ORAL HISTORY TRANSCRIPT

ALFRED M. WORDEN
INTERVIEWED BY REBECCA WRIGHT
HOUSTON, TEXAS – 26 MAY 2000

WRIGHT: This oral history is being conducted at the Johnson Space Center in Houston, Texas, with Al Worden. Interviewer is Rebecca Wright, with the Johnson Space Center Oral History Project.

Thank you again for taking time to visit with us today. We'd like for you to begin by sharing with us how you first became interested in aviation.

WORDEN: As I was growing up, aviation was not really something that was foremost in my mind. I grew up on a small farm in Michigan, had six brothers and sisters. We really depended on the farm for a lot of things. From the age of twelve on, I basically ran the farm, did all the field work, milked the cows, did all that until I left for college. Well, in that period from the time I was twelve until I was eighteen and going to college, I made up my mind that this is not what I wanted to do the rest of my life. So I determined that I'd go to college, and I ended up with an appointment to West Point [Military Academy, New York].

West Point back in the fifties was a school that I think the primary thing they taught at West Point was leadership, military leadership. We got a lot of military classes. We also had enough academic classes that we ended up with a bachelor of military science, which was basically an engineering degree. But it was a leadership school, and I had determined that I was going to be an Army leader. I was going to be the guy that was going to go up the hill first and bring all the troops with me, and we're going to win San Juan Hill all over again.

My last year there, things began to change for me because I had a couple of tactical officers who were Air Force. One was probably not too well known by a lot of people, but his name was Arnold Tucker. Arnold Tucker was quarterback on the West Point football team back in the '47, '48, '49 period, when Doc Blanchard and Glen Davis were playing, and he was their quarterback. He was a very, very outstanding major in the Air Force at the time. He and another tactical officer kind of worked on me, and we talked more and more about the Air Force.

I eventually decided to go into the Air Force, not because I wanted to fly, but because I thought the promotions would be quicker there, which turned out to be a mistake. The Army had much quicker promotions. But I decided to give flying a chance. I'd never had any real interest in it up until then.

I was assigned to a small primary field down in Mission, Texas, lived in Edinburgh, and drove thirty-five miles every day out to the field to fly. It was an interesting time in my life. I'd never really done any flying, and all of a sudden here I am in this small airplane with an instructor in the back seat who's yelling so loud that even with the airplane at full power, those on the ground could hear him. He was kind of an interesting instructor. In fact, he went by the call sign "Bendix," and the reason he was called Bendix is because he washed out so many students. When I was there, he went through eight students, and I think I'm the only one who graduated from his table. So that gives you an idea how difficult this guy was.

But through all of that, I began to realize that flying was kind of my game. It was a thing that I was very attuned to. I got involved in all of the systems on an airplane. I really got wrapped up in how you fly an airplane and what you do. I found out that the very best part of the flying in that airplane, for me, was instrument-flying. We'd go flying, and I'd put this hood

over and fly only by instruments. I suppose I fell into the instrument-flying part of aviation as much because my instructor stopped yelling as for any other reason. He was very calm, cool, collected. If I made a mistake, he was very cool, he brought me back. I just took to instrument-flying like glue.

So I graduated from there, went to Laredo then for my basic training, learned to fly T-33s, and from there I went to Tyndall Air Force Base in Florida, which is in Panama City, and became an all-weather interceptor pilot. But in all that time, it was only after I started flying that I realized I had a knack for flying and that it was really the thing that I could do quite well. So it was not that I ever looked up at the sky and said, "Gee, I want to be a pilot. I want to fly. I want to do this, I want to do that." It was that I kind of drifted into it because of a couple of tactical officers I had at West Point, and then once I started flying, realizing that I had at least some gift for flying.

WRIGHT: And this gift led you into another part of your career. How did that all happen?

WORDEN: Well, it did. I was assigned to an air defense squadron in Washington, D.C., and it was one of those things where we're flying F-86Ds, an old, old airplane. We had a lot of maintenance activity going on and a lot of armament activity going on with these airplanes because we were flying live missiles and rockets. I got very interested in the maintenance side of things, because as a pilot, you really don't get to fly too much. You can sit around the coffee shop and drink only so much coffee, and you can only play so much ping-pong. There are only so many things you can do to kill the time till you go fly. So I got to hanging around the hangar, in the armament shop, and became very involved in what was going on there.

One day the squadron commander came up to me and he said, "You really seem to like that work over there. Would you take over the section and run it?" So I did. At that time we were transitioning into a new airplane called the F-102, and as we were going into the F-102s, all of the electronics in the airplane changed, all the armaments changed, everything changed, and we had what I would call a shade tree kind of operation in the armament shop. So the very first thing I decided to do was clean it up. It was always my opinion that people who didn't have a clean work environment were not going to do clean work. I insisted that everything be done absolutely correct, the way it should be done.

So my first project was to clean up the armament shop, and I got all the commercial suppliers, like Hughes Aircraft and Convair [Division of general Dynamics] and the people that were supplying the airplanes and the armament and all that, they kind of chipped in and we rebuilt the armament shop. We tiled the floor and polished it, and we built all new work counters, and we put in a false ceiling and air-conditioned it. We did all the things that you would expect to see in a modern repair shop today, but we're talking 1957 and 1958, a long time ago.

That program was so successful that the Air Defense Command came down and asked me if I would come to Air Defense Command Headquarters to head up a program there that would go throughout Air Defense Command and get individual fighter squadrons to all do the same thing that I had done in my own squadron. I thought about it and thought about it and thought about it, and I thought, "If I'm going to sit at a desk somewhere, I can better spend my time at a university than going back to headquarters. It would do me much more good."

So I applied for [a civilian college advanced degree] and was accepted. In fact, being in Washington, D.C.…was a good thing, because all I had to do is get in my car and drive for

twenty minutes and I was at the Pentagon. So I went to the Pentagon and talked to the Civilian Institute Program people. This was in December. In January, I got orders to go back to the University of Michigan. So I went to the University of Michigan for a couple of years in what they called the guided missiles course. That kind of led me into some test-pilot work, and I ended up going to the Empire Test Pilot School in England as a result of that. Actually, I did that because of two of the people that were in the academic program with me, one was the deputy director of the test pilot school at Edwards [Air Force Base, California], and the other was head of academics at the test pilot school at Edwards, and they both kind of pushed me into applying, which I did. I ended up going to the Empire Test Pilot School in England for a year.

Then I came back to the test pilot school at Edwards and taught there for, I guess, a year and a half before I got selected into the program. It wasn't that I ever made a conscious effort to do any of these things, but it was that I decided that if I'm going to do anything, it's going to be to enhance my own ability professionally in some way. I thought that going to test pilot school would do that. Test pilots are kind of the top of a heap, if you will. Never really considered coming into the space program because there weren't any selections being made right then. Only after I got to Edwards and I'd been there for a year and a half did they have a selection program, and that's what got me here.

WRIGHT: During the time that you were doing all this, of course, the Russians launched Sputnik and actually the beginnings of the so-called space race began. What were your thoughts during that time period? Do you remember having any feelings of wanting to be part of a program that might be able to catch up and surpass?

WORDEN: Of course. We talked about it, but it's one of those things, it's like I'd like to win the lottery. And there are maybe one out of 180 million people that win the lottery. Yeah, sure, it's one of those nice things to think about, but it's not something you say, "I'm going to do that," because you recognize at the same time that there are 20,000 others that are all trying to do the same thing. So it's one of those things in the back of your mind and you work toward it. I did. But never really expecting to get into the program.

I remember sitting in my fighter squadron back in 1961, before I went to college, and Al [Alan B.] Shepard [Jr.] was making his launch. As he was launching, we had one of our airplanes come back on an emergency, and he was going to have to crash-land on the runway. So there was a big discussion going on in the pilots' lounge about, "What are we going to do? Are we going to watch this guy flying in this little can up 250 miles for fifteen minutes, or are we going to go watch Major Henderson crash?" Well, we all elected to go watch Major Henderson crash, with the understanding that we could always come back and watch the reruns of Al Shepard's first flight.

But, yes, we were involved in it. In fact, in those days it was a lot of fun. Since we were so close to the Pentagon, we actually had somebody from the Pentagon call one of our squadron leaders, or one of our flight leaders in the squadron, to tell him that he'd been selected for consideration for the astronaut program, and we kept that fiction going for about two weeks. This guy was walking on air about three feet high, having absolutely no understanding of what it was he might be getting involved in. Finally we had to tell him, but it was great fun to keep the fiction going for a while. But through all of that, you think, "That's a great thing to do. I'd really like to be a part of that," but at the same time you realize that your chances of getting into that program are really few and far between.

WRIGHT: Tell us how it happened. How did you become part of that astronaut five group and one of those nineteen people?

WORDEN: I tell you, I was very fortunate. I had the college background. I had a couple of master's degrees from Michigan, could have had more if I'd stayed a little longer. I had the experience of being a student in the test pilot school in England, which then, and even now, I think, for many things is a better test pilot school than the American school.

The difference was that in England we had to do everything by hand. We didn't have all the fancy electronic recorders and all the this and all the that, that they have out at Edwards. So if we had to test an airplane, we had to take up—I took up a yardstick and a tape measurer and a level, and I would carry up what looked like a pair of pliers, but it was a hand-held force gauge. You could put this thing against the stick and you could actually read the pounds of pressure that you were putting on the stick as you were trying to do a stall or something. The point is, everything was done by hand. I thought that was very valuable training because you had to not only consider what you were doing, think about what flight test, what trial you were getting involved in, think about what you wanted to do with the airplane, but then you had to think about the effect of the hand-held force gauge, the measurement of the stick from the centerpoint. You had to understand what the airplane was doing. You couldn't just fly the airplane through a series of maneuvers and have it all recorded.

It's a little like so many of us are computer literate to the point of typing commands into a computer, but if our computer crashes, we're out of luck. We don't know what goes on behind that. We don't know what happens to the CPU and hard drive and all that. What we're used to

is typing things and seeing it on the screen. I always felt that was kind of the way we tested airplanes. That's not really true, it's a whole different thing, but in a sense, in this country we tell a guy, "Go fly an airplane, do this, do that, do the other thing, go into a turn, pull three and a half Gs, maintain altitude within fifty feet," blah, blah, blah, blah, blah, and we're going to record all this stuff. In England, you had to do all of that in very, very old airplanes…[and measure and record data by manual]. As you're pulling these three and a half Gs, you had to sit there and read off the force that you were putting on the stick all the way into that turn, which made a huge difference in how you approach the handling of an airplane.

Then I came back to Edwards. As a matter of fact, it was kind of interesting. I was committed to a three-year tour in England as a result of going to the Empire Test Pilot School. In fact, the guy that was there the year before me was Bill [William R.] Pogue, who was in the program, and I'm sure there are some others who were after me, too, that I'm not aware of. But I got assigned for three years to a basic research flight test facility in England.

