NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

JOHN H. BOYNTON
INTERVIEWED BY REBECCA WRIGHT
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WRIGHT: Today is March 19th, 2009. This oral history interview with John Boynton is being conducted for the Johnson Space Center Oral History Project in Houston, Texas. Interviewer is Rebecca Wright, assisted by Jennifer Ross-Nazzal. We thank you for coming back and visiting with us again. We'd like for you to start today by providing the details of your experiences when you were working in the Mission Planning and Analysis Division during Project Apollo.

BOYNTON: I wanted to work in Apollo Mission Planning when I came here, but a guy named Joe [Joseph V.] Piland talked me out of it and said, "We need you in Mercury." So I was so glad to come back into the fold, because I did Apollo mission planning at General Dynamics. I wanted to do that again. John [H.] Mayer, who was head of Mission Planning and Analysis Division, wanted me to come work for him. I did. He set up an office called the Apollo Trajectory Support Office. They always liked to use acronyms, so that was called ATSO. He had a guy named John [P.] Bryant heading it up. He said to me, "John, as soon as you get your feet wet and you know your way around, you're going to be heading it up."

Well, I had some personality conflicts with John [Mayer], and that never happened. He never did make me head of that office. But that's okay. Bryant did a good job. I was his servant. I worked in that area for about a year and a half and did some good stuff. At least I was made the mission engineer for what in those days was called Mission F & [Mission] G.

[Mission] F was when we go to the Moon but don't land; G was when we go and land. It was a generic job, because that was early in the program. That was '63, '64. So I was the mission engineer for that, a term that I had never heard before, and I don't think anybody else did. But basically you were in charge of designing the mission.

Then the Apollo Program Office decided to set up what's called the Apollo Mission Planning Task Force [AMPTF]. Probably my most important contribution of all the 11 years I was at NASA was being a part of that AMPTF, Apollo Mission Planning Task Force. Jack [John R.] Sevier was the chairman of our group. The guy in Grumman, Tom Barnes, was the official head of it. The AMPTF had representatives from all the contractors, North American [Aviation], MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts], Grumman [Aircraft Engineering Corporation]. Myself from Mission Planning and Jack were the main characters on the panel, but we had all these other people contributing. We met sometimes three times a month but usually about once a month. We would go to the various plants, but almost all the meetings were held at Grumman, because Tom Barnes was the official leader.

The purpose of the Apollo Mission Planning Task Force was to make sure that we could come up with a mission that everybody could fly, all the systems would work, all the crew could do all the things we told them to. We didn't want anything to be a surprise when we flew to the Moon. We came up with what was called a Design Reference Mission; the first one was DRM I. Then we wanted to modify that because it wasn't quite inclusive enough, so we came up with DRM II. Then the final one, the report was about two inches thick. The final one was DRM IIA. That was the one that everybody finally designed their systems and timelines on. By the way, that came out after the Apollo 1, the fire and it included the new Block II spacecraft. So if anybody

says, "What did this guy do?" I helped come out with the DRM II. I honestly don't think we could have gone to the Moon by 1970 without that.

Now a lot of things allowed us to go to the Moon by 1970. Not the least of which was the Apollo 1 fire. But the DRM II—it was the Bible. So that was probably my greatest part because I had to go back to the Mission Planning Division and get all the data that they needed to go into that report. We had to work closely with the crew. That started when I was in that early phase of Apollo Mission Planning.

Now [Christopher C.] Kraft in his infinite wisdom says, "We've got some guys that show great promise in our divisions that we want to groom to be managers." John [G.] Zarcaro was one of them and I was another one. Smart kids that were going to go places. What's interesting is both Zarcaro and I went to and graduated from MIT. Zarcaro went on to become a great manager and then he started his own business and now he's very wealthy. So he's a very successful guy. Zarcaro and I went up and worked on the Directorate staff. We worked for a guy named Dennis [E.] Fielder. That was supposed to be a temporary job. One year we were going to go up there and we'd cycle through and then we'd go back and supposedly do something really important in the Division. I worked on that for—it turned out to be almost two years. I think partly because we did a good job, but partly because Kraft was so busy.

