned up.

I thought, well, I'll go up on the flight deck and see what—I had this thing that, by golly, I'm going to walk around as much as I can before anybody sits me down and says I can't. So I go up on the flight deck and see the swimmer team was up there. I recognized—I said, "What happened out there with the hatch?"

He says, "You don't know?"

I said, "No. What's the matter?"

He says, "Let me open the hatch." And the odor was unbelievable. Thank God our olfactory nerves disappear early in life. Living in a bathroom for ten days is not a desired position. *Life* magazine doesn't tell you about those things. Boy, was that terrible.

WRIGHT: Truly a mission of a lifetime, wasn't it?

MATTINGLY: Oh yes. It really, really was. But all of that—I can neither explain why nor explain the sensation, but the exhilaration of flying that thing solo was as—I desperately wanted to go down and land, but, boy, you really need both. It's just really too much, and there's just so much there.

One of these days I thought, well, maybe I'll go get somebody to hypnotize me and see if they can extract better descriptions of things that I have seen that I can't remember. I don't know.

WRIGHT: And there are so few of you who have seen those images in that—

MATTINGLY: Well, and unfortunately, we get some beautiful pictures, but they are nothing, nothing. I don't know why. It may all be psychological. But no picture comes—I mean, I've seen some beautiful pictures, but they just are not the same. You really see this in the Shuttle when you

get up there and you have a bay window now instead of a peephole, and you've got all of the Earth's colors. We kept taking color pictures of the Moon, but I don't know why, because it's only got one color. It's shades of black.

WRIGHT: Especially when you were on the back side of the Moon, did you feel totally alone? Or did you enjoy that time when you were really alone because—

MATTINGLY: Yes. Both. I enjoyed it, and there was so much chatter and stuff going on, you know, you like to have time to just get away for a minute.

WRIGHT: It must have been very peaceful.

MATTINGLY: The combination of putting music with it is the—I mean, that's why I think some day in the future that this tourism stuff is going to be blockbuster. It's not here today or tomorrow, but it is going to come, because the first cat who comes back and says, "You know where I was last week?" And, boy, the lines will form.

WRIGHT: When you hear the music, does it bring back those images?

MATTINGLY: You know, I haven't heard the music in a long time. I mean, Berlioz, you hear that played a lot. I haven't played the *Grand Prix* in a long time. It would be an interesting thing to try. I've got most of that stuff packed away, but I might have to try that.

WRIGHT: I'd be interested to hear your results of that.

MATTINGLY: I don't know.

WRIGHT: Well, why don't we stop at the moment and see where we'll go from here.

[End of interview]