In November a month before our graduation, the U.S. test pilot school came over for a visit. Chuck [Charles E.] Yeager was the commandant of the test pilot school. Of course, my two friends that I had been at Michigan with were there with him. Yeager got off the airplane, saw me, came over to me and said, "We'd like you to come back to teach at Edwards. We understanding you've done fairly well over here and everything is good, so we'd like you to come back to teach."

I said, "Well, I'd love to, but I'm committed to this three-year tour of duty over here, and I don't know what to do about that."

He said, "Well, let me take care of it." So he talked to the commandant from the Empire Test Pilot School and they couldn't make a decision. It ended up being the Secretary of State

who made the decision to bring me back, because the Americans were very, very afraid of canceling out on an agreement that they had, but they finally did. In fact, the British pushed them into it. They said, "This guy's got to go back. He needs to go back. He's just the right guy to do that."

So everything was arranged, and I came back in January, about six weeks after graduation from the Empire Test Pilot School. I went to Edwards and I taught. They had two levels of teaching at Edwards. There was the basic test pilot course and then there was the space [course], the research pilots' side of the course. The research pilots' side of the course taught things like space mechanics, trajectory analysis, [and] X-15 landings. …When we got into the airplanes to fly them, we were teaching zoom maneuvers…[and] we were teaching X-15 landings. We had a simulator that would simulate weightless conditions, and you could put a guy in a—actually, it was kind of a simulator for a guy in a suit, and he could get in this suit and get up in the simulator and he could do all [the] extravehicular maneuvers from the simulator as if he were in zero gravity. In fact, I was one of the instructors when Gene [Eugene A.] Cernan and—let's see. Who was the other one? Gene Cernan came over. And Charlie [Charles A.] Bassett [II] came out to take some training. I was one of the instructors that gave them their training.

But anyway, that got me into the space area. In fact, I wrote [some] of the courses on the space side while I was there for that year and a half, and taught them, and then also taught the flying side, too. [T]hen the NASA selection…[program was announced]. This [was] back in '65, and the Air Force had what they called the Manned Orbiting Lab [MOL] Program. So the Air Force…[also published] a request for volunteers to sign up for the Manned Orbiting Lab

Program…. So there were two selection programs that went on at the same time. There was the Air Force program and there was the NASA program.

…[We] could [apply] for either one or the other or both, and many of the guys signed up for both. Well, that was fine, except when you signed up for both, the Air Force took a look at you first, they picked who they wanted, and then what was left over NASA could look at. I said, "No, I don't think I want to do that," because I was convinced that the Air Force would never get the Manned Orbiting Lab Program off the ground, and if I went that way, it would be a dead-end street. So I signed up for NASA only.

…[After a records review and first cut, the remaining 75] went through a physical…[exam], and that cut the numbers down [even further]. We [finally] came down to Houston in March of '66 for oral and written exams and [to] meet the [selection] board…. That was…the day we [took] those exams that Charlie Bassett and Elliot [M.] See [Jr.] were killed in St. Louis. So we went through that, through funerals and all that. That's why the time really sets in my mind, because we're right in the middle of this review, meeting the board and doing these written exams, and we get word that Charlie, who was a good friend of mine—I didn't know Elliot, but Charlie was a good friend—had been killed in St. Louis.

That was in March. Then in April, I got a call from Deke [Donald K. Slayton] saying, "Hey, come on down," so we went down. I think I…[arrived] here…[about] the end of April. The 26th kind of rings a bell, 26th of April 1966, is when I…[got] here.

It's kind of funny, because you start out being just a basic pilot, you do things to make your professional side better, you do better at flying, you kind of rise to the top of all that, then you go off to a test pilot school and you're back to the bottom of the barrel again because everybody there is much more experienced and better than you are. You go through all that,

you eventually come to the top of that. Then you get selected into the space program and you show up down here. And I will never forget walking down the hall, and everybody looking down their nose at me because we were the "greenies." We're the green kids on the block, and nobody wanted to really have anything to do with us for a while….

…I underst[ood] the game. You call yourself an astronaut when you walk through the front door, because you've been selected, but there's no way you are [a real astronaut] until you've made a flight. …[Must] make a flight. If you're going to be an astronaut, you've got to make a flight. So you realize very quickly how humbling all of that can be, and you realize that, "Hey, I'm going to have to work hard." There's only one way you're going to get out of the group, the pile, and climb up on top somewhere.

WRIGHT: And there were so many of you when you came down.

WORDEN: Well, there were nineteen of us, yes. I was number thirty-five in the program. When we first got here, we got athletic clothes assigned to us, to play racquetball, to work out, this and that and the other thing. I will never forget mine was number fifty-five, but that was everybody who had been in the selection programs, I think, because there were only like thirty-five of us here at the time. It was a pretty small group. I started out in a room with Paul [J.] Weitz and my [final] office-mate ended up to be Jim [James B.] Irwin, and that was it. I mean, we had the whole top floor of the building, and with thirty-five guys we had…[for administrative purposes,] three flights. Wally [Walter M.] Schirra [Jr.] had one flight, I think [L.] Gordon Cooper had one flight, and I forgot who had the third flight. It wasn't one of those guys.

And I got assigned to Wally Schirra's flight. It was just a kick. I mean, I walked in to Wally…the very first day and said, "Well, here I am." [Laughter] He says, "You've got to understand something. You don't account for anything around here." Have you interviewed Wally yet?

WRIGHT: Yes, we've talked to him.

WORDEN: Well, he's a jokester from the word go. I mean, he's going to put anything over on anybody he can. And I said, "Well, I'll tell you one thing, I'm only a captain in the Air Force, but I know I outrank a commander in the Navy." So from then on, he and I have been great friends. He never lets me forget, and I never let him forget. But we've been really good friends, and he was a great, great flight commander.

That's where it all started…. You just say, "We're going to work. We're going to work hard," and we did. Our group was, I think, unusually aggressive in doing things and in training ourselves and getting things done. For instance, they wanted us to go through…six months' ground school first. That's the very first thing you do. You sit in the auditorium all day long for like six months.

We'd been in there maybe a week doing all this, and I'll never forget, three of us got together, Ed [Edgar D.] Mitchell, Charlie [Charles M.] Duke, and myself, we got together and we said, "You know, we can teach ourselves better than these guys. We know more about it than they do." So we went to Shepard and said, "Hey…we can do a better job than these guys can. We know a lot more about it than they do." Shepard said, "Okay, go ahead and do it." So we ended up teaching all of the technical stuff like orbital mechanics, trajectories, and

rendezvous and docking…. We sort of did that, rather than the instructors that they had lined up. So we kind of taught ourselves. I think as a result of that, we ended up probably understanding it a little better than a lot of the guys did. I don't know.

WRIGHT: One of the first assignments that you had was being part of the support crew for Apollo 9. Could you share with us how that came about and what were your responsibilities with doing that?

WORDEN: Well, we started out, actually, it was going to be Apollo 8. Jim [James A.] McDivitt, Dave [David R.] Scott, and Rusty [Russell L.] Schweickart were scheduled to fly on Apollo 8. The problem was that the lunar module was not going to be ready on time, so, as I recall—I mean, we're talking a few years ago, so my mind is not completely sharp on all this—but as I recall, two decisions were made. One was to slip the flight that was going to do the earth orbital [module] lunar flight by one flight. The other was that since they had to slip that flight, they'd use Apollo 8 to go around the Moon, which they did.

…[T]he interesting part of all that was that the spacecraft that was used on Apollo 8 was the one that I had hatched, if you will, out in Downey [California]. I had…[worked on it] for a year and done all the tests…and gotten involved with all the work when they were putting it together, and I knew that thing inside out. Of course, they're all pretty much the same, so that knowledge transferred to the next one. But I started out on the spacecraft that was used for 108 and then transferred. When all those decisions were made, then I transferred over to the one that was used on Apollo 9. It was very interesting.

…Jim McDivitt and I are from the same home town, so that made it kind of comfortable for me. In fact, our parents only lived two blocks apart in my home town. So not that we had known each other, because he was ahead of me in college and all that, but we became good friends. We're still good friends. He made life kind of happy. We worked hard, but it was happy work.

One of the big tasks I had during those days was to go through all of the docking apparatus for the lunar module and the command module, to make sure that it was all working the way it should be. I can remember spending a lot of time on the docking probe and how you get these two…[machines] together, and writing all the procedures…in addition to following the command module through the manufacturing process out in California. That was very rewarding.

…In those days, when you…[were assigned to a] support crew, it…meant that if you did your job and you did what was supposed to be done…that would be followed by being a backup crew and then being on the prime crew. …That's exactly the progression that we made. I was support on 9, backup on 12, and prime on 15, and that was the progression that was followed. There were…maybe two crews in all of that time who actually made that full progression, and we were one of them that went to 9 to 12, to 15. So it was great fun. Being on the support…[crew] meant that actually I was on the road every week in a T-38 going somewhere to do something for the crew. The understanding, of course, was that the prime crew was totally involved in training and doing flight plans and time lines and procedures and all that, and the backup crew was going through that with them, so what I'll call the dog work ended up with the support crew, and they did all of the running and all the errands and do this, do that. It was a great time. I really enjoyed that.

WRIGHT: You worked with Fred [W.] Haise [Jr.] and Ed Mitchell at that time.

WORDEN: Yes.

WRIGHT: Share some of the tasks and responsibilities that you had as a unit, or were you all separate and doing different of this dog work, as you call it?

WORDEN: Basically…we all had different things to do. A support crew was not a cohesive crew. It was just a group of three guys who did the running for the prime crew, and we all did different things. Ed Mitchell and Fred Haise spent more time in the lunar module…. They'd go off to Bethpage in New York, and I'd end up going to Los Angeles and doing the tests out there. That's, of course, where I got to know Dave Scott. But as a support crew, you're not necessarily a team; you are three individuals. You end up being capcoms [capsule communicators]…because you know the flight plan better than anybody outside the backup crew. They're capcoms, too. But you know it better than anybody else, so you end up doing a lot of capcom work, and if…[problems] come up, you do some simulator…[time to work out solutions].

…That's just kind of priming the pump in a way. That's just kind of background stuff…. When you get to the next step, which is the backup crew, you find that there's a…lot of [information] that you have soaked up, that you've absorbed, that you…know. …Especially after the fire in '67, [when] I spent…a year and a half…[every] week…in California working on the command module. So I really knew the command module. Jack [John L.] Swigert [Jr.] and

I knew the command module probably better than anybody, because we were so involved in it. We knew where the wires went. I mean, we knew where everything was. In fact, we ended up writing all the malfunction procedures and doing all of that out at Rockwell, or North American, and Downey.