The purpose was advance operations planning. The reason for the office was this. Beginning in about 1964, [NASA] Headquarters was sending down messages to the various centers, particularly the ones that were involved in manned spaceflight. "What are we going to do after Apollo? What are we going to do after Apollo," because they wanted to be able to go and lay the groundwork for funding. As early as '65 we were sending out studies to Headquarters and other places. They kept coming to Kraft, and there wasn't any place in the center that you could

go and say, "You guys put this report together," because they were all involved in operational missions, particularly Gemini.

They told Dennis to do this, and Dennis actually didn't like to write. He was a very verbose guy. He got Zarcaro and me to do that to help him. So, that's what we did. We looked at Space Station. We looked at Skylab. We looked at planetary missions. We looked at Venus. We looked at post-Apollo and lunar base and that kind of thing. As it turns out, nothing was ever done with any of those studies, which is a shame. So I did that for almost two years. Then they sent me back to MPAD [Mission Planning and Analysis Division] to continue doing what I was doing. I was still a mission engineer on Apollo F&G, which is now rapidly becoming Apollo 10 and 11. And, I was made the mission engineer for Apollo AS-501 and 502.

That was exciting for two reasons. One is AS-501 and 502 were repeats of each other. One was a repeat of the other. It was where they launched the Saturn V, which had the three stages—for the first time. AS-501 was the first time the whole Saturn V had been launched. They took the third stage, which is Saturn IV, and they drilled the Command Module right down in the atmosphere to get close to entry velocity from the Moon. When we came back from the Moon, it was very close to what's called escape velocity. Escape velocity is the velocity that if you're going that velocity, you'll leave Earth's magnetic field and go away. When you go to the Moon you go very close to escape velocity, which means of course when you come back it's the same deal. So I'm thinking escape velocity is like 36,000 feet per second or 25,000 miles an hour. We came back at 24 something. I don't remember the entry speed for AS-501, but it was close to that. The S IV stage just drove it back in the atmosphere, and then it separated.

They found out a lot from those two flights. But the other important reason was I got to go down to the Cape [Canaveral, Florida] and see the first Saturn V launch. What an experience that was. It was just unbelievable, the power of that launch.

Then I worked on the F & G missions as they gradually became [Apollo] 10 and 11. Then [Donald D.] Arabian, who was head of the Test Division in the Apollo Program Office, needed somebody to do the postflight reports, like I did in Mercury. There wasn't anybody that wanted to do them. They had one guy but he wasn't a technical person, he was simply a technical editor. They didn't have a technical person to write those reports, and you really couldn't find anybody. I hate to say it, but most engineers simply can't write. So I got roped into that job and pulled out of mission planning in '68. But personally it wasn't so bad, because basically all the planning for Apollo 11 had already been done in 1967, so all of that had been done. That was nailed. They were building the spacecraft actually. They were making it.

So I went over to work for Arabian, and again, it was another case of personality conflicts, because I have a lot of personality conflicts. Arabian is a guy that likes to dictate, like a tyrant or a dictator. He's ruthless actually. I got to where I hated him. But when I went over there he said, "We're going to have a thing called a Mission Evaluation Room." It was actually a wonderful idea. In the Mission Control Center, you have specialists who are sitting at the consoles, and they're flight controllers, and they're trained to be a flight controller for their system. Like they have the guidance officer. They really know very little about the design and operation of the guidance system, but they know how to find out if anything's going wrong. So that's their job.

Then they have a Staff Support Room. In that Staff Support Room there are experts from NASA who know more about the design and operation of their system. If they have any problems, they can call a contractor guy into that room. But the idea for Arabian's job was to have a Mission

Evaluation Room over in Building 45 which would support the staff support rooms. That's where the contractor people could hang out during the flight and watch all the data, the same data that they would see in Mission Control, only they didn't have any decision authority, but they were there in case something like Apollo 13, they were really busy. All the systems were involved in that. I can tell you that. To get those guys back up.