Then Apollo 9 came along, and Apollo 12, same thing. I flew back and forth to L.A. all the time with Dick [Richard F.] Gordon [Jr.], because I was his backup pilot, and then we started getting into more and more of the training and understanding what was going on. Probably could have flown if we had to, but probably not totally comfortable with it either, as Jack Swigert…was on 13. But it was just one more step.

Now you're becoming, as backup crew, you're becoming more recognizable. What's nice about it is, as a backup crew in 12, fly to Los Angeles to go to North American Rockwell to work, you know where the rental cars are, you know where the telephones are, you know where the hotel is, you know where the front door is. You've already got a badge. I mean, it's like, gee, this part's easy. That really made it, I think, a lot easier for us to concentrate on what we had to do, rather than be involved in a lot of details that had nothing to do with making a flight. So that was just more training. Then, of course, as the prime crew in 15, then you're the one calling the shots. It's kind of nice.

WRIGHT: Let's, if we can, talk a little more about your role as a backup crew on Apollo 12. At what point did you learn that you were going to be joining or that you and Irwin and Scott would become a crew to back up Apollo 12?

WORDEN: Gosh, you know, I don't even remember. I think Dave Scott came and told me one day that he was putting a crew together and that he and I and Jim Irwin would be the backup on Apollo 12. I don't even remember the exact circumstance…when that was announced, but I do remember that it was shortly after Apollo 9, because we had to get into the cycle, that three-flight cycle from 9 to 12, rather quickly. In those days, we were launching rather frequently, so we didn't have—I mean, even today I think there's long enough time between flights that that cycle is not as urgent as it was when we were there. So we had like a year and a half to get ready for Apollo 12, then we had another year and a half to get ready for Apollo 15. So it was like three years altogether from 9 to 15 that that required us to be involved.

I think it was shortly after Apollo 9, although I don't remember the exact dates, but I think it was shortly after that one, Dave came and got Jim and I together and said, "Okay, guys. We're going to be backup on Apollo 12, and if we keep our nose clean and we do the right things, we should get a prime crew slot…down the road."

WRIGHT: Must have been a happy day.

WORDEN: It was. It was. The program's interesting. I think it's got to be different today than it was then. But I remember all through the support crew, the backup crew, and the prime crew training days, it all used to be when we were a year away from the flight, it was so easy to decide that there [were] lots of things you could do on the flight. The flight is kind of a dream that's still a ways away. It's not real. Even when you become prime crew, your flight, the actual flight, is not totally real to you. So you agree to do lots and lots of things.

Well, as you get closer and closer to the flight, to the launch date, reality begins to set in, and you say, "Hmm. We're really going to do this thing. This isn't just somebody's imagination anymore." Then things begin to change a little bit and you get a little bit—I won't say more serious, because we were always serious about it, but you get maybe a little more practical about the things that you can do. You get a little more practical about the information that you don't have. You get a little bit more insistent on flying more launches and reentries on the simulator. You get a little more insistent on performing more and more maneuvers that you're going to make during the flight. You're a little more eager to do all-up simulations with mission control in the act, because that's what uncovers any weaknesses you may have, and those are the things you need to know.

It's fun to think about them when the flight's two years away, but it gets pretty serious when the flight's only a month away. So all of a sudden you're faced with all this, and you say, "Thank God I trained so hard all those years, because I'm relatively comfortable and confident that we'll do the job." You end up with an attitude that, "I don't care what happens on the flight as long as I don't screw up." That's sort of the attitude you have.

WRIGHT: Do you feel serving as part of the backup crew to Apollo 12 got you into the position you needed to become the prime?

WORDEN: I think it was the only way. …I don't…know how the program runs today, but in those days you had to start out on a support crew, then a backup crew, and then to finally make it to a prime crew. You've got to prove yourself. You've got to show that you know what you're

doing and that you can handle things. And they evaluate you as you go through simulations and all the training you do.

[For] our flight, we probably trained a little differently than most crews. We got so much of the technical training and background. Dave was a slave driver, and he made us do a lot of things. He was a very professional, very no-nonsense kind of commander…but he urged us [to do more and more during training]. I mean, he kept leading us on, "Let's do more and more and more." So by the time we got to be prime crew, flying the spacecraft, we were already there. We could have gone anytime. So we spent a big percentage of our time learning lunar geology, learning astronomy, learning all the other things, all the things we're going to see and we're going to look at when we get out there.

I thank Dave for that. We were more scientifically oriented. …We trained for our flight…[so] we could handle any malfunctions. We could handle any problems. We could handle anything that happened on the flight. …As long as we were on the nominal flight [it would be] a piece of cake. If everything worked the way it was supposed to, it's like getting in your car and driving down to the corner. We trained on the things that could go wrong, and that's where we concentrated. By doing that and already having the experience of the backup crew behind us, the basic flying of this thing was relatively straightforward. That gave us a lot of extra time to learn the geology and the astronomy and everything else that we had to know. So we spent a lot of time in the field learning geology, and a lot of time at planetariums learning astronomy, and a lot of time spent with cameras, learning our photography and doing the things that we needed to do. And it showed up in the flight, because I think even today 15 is probably considered the most scientific flight.

WRIGHT: What were your thoughts when you found out that Apollo 15's designation had been changed from an H to a J and there was going to be such emphasis on all those scientific aspects?

WORDEN: Well, it posed some additional burdens [for] us, of course. The Lunar Rover was…coming along, even though there were problems with it. The scientific instrument module was being added, and that was something that I had to learn, all the…[instruments that were] in there, the mapping cameras, the big camera, the high-resolution camera, all the scientific instruments that we used in lunar orbit to measure whatever the atmosphere was, measure cosmic radiation. There are a lot of things that we did.

Yes, that added an extra burden, but it also added a lot of excitement, because we kind of felt like the program'…[was] getting mature. We're doing the all-up program now. We're not just getting out on the Moon and walking around for six hours and getting back in and saying, "Hey, I've been there," and collect a few rocks. Now we had to do some things.

Dave and Jim had the Lunar Rover and it gave them the opportunity to drive…something like 17 or 18 kilometers around the landing site. [They] couldn't have done that on foot; it's just too [great a distance]. In the scientific instrument model that I had on board, we did things that you couldn't do any other way. So it really became a very scientific kind of flight, and kind of exciting.

Our purpose, I think between 14 and 15, the purpose of a flight changed from getting there and getting back, to going out there and collecting all this science. There was an end game here. There was an end purpose to going. It wasn't just to go and come back. It was to go out there and really do something scientific that was worthwhile, and I think that's what we did.

WRIGHT: You were chosen to fly the solo command module position, so how much of your training and simulation did you spend away from Scott and Irwin, and how did they prepare you to fly this orbiting lunar science platform that had never been done before?

WORDEN: They had very little to do with the scientific instrument module [SIM]. That was…between myself and the prime investigators and the flight planners, so that we got that all worked into the flight plan. Dave, of course, had…an overview of everything. When the three of us were together in…[the command module], Dave and I kind of shared the [workload]. Jim didn't really have a lot of input, and it's a function of where you are in a crew. Dave flew the lunar module, I flew the command module, and Jim was kind of the systems engineer for both, even though he got to land on the Moon. Jim had some scientific things to do on the lunar surface, but very few things to do in the spacecraft, in the command module.

So…what I'm saying is…I [planned]…the SIM bay activities…with the principal investigations, with the guys behind the room over at mission control who really were the ones who knew what was going on, the technical guys, and the flight planners. We put all that together and integrated it into a flight plan that included what was going on on the lunar surface while I'm up there, and how we get in contact and what we do together. But I would say basically of the SIM bay activity, 95 percent…was mine. Dave and I did some of it together. We did very little on the way home because it was really designed for lunar orbit.

We did do some things…[from lunar orbit that] were very, very interesting…[such as] map[ping] the lunar surface. I did that mostly while the guys were on the…lunar surface. We ended up mapping about 25 percent of the lunar surface with a high-resolution camera.

The high-resolution camera, incidentally, was an interesting camera. We could take pictures from 60 miles that…[had a] resolution maybe down to 3 meters or something like that, which was pretty good for those days. Turns out that the camera was an obsolete Air Force camera, had been used in reconnaissance airplanes, and when the Russians found out about it, they had a fit. So as a result of that, we were restricted from turning the camera on until we got to the Moon. We couldn't take pictures of the Earth with it. There was a lot of uncertainty in somebody's mind that maybe we could take pictures they didn't want us to see. Of course, what's silly about it is that those cameras probably flew all over Russia in U-2s, and they knew it and we knew it. What are they going to do about it? But that was one of the political constraints that we had on our flight.

But the whole purpose of the lunar orbit activity is to understand the rationale for the scientific investigation of the surface of the Moon. You want something called ground truth. Ground truth is a rock [that is found on the lunar surface]…. You pick up that rock…[look at it] and you say, "All the other rocks around here are the same or very similar." You analyze that rock in terms of its chemical constituents. Then you figure out a way to measure the chemical constituency in the rocks from lunar orbit, which we did with microwave and a lot of other things.

Now you can take that ground truth, you take your picture from lunar orbit, looking down at that same site, and you calibrate the two. …From the data that you collected in lunar orbit, you can analyze the constituency of the rocks all the way around the Moon, not just in one location. So now you know what the entire surface of the Moon is made of, not just a rock that you pick up in one place. This is the basis of that kind of scientific investigation. That you've got to have the ground truth to anchor your remote sensing, but once you've done that, your

remote sensing can tell you what you need to know about the lunar surface. We did that with all the flights that landed there, but we only had the high-resolution camera, the microwave, and the infrared and all the other instruments that we carried into lunar orbit…on the last three flights.

So the ground truth was very important in all this, and I'm sure that in analyzing the ground truth and all that, there's a lot of juggling that has to be done to make sure that it's all right. But that's how you eventually figure out the makeup of the lunar surface all the way around.

WRIGHT: In preparation for your duties, you worked very closely with a lot of people, including one that I think served as your mentor, Farouk el-Baz. Could you share some of those experiences of learning from him?

WORDEN: Farouk is an interesting man. His life story is a book, and he should write it some day. Farouk is, of course, Egyptian. He got his Ph.D. at MIT [Massachusetts Institute of Technology]. I think it was MIT. And while he was there, he met a red-headed Irish girl, [Pat,] and married her…and took her back to Egypt. The Egyptian Government wouldn't recognize the marriage. They made her wait endlessly in lines to try and get an Egyptian marriage approved…[with no success]. While she was doing that, they sent him out into the desert to train soldiers. They made him an instructor in some training base clear out in the middle of the desert.