I was going to be the head of the Mission Evaluation Room. In fact the first mission that I was over there, I was head of the Mission Evaluation Room for Apollo 7, which was the first manned Apollo flight. Then when Arabian found out that I wouldn't do everything he wanted me to do, because I didn't believe in it, I didn't have that job anymore. But that's okay. So I wrote all the postflight reports for Apollo, beginning with Apollo 7, the first manned flight, up through Apollo 13 which of course was a tragic mission. Then I got caught in the first reduction in force and was sent back to Mission Planning. So I didn't do any postflight reports after Apollo 13. But actually the rest of the flights were routine, and Gene [Eugene A.] Cernan will tell you that. He flew the last flight. So [Apollo] 14, 15, 16, 17 were fairly routine flights. I don't remember any major problems. They came up with the [lunar roving vehicle] rover, which was wonderful. I didn't know anything about the rover, because I went back before that, but great design. They went to a lot of different sites on the Moon, and basically it was a very successful program after [Apollo] 13.

WRIGHT: Could you take just a few minutes and share a little more information about these postflight reports? Why they were important and what all was added to make them what they needed to be?

BOYNTON: In Apollo, we had a higher priority for the reports, because when Mercury started flying after [John H.] Glenn's flight being so successful and the general public being so interested in it, they weren't much interested in the flights after that, because they were kind of repeats of the same thing. [Walter M.] Schirra's flight was twice as long as [M. Scott] Carpenter's. Carpenter's was the same length as Glenn's. Finally [L. Gordon] Cooper went into a flight that was over a day long, but by that time people were "Ho hum." But in Apollo everybody was interested. We had what's called the three-day report and the five-day report. It was just a little summary of everything that went wrong, and what did we think, what it was that went wrong and why it went wrong, with the understanding that we could change our minds completely after that.

Then the postflight memorandum report, which is similar to Mercury, came out I think in 14 days. It's still a phenomenal report. It was about that thick [indicating thickness]. But it had all the details and everything we knew from testing down at the Cape. Still almost all the testing took place down at the Cape. So that was a very important report, because it went to all the contractors to say, "This is what you better fix for the next flight." That's one reason it was a 14-day report. We were trying for a two-month turnaround on flights. We wanted to be able to keep that. The 14-day report was going to help that.

I know we came out with a postflight report in 21 days sometimes. We had to keep extending it to make it right. Apollo 7 was an eleven day mission, a long time in Earth orbit. They stayed in orbit the whole time that they were supposed to, but they had a lot of little two-bit problems. I do remember that we had like 35 or 40 what we called anomalies, things we had to chase down, not the least of which was Schirra had a cold and he [later] became a spokesman for what was that?

ROSS-NAZZAL: Actifed.

BOYNTON: Yes, Actifed, for years and years, because he was having a rough time. Schirra—I got to say a little anecdote. Schirra had a temper, and he was a friendly guy, joke any time you wanted, but you push him so far and he went over, and he was cussing the ground [Mission Control Center], and they were fighting with him. They turned off the air-to-ground voice so people around the country couldn't hear it. They were basically ready to bring him home early, because he wasn't doing what they wanted. He said, "Look, I'm the one up here, I'm sick, you leave me alone." So there was a big battle in Apollo 7. I think the reason was they were having so many problems. The ground said, "These are serious," and Schirra was saying, "No, they're not," because he wanted to keep flying. They all want to keep flying. I remember that mission had a lot of little tiny bad things going wrong.

At the time I worked at NASA, I didn't know why they did Apollo 8. I found out later they did it because they thought the Russians were going to go to the Moon, but I didn't know that at the time. So when they decided to make Apollo 8 a lunar mission, of course that made me feel good, because I was the mission engineer for the lunar missions. The interesting thing about Apollo 8, as I remember it, is almost hardly anything went wrong. It was a really really successful flight. Now they didn't take the LM [Lunar Module] with them. They went out, with just the Apollo [Command]/Service Module. They didn't go into orbit, which was a risk right there, because that burn is behind the Moon. It worked fine. I don't know if you remember, but the Earthrise was the first picture, and that is so famous. Frank Borman was the commander of that mission. I have to tell you right now all the astronauts that I knew—let's say a couple dozen that I met—Borman was the smartest guy. He really, really was bright. When we came back and I

had to debrief him with all the other systems people, it was a joy to be in the room and ask him what went wrong and how did this happen and to hear him talk about it. Because he knew what he was talking about. Of course he didn't have a lot to talk about because the mission was incredibly successful.