Well, he was a petroleum geologist, and so as a sideline, even while he was training soldiers, he worked for some of the oil companies and he did a lot of [petroleum] investigations. He was very valuable to them. One day one of the oil companies asked him if he would go to

Heidelberg University and give a lecture, and he said, "Sure." The Egyptian Government let him go, and from there he went to Boston, and he's been there ever since, except when he was with Bell Labs training us. Brilliant man.

In fact, I know this dates this interview, but just within the past few days there was a two-hour segment on television about uncovering the tomb of the 1,000 mummies in Egypt. That's what Farouk does. He is probably the foremost liaison between this country and the Egyptian Government in all that kind of activity. In fact, he was on the show. Wonderful man. Wonderful man. He's like a brother.

Farouk and I developed a very special relationship. He came down to the Cape all the time. I'd go to Washington, he'd come down to the Cape or to Houston or wherever, and we would train and train and train and train and train. He made me memorize the name of every crater there was on the surface of the Moon, and where it was and how it got there, and what was happening to it, how the shapes got the way they are….

In fact, Farouk named our spacecraft for us. I'd had these long discussions with him about what can you name a spacecraft. All the good names were taken, you know, Viking and all kinds of names like that. They were all taken…. We probably went through a hundred names. Farouk came down one day and he said, "In getting on the airplane at Washington National, I happened to go into the bookstore and here was this big book, a children's book, on famous explorers. We ought to take a look at this, because there's a couple of names in there that you might really enjoy." So we did, and Captain Cook's section in there came up with Discoverer and Endeavour. I forget the name of the third one now, but there were three ships that Captain Cook had. Endeavour was the second one. When you read the literature, you

recognize that the Endeavour, the way we named our spacecraft, was the English spelling of Endeavour. It wasn't the American spelling; it was the English spelling.

So anyway, Farouk and I spent endless, endless hours training on the lunar geology. I really felt that I knew the surface of the Moon backwards and forwards. To show you what an interesting guy he is, we were talking about the flight one day and I said, "Farouk, I'm going to be up there for thirty-six revolutions by myself. I'd really like to do something different. The program is getting…[less attention]—people are losing interest. I'd really like to do something that would make it personal, bring people into it, people all over the world."

He said, "What do you have in mind?"

I said, "Well, it would really be nice if I had a salutation, a greeting that I could give everybody, and maybe do it in different languages."

Well, he thought that was…absolutely fantastic. So he…[went] off [to Washington], and he [came] back a week later…[with a] salutation called "Hello, Earth, greetings from Endeavor." He [has] it phonetically spelled in about fifteen different languages. …We spent [a lot of] time practicing that than we did practicing…[the phonetic phrases]. Every time I came over the horizon of the Moon…I gave that salutation in a different language, with his phonetic spelling, and it was a wonderful thing to do. In fact, it became the title of a book that I wrote, with his original hand-printed phonetic spelling as the centerfold in the book.

But that's the kind of guy he was. He was so good at accepting or taking ideas, and he was so eager to do things, and he was so insistent on everything being done correctly. He's still my mentor. I still look up to Farouk. I don't talk to him as much as I should, as much as I could, but he knows where I am and I know where he is, and we're still good friends. He taught

me what I knew about lunar geology. He was to lunar orbit geology what Lee [Leon T.] Silver was to the…[surface geology]. I think that's probably it pretty much.

WRIGHT: How much did you know before you started working with him?

WORDEN: Geology? Well, my kind of geology on the Moon was different from surface geology. Lee Silver taught all of us how to describe a scene. There's a difference. If a meteor impacts the Earth, the way the material is blown out of the meteor crater then, when the meteor releases all that energy, converts all that motion into heat, and that explodes upward and all this stuff comes up and lays back on itself. A volcano just comes up and…spews stuff out; it's not laying back on itself. So if you look at a feature, there's a big difference whether it's volcanic or whether it's meteor impact and the way it lays out.

So anyway, we did a lot of that. Lee Silver taught a lot of that. A meteor impact, as an example…lays back on itself…the flap comes over and lays down on top of the ground that's surrounding it. Right at the corner you should have the same kind of rocks both above and below where that comes down, because you've taken the top surface and laid it over the top surface of what was there before. A volcanic crater, all you've got is stuff spewing out and settling down. You don't have that regime of those zones of material that match up. These are the kinds of things we learned.

But then with Lee Silver on the ground, you have to take the rock and…analyze…[it]. Is there a crystalline structure to it? Is it amorphous? …Whatever it happens to be. And you've got to be able to analyze the rocks in terms of if I pick up this rock here and then 1,000 yards over here I pick up the same kind of rock, what does that mean? Okay? So you begin to

develop a picture of the scene that maybe there's a sedimentary layer that slices down through the ground, and you can pick up a rock here, and you walk along and you see the same rock. But then above and below it, you get a different rock. So that says, yes, there's something that's been upthrust and you've got these layers that go through it.

So you have to be able to analyze the rocks. Dave and Jim were very good at that. They were as close to being a Jack Schmitt as you could be. My kind of geology was different, though. I had to look at major features. I'm looking at a volcanic…crater or a meteor impact crater from 60 miles away…but there's no way I can look at individual rocks. That gets back to why we had the ground truth, because if we do our job correctly in lunar orbit, we're going to get a recording of all the kinds of rocks that are around these features and then tie that to the ground truth, we can make a picture of what it is.

So I looked at macro features, and Dave and Jim looked at micro features. There's a difference in the kind of geology you look at. I'm looking at what are the processes. Dave and Jim are looking at what's the final product of the process. So that's where…[our observations differ]. Dave and Jim went one way and Farouk and I went another way to learn what there was to know about the surface of the Moon. Couldn't have done it without him.

WRIGHT: Your crewmates had somewhat of an advantage because they could walk ground and they could pick up rocks and go through this, but you could not actually do that in your position. How did you prepare yourself? What kind of exercises did you and Farouk walk through that you could learn to distinguish what you needed to distinguish on the lunar surface from your position?

WORDEN: We did some flying. I don't recall that Farouk ever flew with me, but I did that. If we'd go off on a geology field trip, Dave and Jim would be down on the surface doing their thing with rocks, and I'd be flying over the same area in an airplane, describing the general scene, so that we'd get some correlation between the two. Farouk always helped with those. He was always around. That was good training, and it helped tie the two ends of this thing, the orbital and the surface stuff….

In all honesty, I think the geology that Dave and Jim had to do on the lunar surface was more difficult than what I did, because they had to distinguish between tens of different kinds of rocks, a hundred different kinds of rocks. They had to know what they were looking for. They found a rock on our flight that was called the Genesis rock. I think they've later age-dated the dust around it older than the rock, but it was called the Genesis rock at the time because it had a crystal in it. It was a crystalline-structure rock, and the assumption was that the original rocks that made up the Moon had some crystalline structure to them through the cooling process. But that was the kind of things that they looked for. They see a big chunk of rock somewhere and they're looking at it with their little microscope, seeing if there's any crystalline structure in it, and I'm looking at it from 60 miles away, saying, "What's that big boulder have to do with the general scene around them?"

In fact, because of the kind of macro geology that we did from lunar orbit, we were actually able to pinpoint a landing site for Apollo 17, and that was through visual observation. I…saw this field of what I was positive were cinder cones. Until…our flight, there was a big discussion in the geologic…world about [whether] the features on the surface of the Moon were made by volcanic activity or by meteor impact, and there…[were reputable] advocates [on] both

sides. It wasn't a clear-cut thing from what you can see looking at the Moon from here. It's difficult to tell.

So there is this kind of age-old discussion about how the surface of the Moon came to be the way it is. If there [had been volcanic activity on]…the Moon…there would be…cinder cones [as artifacts]…of [the] dying gasps of volcanic activity.

So I flew over [the lunar surface] and saw…[what] I was sure…[was] cinder cones. They were just small enough that there was some question about whether you could actually see them with the naked eye. …Your eye can [see objects that] subtend [a very small] angle…[but] from 60 miles away, supposedly your eye can't see objects smaller than…[about 50 feet]. …[For instance,] your eye, from Earth orbit, should not be able to see the Great Wall of China, but a lot of guys have said they've seen it. That's because what's now well understood about the eye is the eye can see a linear feature. It may not see the width, but it can see linear features. Anyway, [the fact that I could see, and pictures would verify the presence of cinder cones was]…used as a basis for landing Apollo 17…[at Taurus-Littrow].

So the lunar orbit observations were valuable from many aspects. One was to [extrapolate] the surface [findings to large areas], and the other was to find things that we didn't know were there, like the cinder cones. Of course, we took pictures of them and when they got blown up, sure enough, there were cinder cones. I took them with a high-resolution camera. In fact, I have a picture in my house of a lunar module sitting on the lunar surface taken from 60 miles away. It's kind of an interesting picture. But the high-resolution camera really worked well.

WRIGHT: Share with us, please, the communication that you had with your crewmates and how often that you were able to talk with them and how you were able to use those precious moments of communication in telling each other as much as you could.

WORDEN: Well, we didn't really have a lot to say. Of course, the truth of it is that we tried to eliminate activity in those parts of the flight where I could talk to them. We did have some direct communication, but most of our communications was through Houston. I'd make a comment and Houston would transfer it back up to the guys on the lunar surface. So they could get me. If I was in sight of the Earth, then I could retransmit to the guys on the surface without any trouble. We tried to set it up that I could talk directly to them, but that only gave us a few minutes, because you'd go from one horizon to the other fairly quickly. So there were only a few minutes, and I had to be very quick.

In fact, when I took the pictures of the lunar module, had to be very quick to do that because you go over them so fast, you've really got to move that camera quickly so that you don't get what's called smear. If you're going over the surface…at [say] 5,000 miles an hour and you take a picture…[with] the shutter open[ed] for, let's say, one second, how far do you go in one second? Well, at 5,000 miles [per] hour, you go…[about 7300 feet in one second and] if you have the lens open for…[1/100th] second, that spot on the ground is going to smear…[about 73 feet] on the lens or on the film.

So you have to rock the camera to [steady] the picture [on one point on the surface]. …What was so wonderful about [the] high-resolution camera, [was] that [it did] exactly [that]. So we got these great pictures of them down on the surface, but you're only there for thirty

seconds maybe, and whatever you had to say had to be quick. "Hey, guys. How are you doing?" "Fine. How are you doing?" "Fine," and you're gone.

We didn't have any technical information to share. We didn't really have any scientific information to share, because they're doing their thing, I'm doing my thing. So it's really like, "Hi, guys. I see you." And you let the rest of it go until you get together again.

WRIGHT: Which you did.

WORDEN: Yes.

WRIGHT: And you were united and you were on your way home, but before you came home, you didn't stop but you managed to work in about a forty-minute EVA. Share with us—because that was part of your responsibilities—and tell us how that all happened and how you trained for that as well.

WORDEN: Yes, we did the EVA on the way home. …[It] was [part of] the J mission. In the scientific instrument module we had two cameras. One was a high-resolution camera called the Balloptican camera, and the other was a mapping camera, which didn't take high-resolution pictures, but it was instrumented such that you could actually measure [linear features] on the…[surface with good accuracy]. Associated with it was a laser altimeter that [measured] your exact altitude above the surface. So it was a very, very valuable camera for mapping. …[With precise altitude matched to the wrapping camera picture allowed a very] detailed [and] accurate map of the Moon.

…[Those cameras were installed] in the SIM bay, and before you come back through the atmosphere, you've [have] to get it out of there [and into the Command Module] because the SIM bay doesn't come through the atmosphere very well. So it was my job to go…out there, after we left lunar orbit on the way home, and bring these two film canisters back inside. I had probably practiced that 300 times in the zero-G airplane and under water and every way you could think of to practice that.

Kind of interesting that before we got assigned to the J mission, or before they moved the J mission up, there'd already been some preliminary work on how to get this film out of the SIM bay. Of course, it had been in the pipeline for several years, and there were a lot of schemes to get the film from…in the back of the scientific instrument module all the way up into the command module, [which was] a distance of about thirty feet. How do you get out there safely so that you don't lose it, so that you don't hurt something? There had been some things suggested.

One of the schemes was…an arm…on a hinge that would go out and pick up the film and…bring it back…by the hatch where you could pick it up. There was an endless clothesline. …[The idea was to hook the film canisters] to the clothesline and…[reel it in to the CSM]. I objected to all of those [schemes] once we [were] assigned to the flight, [because]…none of them were very practical.

We actually proved it with the clothesline. It's nice to think about something like an endless clothesline with [a canister] hooked to it, [so] you [could] just reel it in. But the truth [was], when you're in space and…[there is no atmosphere or gravity] if that canister started to…bounce around, there [would be] nothing to stop it. And sure enough, in a zero-G airplane one day, trying to get this eighty-pound canister back into the command module, the line

[started] moving [sideways] and it moved enough so that the eighty-pound canister…knocked the RCS [reaction control system] quad right off the side of the service module. And all I could say was, "You know, I told you."

I worked out a deal. I said, "You know, let's do this simple. There's [an easy] way of doing it. Give me a wrist tether and a hook on it, and I'll [attach] the canister [to] the hook and…walk it back [to the CSM]. I don't need both arms to move. I mean, you don't need anything out there to move. I can work my way back with one hand and I'll bring the canister back in with the other hand, and if something should happen and I have to let go of the canister, it's on a wrist tether and it won't go away." Well, we finally agreed to do that, with a provision. …[Management] wanted a safety pin in the hook so that [it] wouldn't open on the way back. I said, "Okay, that's fair enough. So we'll put a pin in it. After I've got the canister and all that, we'll put a pin in the hook so it won't come off."

That was okay for about a week, and then they came back and said, "Well, we're just not sure that that pin is secure enough, so we want you to put a cotter [key] in the end of the pin so that the pin won't come out." Well, I finally had to do that….

Space is very simple to deal with if people just give it a little thought. You start moving something, it's going to continue to move. You start something turning, and there's nothing to stop it from turning. We played games inside the spacecraft on the way out, where we'd take something in the middle of the spacecraft [and] start it spinning. And it's amazing, it just kept spinning and spinning and spinning. There are some Newtonian laws that apply here. If you take a book and spin it, the book [will flip over] about every second turn and it'll spin and flip over again and spin and spin. There's some interesting dynamics to all that, but the truth is, once you start something going, it's not going to stop. In the same way when you're outside,

you go out to get the film and you bring it back in. If you put it on an endless clothesline and it starts whipping, there's nothing going to stop it. So we did it the very simplest way we could, and it turned out to be very…[straight forward and easy] to do.

The EVA itself was kind of unique. It's sort of a unique perspective. I did have a chance to stand up on the outside [of the SM] and look [around, and]…I could see…the Moon and the Earth at the same time. And if you're on Earth, you can't do that. If you're on the Moon, you can't do that. It's a very unique place to be.

As far as the EVA itself was concerned, it was easy. There was nothing to it. We had, again, practiced it enough so that it was kind of second nature. We knew what we were doing. It was easy to set up. It was easy to get everything organized the way it should be. I guess our biggest concern was that we had everything tied down so that when we opened the hatch, we didn't have something go wandering off into space. But outside of that, it was pretty easy.

WRIGHT: Quite a voyage home to have that for a last view before you start to head for home.

WORDEN: We had some fun on the way home. We did one experiment on the way home which was a very unique experiment, and I think kind of started the whole astronomy world thinking about things a little differently. We did an X-ray scan of a portion of the universe, and we found that in the data that we got back…there was a hole. …There was one spot in that part of the universe we were looking at that didn't return any X-ray data. And that's, I believe, considered the first black hole that had ever been recorded. Now, of course, we talk about them all the time. I mean, it's part of our literature. It's part of our discussion about astronomy these days,

but it was really not known at all back in those days, that there was such a thing as a black hole. I think we probably recorded the first one.

We also did our own navigation on the way home, which was another change from the way things had been done. There was always a question of, what do you do if you're out at the Moon and you lose all your radios? How do you get home? In the computer there was a return-to-Earth program, but it left a lot to be desired in terms of its accuracy and where it would leave you. So the question was, if we had to use that program to start on the way back home, did we have the confidence that we could do our own navigation to get us back to Earth safely?

So we did [the]…navigation on the way back home. I did…[many] star sightings using the old tried-and-true sextant, just like the ancient mariners…. We took Earth-star sightings, and we took Moon-star sightings, and did…quite a [few] on the way home and found that, yes, indeed, we could navigate accurately enough so that the ground never had to give us an update on the way back home. They kept monitoring where we were. I mean, they could download everything and see where we were with…[the navigation program]. If we got outside a certain parameter, outside some certain limits, then they would send up a new…state vector, and we'd go from there. But they never had to do that because we found that we could do it quite well in flight. And that's a good thing, because some day we're going to be going to Mars, and somebody's going to lose their radios, and it's going to be very important that they have the confidence that they could get themselves back home if they had to. I think that there's no question…[that] they could.

We have the capability to navigate anywhere we want to go, I think, on our own. I mean, we don't need the ground to tell us where we are. I [believe] we could go on our own, and I think that's another good lesson from the flight.

WRIGHT: Also on your way home you were involved with a press conference that was broadcast. How was that, knowing that what you were saying was being broadcast and knowing that people were listening to you from all over the world?

WORDEN: Well, yes, we knew that. Of course, we still had our TV camera, and that was all set up and we…sat back and answered all the questions…. I guess we didn't really understand the extent of the audience that might be there, but it was kind of fun having a press conference from [space], and it was fun showing people what it is like in zero gravity. Of course, all the flights did that, too. Ours wasn't the only one, and they still do it. I mean, they have press conferences all the time, even in the Shuttle. But it was a fun thing to do. It didn't last very long. I forget now how long it was. It was maybe half an hour. I think Dave answered most of the questions….

WRIGHT: Just [unclear].

WORDEN: God, it's been thirty years since I've seen it, so I can't comment too much on it. I probably said something wrong. [Laughter]

WRIGHT: You were on your way home, and as you started the return process, there was a problem with the parachute.

WORDEN: That's after we got back in the atmosphere. Yes, it was more than a problem; it was a disaster. We came through the atmosphere. We got down to 24,000 feet, and we let the drogue chute [out]. It stabilized our descent and kept us with the big end down. At 10,000 feet we dropped the drogue chute and opened up the three main parachutes, and [when] we got down to maybe 3 or 4,000 feet—I [was] there in the left seat watching the chutes—[I saw] one of the chutes start to billow. At the same time we [were] beginning to get calls from the helicopters that [were] circling us that it looked like we were losing a chute. Of course, we didn't know what was going on.

We came down a little faster than we would…normally, but surprisingly, not a lot more. …Instead of twenty-eight feet per second, we were probably thirty-five feet per second or something. I don't know. It wasn't much, though. We came all the way down, and we still had two chutes when we hit the water. But before we hit the water, I was already watching a second chute start to go. So we still had two chutes when we hit the water, but another [few] seconds and we'd have lost the second chute. We went quite a ways under water, came back up. They lost the chutes; they sank.

But we know what happened. It was kind of a simple thing, and I guess we hadn't really considered it. The reason we lost the chute was because the day was very, very calm. The procedure was, you get on the parachutes, you know you're stable, you know you're coming down, everything is fine. …[Then before you hit the water] you want to…get rid of any explosive [RCS] fuel that you might have on board. We had hypergolic fuels on board, which, of course….ignite on contact…. We had these fuels for the reaction control system in the command module. The idea was that we wanted to get rid of that fuel before we hit the water,

because if we should rupture some lines…these fuels [could mix] together [and] we'd be in a nice bonfire…. So there was a procedure for releasing the pressure in all these RCS lines.

…These fuels that we had are highly corrosive, and if they get into a nylon chute, that chute's gone. Very calm day, and as we release this [fuel], it went right up into that chute and the chute just dissolved…. I think it was probably the first time that it happened in the program, because I think on every other flight there had been some surface wind that [moved] the spacecraft…[horizontally while it was descending. That meant that] when they [released the] rocket fuel, it went off in back of them and they never had a problem. It just got lost in the wind. But with us, coming straight down, this stuff went straight up into the parachute, and there we had a problem. It probably would have gotten into the second chute if we'd been much longer. But we did go under water a little bit more than most, but everything was fine.

I think Apollo 13 taught us that as much as we know about all of this, we don't know everything. It's like education. I think education probably is more humbling than anything else because the more education you get, the more you realize that you don't know. Uneducated people often think they know everything, but the more educated you get, the more you realized the things that you don't know. Well, I think the same thing is true in the space program. We get very sophisticated about these things, but we also realize that there are things we don't know, and this parachute thing is a good example of that.

WRIGHT: Well, once aboard the rescue ship, the crew was treated a little differently than any other crew before. You were not quarantined and you were able to stay together. Could you tell us what background information that you can about why that decision was made and what the procedures were?

WORDEN: That gets into the whole discussion about bacteriological contamination—back contamination, it was called. Interestingly, Carl Sagan was the group leader in that effort, and we had many, many discussions with him about this bacterial contamination. Interestingly, he was worried about us bringing contamination back from somewhere else. …Apollo 11, 12, [and] 14…didn't [bring] anything…[back to Earth], so they elected to do away with the quarantine on our flight…. We didn't bring anything back. [However,] they were concerned about us taking…[contamination into space].