I remember how proud I was after Apollo 8, almost more so than Apollo 11, because we went to the Moon. By the way, one thing I'm going to say later, and I want to make a point now, is when we go to Mars we ought to go into orbit first and not land, because it's so risky. I've been telling people that for at least three decades. I've written letters to Presidents. If we go to Mars we ought to go into orbit, because that's what we did on Apollo 8. The risk was a lot less. If we had said, "Okay, we'll send Neil [A. Armstrong] and Buzz [Aldrin], and they're going to land this time," bad things could have happened.

Then on Apollo 9, that was an Earth orbit with the LM to test out the whole stack. It's a good thing we did that, because we found some problems that it would have been kind of hairy if we'd found them out at the Moon. So 9 was a good mission as far as developmental. [Apollo] 10 was the one where we went to the Moon and we went through all the steps except we didn't land. A lot of the astronauts—and I'm included in the group of engineers that agreed with them—thought it was a wasted mission. Since everything was working, why didn't we just go down and land? Well, that was [Thomas P.] Stafford, Cernan, [John W.] Young. So basically we went all the way up to the Moon, we took all those risks, everything was working, they went right down to the lunar surface, and then they didn't do the final burn. They came back. So that's the feeling. All the systems people and the engineers wanted them to go ahead and just go ahead and land, because what if [Apollo] 11 had failed, had to bring them back early. But that's the way life is. [Apollo] 10 was successful from that standpoint, then we flew 11 and that worked.

I want to tell a story about [Apollo] 11. Neil was a self-contained guy. He didn't expound very much on anything. He liked what he did. He was a test pilot. But when everybody asked me how did they come to choose Neil Armstrong to be the guy to land on the Moon the first time, the answer that people always gave—and I was familiar with the astronaut selection procedures—they said, "Well, his turn just came up." We were training for lunar missions. We had two or three crews doing that. When we finally said, "Okay, [Apollo] 10 was good, we found out what we needed to with 10; [Apollo] 11 is going to be a landing mission," we didn't say, "Neil is going to be the one to be the commander," he was the next crew up, he was the most trained, let's put it that way. So his number came up. I tell people this, because very few people know it. He was under investigation for three flight failures prior to that. I don't think they ever resolved any of them. Now they knew a lot more about some than others, but the first one was an X-15. He crashed an X-15 and the plane broke right in the middle and went skidding down the runway. Well, fortunately it didn't start a fire and he lived through that. But they don't know whether it was pilot error, the way he landed, or there was something wrong with the vehicle. He was selected soon after that to be an astronaut. I think they kind of said, "Okay, we'll stop looking at that." Because what if they found out something bad?

So there was the X-15 [crash]. The second one was Gemini, where he and Dave [David R.] Scott were spinning out real crazily and somehow they stopped that spin. In another two or three seconds they would have been dead. Well, dead at some point, because they would have run out of RCS [reaction control system] fuel, and they would not have been able to do a proper reentry. Somehow they would have probably not come back. So it was very lucky about that. Again they don't know whether it was pilot error or whether a thruster stuck or they did something wrong.

That was never resolved. Although they're pretty sure it was a system failure, but it could have been Neil.

Then finally he was in that flying bedstead thing [LLTV—Lunar Landing Training Vehicle] that they had out at Ellington [Field]. It was a jet engine, but they were doing LM simulation landings, and that thing failed, and he had to eject from that. He was at such a low altitude that when he ejected the parachute just barely came out before he hit. Again another two or three seconds and he would have broken his back. That kind of thing. So his three failures that don't speak well for the next one. So you could have said, "Well, why would they choose Armstrong if he's smitten?"

Well, as it turned out, he landed. But I got to tell you this little anecdote. When they got the 1201, 1202 alarms coming down through the final burn [descent to the Moon], they had two different kinds of alarms, but they all said the computer was overloaded. A guy that sat at the console was a guy named Steve [Stephen G.] Bales, and he's gotten several awards for this. They're in the final burn, and I'm going to say the final burn is about eight minutes. So they're like a third of the way through the burn, say two and a half minutes, and they get a 1201 alarm and hear this "beep, beep, beep" on the panel. Neil calls down to the ground and says, "What is this? What is it? What do we do?"