So actually, our quarantine was a month before the flight, not after. I think this bacteriological contamination, the whole thing is you try and think of everything. You know, what could happen? And it would be unforgivable if you overlooked the fact that a piece of material brought back from the Moon might have a virus in it that could kill everybody on Earth. I mean, you can't conceive of that happening, but we live in a universe that we don't know anything about. So all kinds of things could happen, and I think that was Carl Sagan's real concern, that we didn't know what was there and how [could] we take any chances? So that's why all of this.

We didn't have quarantine after the flight. I'm almost convinced that quarantine was a good thing after flight…. [What] we found [when] we got back…to Houston [was that we would] spend our days debriefing for the first two weeks…. Then we'd get outside the walls here at night, and there [were] people all over the place wanting to talk. I mean, I had a hard time getting four hours' sleep a night. And then we [had] to be back over here for debriefings the next day, and it was just a constant cycle.

Those guys who had to go into quarantine at least got a good night's sleep, and they probably bounced back much more quickly than we did. But we were doing physical exams every day. We were doing debriefings every day. We were running around doing this, doing that. We [would] go home at night and [the] whole neighborhood [would be] up in arms. They [would] all want to party and talk and whatever, and it's really hard to settle down in those conditions.

…Well, of course, on Apollo 13 again, here we had the measles scare…and the impact that [it] had [on the following flights]. It impacted us because for that month before the flight we were isolated from contact with anybody outside so that wouldn't happen again. And it never did.

So it's interesting how things change as you get into the program, as time goes on and you make a flight and you make another flight and you find out things. So you begin to change the ground rules to take into account the things that you didn't realize at first. I mean, conditions were different than you thought they would be, so you've got to change things.

WRIGHT: Were you involved in the scientific findings? Your pictures that you took, were you able to watch these being developed or any of those types of activities that are being processed afterwards? Were you involved in, are the crew involved in any at all of the findings?

WORDEN: Yes, in fact, [for] much of the scientific data that was collected in lunar orbit, I was considered a co-PI [principal investigator]. So many of the reports that were written had my name on them, too, even though I didn't do the analysis or write the report. I collected the data. I worked mostly with a group of scientists out of [Goddard Space Flight Center] Greenbelt

[Maryland], and they kept me informed. Farouk, [Isadore] Izzy Adler, [Jack Trompka] that whole bunch, wonderful group of people. They would call and we'd talk about it.

But the problem is, circumstances keep you away from that, too. We got back. We did two weeks of debriefing. Then all of a sudden we're here, we're there, we're over to Europe, we're to someplace else, and for six months we're out of the loop. We're doing the President's [will], and that kept us away from a lot of [the science]. I think Dave Scott might have been a little bit more involved in it later on than Jim and I were, but I don't think any of us got so involved that we were really part of the scientific discovery that went on after the flight. I think that's a very difficult thing to do because there are too many other demands on your time. We weren't really that kind of scientific investigator anyway. These guys were looking at the minutiae of everything, and we were looking at rocks, big features, and that kind of thing. So it's a different kind of thing.

The results of all the lunar orbit stuff, the lunar orbit experiments that we did, from a scientific standpoint were very interesting, but the interest is in the details and you have to understand the details. Unfortunately, I wasn't and I don't think many of the guys were smart enough to understand the details. We took the data, and we knew what it was going to do, but the details were far beyond us.

WRIGHT: So many years of planning and so many years of training took place before the mission, and then after the mission you had your presidential tours and your press conferences. What were your next duties that were assigned to you then after you returned?

WORDEN: We were assigned…as a backup crew on Apollo [17]…. [All flights after Apollo 17 were cancelled] so there really wasn't much left. We probably could have made the decision to hang around. …[This was] now late '71, early '72. [We] could hang around for the Space Shuttle. The Skylab Program had already been filled. Apollo-Soyuz had already been filled. So the next real program that came along was the Shuttle Program, and that was ten years away. I think most of [us], even Dave…said we're just not going to hang around for that. I [didn't] need to cool my heels for ten years waiting on another flight. There were guys that were in my group who had not made a flight up to that point. They had no choice. They really had to stay, stick around for the Shuttle. But I'd made a flight and I didn't need to. So [I] decided that it was time to leave, much as I loved this place. There were bigger and better things.

I guess I'm a little different than a lot of pilots. I'm not a pilot because I just love to go burning holes in the sky. I think being a pilot means it gives you the opportunity to go someplace and come back. An airplane is a transport. An airplane is like a car. It's a device for transportation, and you go somewhere. You do something when you get there, and then you come back. A lot of people I know just like to go up, and they'll fly around the flagpole for two hours and say, "Gee, what a great day. I went flying for two hours." Well, that's pointless to me. So I couldn't see hanging around for ten years just to fly again, you know. I suppose, looking in hindsight, that ten years might have gone pretty fast, but I don't think so. So I transferred out to Ames and headed up a division out there, and I did that until I retired in '75.

WRIGHT: And what were your responsibilities there?

WORDEN: Well, I started out working in the Airborne Science Group out there, which was kind of like what I did in lunar orbit, except it was…[accomplished with] an airplane full of scientific instruments. We…[did] earth resources surveys and all kinds of in-flight experiments. In fact, it's the airplane that monitored the ozone hole in Antarctica. They flew through it and took readings on the ozone, and it's the same airplane that does that.

[As] part of our duties…we did a lot of infrared astronomy. In fact, I was part of the group that flew the astronomers out there at Ames [Research Center, Moffett Field, California] to [conduct] infrared astronomy, and that was both fun and interesting. I [also] did [some] flight tests out there. We did a lot of [aircraft] zero-G work with biological experiments. …One [was] called the frog otolith experiment…. And you just watch, you take pictures of what happens to [the] fish eyes, when they're in zero gravity as compared to being in 1-G gravity. Eyes do react a little differently. These are all part of the scientific investigation for long-term space flight. We did a lot of that.

I then headed up one of the directorates out there called the Systems Analysis Division. We did analyses and assessments of future programs and plans…. It was a group that used to be in Washington, and they…[were relocated outside] of Washington because of the politics. They decided to get them as far away as they could so that congressmen couldn't just call this group and say, "Hey, I'm pushing this certain technology. Make it look good." So they moved it out to Ames. I headed that division for, I guess…two [or] three years. Ultimately…that was one of the divisions that got caught in a scale-back…at NASA, and so [it was] disbanded.

Then I took over the Airborne Science Division that I had worked in before. In fact, we had three U-2s and a couple of DC-8s and quite a fleet of airplanes…. It makes up the

backbone, I guess, of the NASA fleet, if you will, on the West Coast today. They do a lot of very, very good scientific work. It's an amazing program.

In fact, you can actually do a better job from an airplane than you can from space, I think, because you're closer. You can get better resolution pictures, and you can get better data, and if you're flying along and something goes wrong, you can fix it. There are a lot of advantages to doing it in an airplane.

NASA had…a program called LACIE, which is the Large Air Crop Inventory Experiment. They were trying to inventory and analyze crops in Russia, and what they wanted to find out, was this year's crop going to be good or bad…. [It] was a satellite program. We did the same thing with U-2s and we had a very simple small computer program to analyze all the data, and we got better results than LACIE did, simply because we were closer to it. You could get better definition in the data from the lower altitude of an airplane than you can from space.

Space is a difficult environment to get…fine detail on Earth. We're getting closer and closer to doing that, but it's all compromises. It all depends on what you want. If you're at orbital altitude, let's say, 120 miles up, you're traveling at 17,000 miles an hour, and you [have] a camera that's looking down [at] the ground. It's that same thing we were talking before. If you open that shutter for even a hundredth of a second, how far have you traveled in a hundredth of a second if you're going 17,000 miles an hour? And it's that simple. So if you're in an airplane, you can compensate a lot easier because you're not going as fast.

WRIGHT: You mentioned you retired from NASA in 1975. Do you feel like your career was affected in any way by the controversy that surrounded with the stamps issue and the Apollo 15 crew?

WORDEN: Oh, I knew you were going to bring that up, Rebecca. [Laughter]

WRIGHT: Well, we wanted to hear your perspective on that.

WORDEN: …I'll tell you that everything I carried on the flight was on the manifest—everything. There was nothing in my suit or in my kit or anywhere around me that had not been approved by Deke Slayton. …There were some covers carried on the flight. There were 100 covers carried by Dave that we had agreed…to take. I had assumed they were on the manifest, but I'm not sure they ever were—that were going to go into our kids' educations, you know, the proceeds. But there were going to be nothing done until the program was long, long, long gone.…

Well, unbeknownst to Jim and I…Dave had another 300 in his pocket, and that created quite a flap. It was unfortunate for a lot of respects.

One thing I found out from that episode was how little NASA management cared about us, how they were just delighted to get rid of us if they could. I learned that NASA management was pretty gutless. Some senator or some congressman asked the question, and they caved under right away and tried to get rid of us. Nobody stood up for us. Nobody.

What was interesting is that they had just gone through the same thing on Apollo 14. The Apollo 14 issue was golf balls, not covers, but it was the same thing. …They had just been through that. It's unfortunate that they never went any deeper than what was public knowledge at the time. …They never looked at Apollo 11 or Apollo 10 or any of them. If they had looked pretty carefully, I think the whole thing might have changed. But there was some pretty self-

concerned management. They didn't want to get tarnished by the brush, so they were only too happy to dump it all on our back. I won't say what was done was right, but I think the reaction was overdone. And in light of what's happened in the last few years, I think that that's a correct assessment. It's coming to light now that we may have carried fewer covers than lots of other flights. The difference was that their carrying those covers didn't become public knowledge and ours did.

I don't know how much of the story you know, but after all this happened…[all the covers were stored] in the National Archives…[without a legal hearing] That constituted as taking our property without due course of law]. We probably didn't do the smartest thing in the world, but we didn't do anything that was illegal. We didn't do anything that anybody else hadn't done, but the consequences were rather severe to us.

I took it upon myself in [April 1983]…to sue the government to get my [covers] back. …[It took about a year until] the Justice Department finally determined that what NASA had done was totally wrong. The only request they made of me was that if they gave my stuff back, would I drop [the lawsuit] at that point and not do anything further. I didn't know it at the time, but if I had wanted to do anything other than just get the covers back, I could have sued for damages and would have won. I don't know about the rest of the guys. I think you have to sue. …The Justice Department asked me if I would be the spokesperson [for all the astronauts], I would be the focal point for everybody and that they would give everything back through me to whoever owned it.

So, yes, I became the focal point and went to Washington and signed all kinds of documents and got all the [personal artifcats] back and made sure that everybody got their['s] back. …[The] guys in…[Apollo] 16 and 17 had the same problem. NASA had all their

[belongings] locked up, too. …It was a little cowardly, I think, of NASA management. I have fairly strong feelings about it. I don't know that I would have stayed here even if that hadn't come up, because…looking down the road ten years, just wasn't my cup of tea anyway. But that certainly helped accelerate the move.