Bales of course had no idea, not even a clue. So he said, "Hold a minute. We'll find out." He went to the Staff Support Room and asked the head guidance guy, and he had no knowledge either. He said, "I don't know what's happening. I don't know why they're getting that alarm." Well, as they're running it around, and they're looking through manuals and trying to come up with an answer, while the burn is still going on, it goes off. So they called back and said, "We don't know what it is. We'll let you know as soon as we do." Of course they know they're still

in the burn. Neil says, "The light went off." Oh, okay, they were hoping it stays off, so they go another minute or two and the light comes on again. Now that might have been a 1202. Again I don't know the details, but it comes back on. So Steve Bales says, "Wait a minute," and he goes back in the Staff Support Room, asks the same guy. The same guy has not found an answer yet. There's an MIT geeky guy standing there—as they did. A lot of the contractors would hover around in the Staff Support Room. This MIT geeky guy—and I have no idea who it was—says, "That's no problem. It's getting rendezvous radar data. It doesn't operate on that anyway. It's not calculating it. Just forget it." So he told the guy in the Staff Support Room to tell Steve Bales to tell the crew, "Continue."

Well, a lot of people got credit that shouldn't have gotten credit for that, and I want to go on record that that's true. Now Steve Bales had a tough job. I'm not saying there's something wrong with him. But he could not have possibly known. This guy, the geeky guy, had the flowchart in his head. He was one of those people. He could go through the flowchart and say, "Oh yeah, rendezvous radar, they forgot to disable."

Now the end of the story is this. Knowing Neil like I did, I was at a party in 1989, a 20th anniversary lunar landing party. Neil and Buzz were there. I walked up to Neil and he knew who I was, because I had worked with him on a previous report. I said, "Neil, I got to ask you a question." He said, "What's that?" I said, "When you were in that final burn landing on the Moon and we didn't know what that 1201 alarm was, if the ground had said, 'I'm sorry, we can't figure it out, you're going to have to abort"—there were all kinds of abort situations that we'd studied, so that was real cut and dried, he would have just turned [the LM] over like this and gone back to the Command Module. I said, "Would you have aborted if the ground had told you to abort?" He had this huge grin. The Cheshire Cat grin. He said, "We'll never know." In other words, he

probably would not have aborted. They would have landed successfully. I want to make this on the record that they practiced manual landings with the LM hundreds and hundreds of times, and it wasn't that hard.

In fact, they used to have a simulator over at Space Center Houston and you could go and do it yourself. Now they have the Shuttle; you can land the Shuttle. But they used to have a landing with the LM. These guys got to be really good at it. It wasn't that hard. It was like flying a helicopter. So I'm sure that if you've seen any of those World War II movies where the guys want to continue the mission and it's saying, "Turn around and abort, everyone's going to die, please turn around," they would say, "Sorry, I can't hear you." [Imitates static.] "You're breaking up." I think Neil would have done the same thing. "Sorry, I didn't hear that." [Imitates static.] Then he would have landed. Everything would have been great. But then you slap people in the face when they get back and say, "I don't care." But I think Neil would have landed, and I think it would have been a successful mission. But it would have been for the wrong reasons. The rendezvous radar problem we didn't know, but it turned out.

So that's the end of that anecdote, but I just love the personality that he had. As you know, Neil just went into reclusion after [Apollo] 11, because he really didn't like all the fanfare. The only explanation I can give you for that—I haven't talked to him about this, but all the astronauts want to give credit to the people on the ground that did all the work, and they will all say that to a person. "I flew the mission, but there were a thousand people that made it possible." I think Neil had an overreaction to that on that basis. It's like the people that survive a crash, and then they feel guilty because they didn't die with the others. I think Neil just was tired of people saying, "Oh, what a hero you are. You built the spacecraft, you built the booster, you did the whole thing."

He'd say, "No, I didn't." So Apollo 11 was a great mission. It was the culmination of my ten years of work in Apollo. Few people worked that long. So I was amazingly rewarded by that.