WRIGHT: And you moved onto a different venture with Jim Irwin. Is that correct?

WORDEN: Well, not really. ….Jim and I were always very close. Jim left and…started High Flight Foundation in Colorado Springs. I was getting ready in '74 and '75 to retire, and just about that time Jim had a massive heart attack. I was on his board.… Jim['s]…heart attack…was going to [keep him] out of action for a while, so he asked me to take over all of his public appearances till he got back on his feet…. So I think because of that and because of the fact that I was on the board of High Flight Foundation, people associate me a lot closer with Jim than I was. He was a dear friend. I would do anything for him. I covered for him when he was sick, when he had those heart attacks, but I wasn't ever in the religious movement the way Jim was, or the way Charlie [Charles M.] Duke [Jr.] is. That's just not my nature.

I think what Jim did was good, but I think he got so obsessed with it that it really changed his life. I could never do that, but for years I was on the board….

[I was] very close to the minister that helped Jim put it all together. His name is [Bill] Rittenhouse. He's a wonderful man. He was the Baptist minister across the street here for a long time. In fact, he built [the] Baptist church [in] Nassau Bay. He was also a B-24 bomber pilot in World War II, and he was shot down over Romania during the Ploesti air raid. He was in the Romanian prison camp for the rest of the war. He didn't want to be a preacher, but his

dad was a preacher, and he knew the Bible, and so he [was] forced into service by the prisoners that were in the camp.

Then the Romanian commandant found out about him and came to him and said, "You've got to be the chaplain for all the other POW camps around the area." So [the commandant would] come [to Bill] every Sunday and put [him in] a Romanian military officer's uniform…and off they'd go through town. The commandant would go with him, and they'd go to all these camps. Rittenhouse would give a sermon, and then they'd go sit in the park and chat and have a good time. Then he'd take [Bill] home, [where] he'd take off the uniform and put on his prison garb again. He did that every Sunday. In fact, about ten years ago he went back and had a reunion with the guy. So it was quite a nice story. He wrote a book called *God Is My Co-pilot*, which I think was made into a movie. He's a very nice guy. Anyway, he's the guy that helped Jim set up High Flight Foundation, and they all moved to Colorado Springs….

WRIGHT: Well, you and Jim shared one thing, or more than one, but one for sure thing in common on the mission is the first time that you both had flown. Did you have any apprehensions about sitting on the launch pad before you took off, or you felt like you were fully trained and you were just ready to go?

WORDEN: …To refresh my mind, I'd have to go back and look at the EKGs [electrocardiographs]. It would be interesting to find out what my heart rate was, sitting on the launch pad, because I don't remember it going up very much. I think it probably did a little bit.

I don't remember being particularly nervous or anticipating anything or really being concerned about it.

I do remember that the night before launch, my whole family was down in Melbourne [Florida] and there was…a pre-launch party [that] they [attended]. I remember talking to them at the party and giving them a little talk and thinking at the time, "This is my goodbye." I mean…I may not come back. So, "So long, everybody," and I don't expect to come back…. If I don't come back, I guess the compensation is that you'll be known forever. I think the three guys at the Cape in Apollo 7 or Apollo 1 fire, their names will be known forever. The *Challenger* people, maybe not quite as well, because there were so many more of them, but I think anybody who got lost on a lunar flight, especially if you got lost at the Moon somewhere, I suppose that's…compensation? I don't know. …But I wasn't worried about it. I was not worried about not coming back.

I figured that if something happened on the flight, chances are, we'd be able to work around whatever the problem was. And if we couldn't work around the problem and we're dead ducks, then that's the way it is. That's what explorers do. That's what test pilots do. We all take that risk every time we step out our front door every morning. It's just that we've got an event going on here which kind of puts a lot of focus on it. But I guarantee you, more test pilots die testing airplanes for this country than have ever been lost in the space program, and they accept that challenge. They accept that risk.

I actually thought that I'd figured out the Eastern mind, that what's going to happen is going to happen, and you approach whatever's going to happen calmly. If something goes wrong in flight, if you're not calm, you could probably make it a lot worse. So your best chance of survival is to be calm, react calmly, get your checklist, go through it, do what has to be done.

But if you panic, you're probably going to be dead…anyway, so it doesn't pay to get excited. In fact, it can harm you, and you just sort of train yourself that way. You just say, "This is going to be okay." And if we blow up ten seconds into the flight, as long as I didn't cause it to blow up, that's the way the game goes. I just wouldn't want to be the one to cause it, that's all.

WRIGHT: Is there a time in your career especially preparing for this mission that you found to be the most challenging, that might have tasked all your enthusiasm or all your ambition where you thought, well, maybe you're in the right place at the right place, maybe you didn't make that right decision of becoming an astronaut?

WORDEN: No, I never had that [feeling] in the astronaut program. I did in the Air Force. I very seriously considered getting out of the Air Force at one point because I was very unhappy with the quality of the people I saw around me. I'm not a snob, but…maybe half of the pilots in our squadron were guys who just liked to fly. That's all they wanted to do, just fly. They'd go up and go around in circles. They didn't care, just wanted to fly. And yet the Air Force is a lot more than just flying.

The Air Force is a hierarchy of management levels that have to decide how we're going to [do] certain things…. If we go to war, they've got to organize it and manage it. You can't just be satisfied with flying, that's what I'm saying, if you really want the Air Force or the country to be where it's supposed to be, and yet half the guys in my squadron were just pilots. That's all they wanted to do.

I used to write to my old tac [tactical officer] at West Point and say, "This is really awful. I'm working for guys who don't even have a college education…." They graduated

from high school. They were World War II guys, young eighteen-year-old World War II guys who got in the Air Force, went in the cadet training program, never had any college. Some of them didn't even graduate from high school. Here we are, in 1957, twelve years after the war, and they're captains and majors, and they don't like young guys with an education coming up and pushing them from below.

So there was this kind of a division, and I used to get very discouraged and write [my friend] and say, "You know, I just don't think this is for me." He said one thing that made me stay in the Air Force and do what I thought had to be done. He said, "If you get out of the Air Force, you're just going to leave it to them." I thought about that, and I said, "Yes, you're probably right. Somebody's got to be around when these guys are gone, to do the job right. Whether that's me or not, I don't know, but if I get out, it sure as hell won't be me." So I stayed in.

Never really had that in the astronaut program. I loved it. It was a great thing to do.

WRIGHT: Do you have a specific time or a significant moment of accomplishment during your astronaut career that you feel is the highlight of your program? What would you consider your most significant accomplishment in your career with the space program?

WORDEN: Hard to tell. The flight was probably the most significant thing in the program. Intellectually, I think there may be more significant things done outside the program. Going to the Moon [was] like flying an airplane. It's a skill that you learn. It takes some knowledge. It takes some analytical ability if something goes wrong, but outside of that it's like driving a

car…it's a skill-oriented thing. So I kind of divide what turns me on more into the intellectual side than maybe into the skill side.

Doing some of the things I did at Ames were probably more intellectually stimulating to me, but the pure thrill of doing something was making the flight. That had to be—I don't want to say it's a high point. It was a significant point of event in my life. I think learning to fly initially was a high. Going to test pilot school was a high. Making the flight was a high. But I have a hard time differentiating.

I went to a test pilot school…in England. I lived with the English people. I lived in the countryside. I was in a group of thirty guys that were Royal Navy, Royal Army, Royal Air Force, Indian Air Force, Italian Air Force, French Air Force, Canadian Air Force, Australian Air Force, and three of us from the States. Wonderful environment. Wonderful atmosphere that we had there. Just met all these different people from all over the world. That was a high to me.

Yes, the flight was a high, but it was a high in a kind of different way, and I would not say that it was the high point of my life. I think there are other things in my life that I consider more significant from an intellectual standpoint.

Even losing something sometimes is more significant. I ran for the U.S. Congress in 1982 down in Florida, and I lost, but that was a very significant thing for me. I thought that was one of my better attempts at something. I probably should have [run] again, but I didn't. I decided that once was enough, and I'd lost too much money in that. But I really think that was a great thing to do, and I'm proud of that, even though I didn't win.

So there are lots of highs, but they're all kind of different categories. Some of them have to do with doing things, driving cars and flying airplanes and things. And others have to

do with…what's going on in this country and what's important to us and where should we be going, the intellectual side of things, and those were just as important to me.

WRIGHT: An interesting change of pace for you to be part of the Congress and having insider knowledge of how NASA's run as I was curious earlier in our conversation of how you must have felt when you learned that Congress had canceled the rest of the Apollo program at a time not too long before you were getting ready to fly.

WORDEN: Oh, I don't think it was Congress that canceled it. Maybe you have more information than I do, but I think it [was] NASA management [that] decided to cancel the last three [flights], for a lot of reasons…. They wanted to put the money into the Shuttle program for one thing.

But number two, and primarily, we'd [had] six landings by the time 17 finished. We had not lost a crew. Every flight was more successful than the last one. Any more flights, the only thing that could happen somewhere along the line is we could lose one. I don't think NASA management was willing to stand up and be counted and say, "Yes, that can happen, but we need to do it anyway." And maybe we didn't need to do it. Maybe six flights was enough to find out what we needed to find out. But I do believe that a major part of the consideration that canceled those last three flights was NASA management's concern that we might lose somebody in flight.

WRIGHT: While you were part of the program, you worked with a variety of personalities and people, some very close and some very casual. We talked earlier about the Apollo 12 crew that

you worked so closely with. Could you tell us some times that—how you got to work so closely with them? They were, of course, an all-Navy crew, I believe.

WORDEN: Yes, and we were all Air Force. So we were the perfect backup crew. They had their cars painted gold and black, and we had ours painted red, white, and blue. So [whatever] they did we…did the same…thing. They were a wonderful crew.

Dick Gordon at the time was probably my closest friend because I did everything with Dick. He was the prime command module pilot, and I was the backup command module pilot. We went everywhere together. We were in an airplane every week together, and we had fun, even though we were working hard. We had a lot of fun. Dick is a great, great guy.

I probably did more things outside the program with Pete than with anybody, certainly than with my own crew. Pete Conrad and I raced cars down in Florida together. We had a little team we had put together down there, and he and I and a fellow by the name of Jim Rathman would go racing through Florida and with little Formula Vs, and we'd have fun on weekends…. We'd meet at the Ontario Speedway in California, and Pete would be racing in the big race, and I'd be driving a little Formula V around. …We had that in common. I didn't know Al Bean that well, but certainly I was very close to Dick, still am.