I have to share one other thing with you. I worked on the radio during Apollo 11. I was a color announcer, whatever you call it. I did a good job. I enjoyed doing that. So I was explaining what happened during Apollo 11. When it got to the time—I think there was quite a wait from the time they landed to when they got out and walked on the Moon. I think they had to take a rest, and that was abbreviated, because they wanted to get out. Then they had to put on their suits, which was a horrible—it was like if you ever watched a lobster shed its shell. It was really hard to get that suit on. So they both had to suit up and then depressurize. Neil was the first guy to go up. But I'm working on the radio, and a guy came down from Dallas that was on the sister station of KMSC—and I think that's what it was, KMSC. He came down. His name was Lincoln Carle. He said, "I'm going to go ahead and take over the mic [microphone]."

Gordon Bassham was the head guy, but he wasn't a technical person. So Lincoln basically told me, "Get out, it's my turn, I want to be famous, I want to make history." So I had to go into the auditorium at NASA, the Building 1 auditorium, and watch it on the screen like everybody else around the world. His wife, who was a very cute young English girl, came in and sat beside me, because he didn't know what to do with her either. So we're sitting there watching it. I have to tell you. Despite the fact that few people knew all the details of that mission and how they did it and how they got on the ground and how they got out and all the suit—it was surreal to me to see that black-and-white image of this person coming down the ladder and making that final hop. It was like I was—an out-of-body experience. It was weird. Again, it was the culmination of ten years of my work, and nights and working late, and not seeing my kids and all that. That was an incredible moment, to see Neil jump to the surface.

[Apollo] 11 was a successful mission. They brought back some rocks. There wasn't anything unusual about those rocks. We were very afraid of a lot of things in Apollo. One of the things we were afraid of was we were going to bring back some microbe and it was going to go around the world and kill everybody, it was going to be something that was totally out of control, we wouldn't have any vaccines, we wouldn't have any—and so to be doubly safe we put these guys in quarantine.

They had to be in quarantine away from the people on the ships when they recovered, and the airplanes bringing them back. Then they went into this fancy Airstream trailer. You know what an Airstream trailer looks like? They're all aluminum. The poor guys stayed in there for two or three weeks. Here are these guys, the most famous human beings in history for that period of time, and they had to stay in the trailer for two weeks, imprisoned basically. I remember pictures of them looking out the window. That was kind of sad, because they didn't bring any microbes back, and neither did any other crew. Eventually they disposed of [the quarantine], because there was nothing on the Moon that was going to kill anybody.

In fact, when I talk about the future of NASA and what we should have done, the Moon simply was not a very interesting place once we got up there a couple, three times. By the way, Jack [Harrison H.] Schmitt was the only scientist to go to the Moon. He was in fact a geologist. I talked to him recently. He was lucky to get on that last flight. That's another mistake that NASA made as far as public relations. To put the one guy that should go in the last mission. What if they'd canceled [Apollo] 17 and said, "Okay, we'll cancel 18, we'll cancel 17," and then—but he got to go. They didn't find any volcanic activity. We thought there probably was. You see all these craters on the Moon. Did any of them come from volcanoes? No. We had seismographs on the Moon and we didn't hear any kind of volcanic activity. There were no earthquakes, there were

no—the Moon was dead. Nothing was happening. There's no atmosphere. Everybody knows that. The gravity is very weak. The rocks were not exotic rocks, like they came from Pluto or Saturn or something like that. They were just plain old rocks like we have on the Earth.

Jack Schmitt knew pretty much what he was looking at. He was only on one part of the Moon. But he went to a place that had a good variety of different soils and rocks. So I'm just going to say right now, because this is the appropriate time to say it, we want to go back to the Moon and set up a lunar base and supposedly farm or extract nice things from the lunar soil. I think it's a mistake. I can't think of any mission that we could fly in the solar system that would benefit from getting stuff from the Moon. I really can't. I don't know how NASA has been sold the bill of goods. But I don't think it's time for us to go back to the Moon. I think we should go to a planet and capture the imagination of the American public.

[Apollo] 12 was a repeat of 11. We just went to a different place. Nothing new came from that. [Apollo] 13, we went to one of the highlands or way up in one of the high areas. So they went to a whole variety of landing sites. I was present in most of those scientific mission planning for the lunar surface exploration. I went out to Flagstaff [Arizona] where the US Geological Survey is located. I even got to hear [Eugene M.] Shoemaker, the famous guy. He was an interesting guy.