I was a lot closer to Pete, although Pete's the kind of guy that's got a million friends, or was. Everybody knows Pete, and so it's hard to be close to Pete because he's got so many friends. He was a unique individual, very unique. He was a good commander. He took care of his crew. Their crew was very cohesive. If one of them did something, they all did it. They were very close-knit. Our crew wasn't like that. We were not close-knit at all. In fact, we didn't always see eye to eye on a lot of things, and so we weren't so tight that we all had to do

the same thing. But Pete and his crew were, and it was a kick watching them drive down through Cocoa Beach, these three cars all gold and black, one right after the other, and they'd pull up there in the parking lot somewhere, one, two, three, and, you know, they were like the Three Musketeers. They were…known by everybody. Pete…was outspoken.… He was the guy that kept everybody in stitches and had funny talk…. It couldn't have been a better crew to be backup for….

WRIGHT: Soon you'll be celebrating another anniversary of your mission. Is there something that, when you look back on Apollo 15 as a whole, that you want people to know that your mission stood for?

WORDEN: Yes, and I think it's kind of recognized by a lot of people that even with all the problems with postal covers and all that, Apollo 15 still comes through as the most…successful scientific flight of the entire Apollo program. I think we did more science. I say "science." I use that term like there's a shovel out here that you're piling it on. But I kind of feel like we were more dedicated to the science. We tried to do more than we were capable of doing, and generally we did more. We accomplished everything we set out to accomplish.

A couple of days before the flight, we were sitting and looking at the flight plan and saying, "Wow. We've really got a lot of stuff in here. You sure we can do all that?" We were saying, "Well, it's easier to take it out than it is to put it in, so let's leave it, and if we've got to let something go, we'll let it go." Well, we didn't let anything go. So we ended up doing [about] 115 percent of the assigned objectives we had on the flight.

Yes, I think that's a good mark. We had a good flight. We did what we were supposed to do. We brought back so much data, they'll never get through it all. I just think we did a better job of the science than any other crew. As far as getting there and getting back, what can I say? We had so few problems that it was like flying to L.A.

…I think our analysis was correct in that the science was really the objective of our flight, and that's what we did well.

WRIGHT: Before we close today, I definitely wanted to ask you if there was some aspect of your career or some topic that we haven't covered yet that you would like to talk about before we close out or is there any comment you would like to make, so that we can include that as well on this oral history.

WORDEN: …We've sat here now for a couple of hours talking about Apollo 15, about the crew, about the Apollo 12 crew. We've talked all about the crews. We've not said anything about the people down here on Earth that made it all happen.

There's kind of a philosophical discussion going on about who was in control of each flight. Was it mission control, or was it the commander on the flight? That could be a very serious kind of discussion if it ever got out of hand.

It's quite clear to me that we could not have made the flight without the people in the mission control room. There is just no way. …You cannot make a flight like that work if you don't have the guys in mission control, and you can't make a flight like that work unless you [have a] crew on board. So there's a synergy between the two, mission control and the crew, and it's immaterial who thinks they're in control at the time….

[I've read] words from some of the mission controllers that they were in control. Then I see comments from some of the flight commanders that that's not true. Just go back to Wally Schirra's flight of Apollo 7 where he told everybody what they could do and [that] he [would] do his own thing, and it's the commander who's in control, and he's going to do what he has to do or wants to do. That's all nonsense stuff.

NASA for years and years and years—it's been over forty years now—has just put together probably the best all-around crew the world has ever seen to do these kinds of things. That includes the crew and the people on the ground. And it's not just the people in mission control. It's the flight planners, it's the suit techs, it's the crew personal equipment people, it's everybody that gets in the act to make a flight possible. You couldn't do it without all that.

I think it's wrong and I think it's harmful to try and put the emphasis on one or the other and say, "You weren't in control. I was." I just don't think it's right. We've got a wonderful crew on the ground here, and I think they're…unsung [heros]. I think they're not given the credit that they're due. We tend to focus on the crews. I don't think we focus on the crews today as much as we did thirty years ago because there're so many more of them, but at the same time I don't think we focus on the mission controllers anymore today than we did thirty years ago. They're in the background, and they're kind of [unappreciated]. I think that's what's unique about this program, what's so wonderful about it.

WRIGHT: It's definitely a team effort. There were times we didn't talk about it, maybe we can now, that you served as capcom.

WORDEN: Oh, yes.

WRIGHT: And you were a bit a part of that whole atmosphere with the flight controllers. Could you share some of those experiences with us?

WORDEN: Yes. As a capcom, you do get into the mission control atmosphere. As the pipeline to the crew, nothing happens that gets to the crew that you don't facilitate. So you do have a certain edge over everybody else in Mission Control. You can say, "No, I'm not going to tell them that," or you can say, "Yes, I'll tell them that, but I'm going to tell them in a different way." You can change what's going on. …A capcom could [challenge] the flight director…if he really, really got upset about something. But your work—it's a team effort, so you don't. [The] capcom [was] not the guy who decided what [to do]. The flight director…[or] mission director [does], whatever we want to call him. But I think everybody in that room has to be mindful of the fact that the capcom is part of the crew, not part of mission control. He is the mouthpiece for the crew, and he's the funnel for mission control to get information up. So, again, it's kind of a symbiotic relationship between the crew and capcom and mission control as to how all this gets done, and one can't exist without the other.

I remember, heck, we had three, four, five capcoms all at one time in there. You know, mostly it's guys that have decided that they want to get down on the floor there and see what's going on and they're not going to talk to anybody, guys who have already flown. Generally, the guys who flew the last flight are sitting in the mission control room a lot of the time because…they just did it, so it's fresher in their minds than anybody. They were there. So they're there in case anybody needs them, and the capcom could ask them a question or say,

"Hey, Dick, what about this," or that or something else. Or, "How did you do that on your flight?" and maybe sort some of these things out. Read Gene Kranz's book.

WRIGHT: I have.

WORDEN: That's a good book.

WRIGHT: It's a good book.

WORDEN: And I think we need some more books like that, from that perspective.

WRIGHT: One of the things that we learned, too, by doing research is so much of what the astronauts, or astronauts who have not flown, the assignments that they have, and you mentioned one of yours was to be out in California after the Apollo 1 fire. Could you elaborate a little more and tell us about what part of those duties were, and how you were able to help solve that situation?

WORDEN: Well…they assigned, after the fire…a team to basically reinvent the command module. …The fire was not caused by the hatch, but the hatch is what cost the three lives, because they couldn't get [it] open. The fire was caused by an electric spark inside that touched off all the foam rubber they had inside in a pure oxygen environment. It's like an explosive, and the guys didn't have a chance.

So they put together a team headed by Frank Borman to reinvent, if you will, the spacecraft. We came up with the hatch that's on it today, or that was it till they quit using it, that opened only outward. The original hatch, you had to pull the hatch inside, put it against the frame from the inside, and bolt it down. That provided the pressure seals. If you get in space, you [have] pressure inside the spacecraft, you [have] zero pressure on the outside, and that pressure inside is helping to maintain that seal.

The problem is if the pressure goes way out of sight inside, you can't get that hatch open. …The pressure vessel on the spacecraft burst at about 32 psi, something like that. I mean, it was astronomical in terms of what it should have been. That had to be redesigned.

We looked at all the flammability, all the things inside that could be flammable. That's when we switched to covering everything with beta cloth. We had to look at all that. We had to look at all the wiring. We had to look at all the malfunction procedures. I mean, it was a complete sweep of the whole thing. It was a monumental task, and Jack Swigert and I were out there every week for over a year, five days a week, working that problem. It took that much.

At the same time, Jim Irwin and Ed Mitchell and some other guys were going to Bethpage and doing the same thing with the lunar module, because we figured [it had] the same kind of problems. Maybe [what] we…[found] out from one [could] translate…to the other.

That was a very significant program…long term, but I think with all that hard work—I was really surprised that we got flying as quickly as we did, with all that had to be done from that, but North American really answered the challenge and did it very quickly. They were very good.

WRIGHT: Are there other assignments that you recall that you'd like to share with us that weren't associated with flights?

WORDEN: Well, that's the most significant one that comes to mind. There're lots of other things that we all did then. I guess looking after my own experiments before flight was what took most of the time once I got assigned to the flight. Making funny little cards for Pete Conrad to read when he's on the lunar surface was another one. [Laughter]

WRIGHT: Any cartoons that you did as well?

WORDEN: We did a few cartoons for Pete. One of them we gave Pete was, "It may not have been a big step for Neil, but it was a giant leap for me," because he was a little, bitty guy. [Laughter] So we did those kinds of things, but all in fun. As far as other projects that I did, no, I didn't really [have] any that weren't directly associated with getting ready for the flight.

WRIGHT: You said you were from Michigan and grew up on a farm, but yet many of your years you spent here in Houston. What was your thoughts of getting to move to the Gulf Coast?

WORDEN: When I moved here in '66, I liked it. I loved the fact that I could build a house in Nassau Bay that was completely covered with trees. I drive by it now and the one big tree that was there is gone, so it probably got too big. This is a beautiful area. I love Clear Lake. Every Saturday you'd find me in Clear Lake doing something, mostly water skiing with [R. Walter]

Walt Cunningham. When we weren't doing that, we were over down in Galveston or some other place. I loved it here.

As I lived here, as the years went by, I got to like the heat less and less, and the humidity. I now live in Florida where we've got the same heat but we don't have the humidity, but even that I'm getting very tired of in the summertime. So we're looking at doing something back up north for this summer if we can.

It's funny, the heat and humidity has an accumulative effect, I think, on you, and every year it gets a little worse. I can remember having some bitterly cold days here. I can remember cars getting stalled under overpasses because of the rising water, just all the fun things that happened back in those days, but back then I thought this was a wonderful place to live. Charming. Nice people, and smart. I'm very glad that my two daughters went to school here. I think they got an excellent education over here at the high school. They both went on to college. It was a good school.

WRIGHT: And you have ventured off into business ventures, and is there anything you would like to share with us about your after-NASA career?

WORDEN: Whatever you'd like. I've managed to retire several times from different things. Mostly I've tried to do my own companies. One of the reasons I retired in '75 when I did is because I just sort of got fed up with bureaucracy. So I decided that if I went to a big company, it'd be the same thing. So I said, "I'm going to do my own thing." So I've had several companies and built them up and sold them. Not a lot of money, but a lot of fun. I have some inventions out there now that I've licensed to various companies and we're hoping that they will

become successful. Just lots of things. There are lots of interests out there. I think the worse thing of all is to retire and say, "Well, that's it. I'm done," and sit in a chair. Can't do that. My wife tells me I can't sit more than a day. I've got to be doing something. Fortunately she's the same way, so we [unclear]. [Laughter]

WRIGHT: Well, we certainly thank you for sitting with us today and sharing with us many of your experiences. We wish you well in whatever you choose to do in the future.

WORDEN: Thank you. Thank you very much. A pleasure to be here.

WRIGHT: Thank you.

[End of interview]