So the lunar geologists had a lot of interesting things they wanted to look at. When they found out that a lot of things weren't true that they thought might be true, they had to change. They changed in real time. I think Apollo 17 was the most ambitious geological mission, and that's a good thing that Jack got to go on that, Jack Schmitt.

I don't remember any problems on any of the flights except [Apollo] 13. Let me say a thing about 13. Again, I told you when I started this I have two different audiences that I'm talking

to. One is the technical people that want to see how did we really did that, 100 years from now. The other is the people who are fascinated by the adventure story and don't have much of a technical background. For those people I talk about [Apollo] 13. Number one, [movie director] Ron Howard and [actor] Tom Hanks both demanded that the [Apollo 13] movie be accurate. They had a lot of consultants. I wasn't one of them. I offered, by the way, to be a consultant on that. They had other people. In fact Jim [James P.] Lovell was one of them. The movie was very accurate, even to the point of using acronyms without telling you what they were, and technically what went wrong and the problems they could have had were demonstrated in the movie. I can't think of anything they really left out that was important.

That was good, because I think people are going to watch that film, that DVD, for years and years and years. I want to talk a little bit about the movie and things that happened during the flight. I'm getting more religious as I get old. I have to tell you I'm getting a little bit more spiritual. You talk about divine intervention. There's a story that goes with that flight that's interesting. I'm one of the few people that can tell it. When they're coming close to the Earth they have to make their final midcourse correction. Those are made so they could hit what they call the entry corridor. They had to be within a certain degree angle of the atmosphere or they would burn up. If they were too high they would come in too steep and burn up. If they were too low they would skip out like a rock and they would come in and burn up. In fact I think I said Carpenter almost did that. They had to hit the entry corridor.

That's no big deal. That wasn't one of the ways that they were going to kill themselves. But they had to do a midcourse correction using the Lunar Module engine, the descent engine. The guidance system on the LM was not designed to do that, so they had to do it manually, which means they punched a button, got the rocket motor firing, they held the attitudes, and then they

shut the motor off. The turning on and shutting off is easy. But holding the attitudes is kind of hard, because they hadn't trained for that. They had trained to do it with the [Command]/Service Module. So they told Tom Hanks in the movie and of course Jim Lovell in real life, "You're going to have to hold the angles yourself."

He said, "What am I going to use for reference?"

They said, "We don't know. You got to find a star in the window. Once you get to the right angle that we tell you"—by the way, the ground told them what angles to get to. "You're going to have to look out the window, find a star, and hold that view out the window."

He said, "What if I don't find a star?" Because some stars are bright, some stars aren't.

They said, "Do the best you can." So they go around and they maneuver the spacecraft to the right angle to make this burn. As they come up in one of the angles—let's say it's pitch. As they come up to pitch, it showed the triangular mirror—triangular window of the LM. Lovell is at the commander's console. The Earth comes right up in the window. Could you get a better reference than that?

The odds on having the Earth in the window when they're making these burns are like one in ten million. It's just incredibly improbable. That's in the movie where he says, "What are we going to use for a reference?" and they said, "We don't know," and then Tom Hanks says, "Well, I guess I got a good one, it's the Earth," or whatever he said in the movie. So that's a divine intervention.

There were about three ways that they could have died on that mission if things had gone wrong. We solved every one of those. The ground did a wonderful job supporting the flight and getting those guys back home. I'm not going to go into the details of how they would have died, but one is they could have run out of oxygen. They had to sit in the Lunar Module, cold as it

was—it was freezing in there. Fred [W.] Haise had a fever because he had some kind of a low-grade infection. They couldn't even talk because when you talk you're using oxygen and they would talk like this, "Do you feel okay?" "I'm okay." They couldn't move their arms. The only thing I can claim to fame that is being an artist myself, when they found out that they had a CO2 level in the cabin of the Lunar Module that was getting too high, they had to do something to get the CO2 out, or these guys were going to asphyxiate. The LM was pumping oxygen into the cabin that they could breathe, but the concentration of CO2 was getting so high that pretty soon it would push out the oxygen.

As you know, when we breathe air, it's 27 percent oxygen. Normally they would have 100 percent oxygen in the cabin. So they said, "Look, the only way we're going to do this"—and this was a ground recommendation—"is go in the Command Module and get one of the CO2 canisters." These are canisters that they plugged in to take the CO2 out of the Command Module environment. As you know they spend two and a half days out, two and a half days back. So that was a routine thing, what they called scrubbing it. They had to modify, they had to adapt this square canister to a round hose in the Lunar Module. They had a roll of duct tape on board. This is really funny. This is standard procedure. We had duct tape. So they took this duct tape and they had to tape the square canister to the hose.

The environmental control system people came up with a way to do this but they didn't know how to explain it to the crew, because it was complicated. They said, "What we really need is a picture." So I drew a picture of this, what's called an isometric view, a three-quarter view, so you could see where the hose went in, how the box was taped, and even the taping pattern, because that had to be just right, or you didn't seal the back of the canister. When I finished that drawing

we sent it over to Mission Control and the CapCom, who was an astronaut, then told them how to do it, and the rest is history. That saved their life.

But my drawing. I wish I still had that. In fact, Ed [Robert E.] Smylie, who was the ECS [Environmental Control System] guy, was given an award about a year or two ago for doing that. They had a special breakfast for him over at Space Center Houston, and I was going to crash the thing. I thought it was a luncheon, and I went over there at lunch, and because I knew Ed real well, I was going to crash my way in and sit down beside him and say, "I'm the one that drew the damn picture, I ought to be here too." I got over there at noon and there wasn't any luncheon, it was actually a breakfast. So I missed it.

But that's just one of the ways that we saved their life. It was quite a story, really. We had no way of knowing that we would get an explosion in the tank like we did. By the way it wasn't a bang explosion. It was suddenly an outgassing of the oxygen. We lost all the oxygen, which was running the fuel cell.

WRIGHT: You had mentioned to me before about all the different types of meetings that you attended and what a benefit it was to be able to collect information from all. Share with us how you were able to gather that information, and how it provided an overview of work within the upper management and also down in the trenches.

BOYNTON: I was very fortunate, because I didn't have a top management position, so I wasn't routinely invited to all these meetings. The only reason I went to high-level meetings was a lot of times the Mission Planning people didn't have anybody to send, or they were too busy. Since I really had the ability to discuss anything with anybody, I was sent to a couple meetings at

Headquarters. I even had to pitch stuff to Headquarters when I was on the Apollo study. So I got to see all those high level people. Then I got to go to quite a few high level meetings at JSC [Johnson Space Center], which was MSC [Manned Spacecraft Center] then. I was in quite a few meetings with [Robert R.] Gilruth. But I knew what they were afraid of, and I knew how they kept things secretive. When I talk a little bit about the culture of NASA I'm going to talk about what I found out from those high level meetings. But most of the people that wasted their lives in those horrible meetings that went on and on and on and didn't accomplish anything—and there were a lot of them unfortunately. By the way our AMPTF meetings were always just chock-full of stuff. We never had enough time to do everything. So those meetings weren't wasted, the Apollo Mission Planning.

But then I went to a lot of working meetings. I was secretary on two panels, the Flight Mechanics Panel and the Advanced Planetary Trajectory Panel. I was the secretary, so I had to write up the minutes. I got to see how that worked. I went to a lot of meetings where they discussed physical things. Bill [Howard W.] Tindall headed up a lot of meetings, because he really knew what he was talking about when it came to rendezvous. One of the guys I really respected was Bill Tindall. So I got to sit in in what I call midlevel management meetings. Then I got to sit in on meetings where all the Guidance people got together and said, "This is what we're going to do." I happened to be the guy from Mission Planning. So I knew what these guys did in the trenches, particularly in Mission Planning where I worked. But I also went over to E&D [Engineering and Development] and all these other places and talked to people sitting at their desks.

I knew the concerns of everybody from the lowest guy on up to the highest guy. I knew what they thought of and how they did it and what they thought was important and wasn't

important. Quite frankly there was a lot of difference. We're not going to waste the time to do this, but I could spend three hours just talking about how those environments were different. The thing I want to bring in later when I talk about culture is the paranoia that was evident at the higher meetings. That's something that people should know. So yes, that answers your question.

I saw these guys waste time. I saw some of them working hard. I remember leaving Building 30 and going to my car at 3:00 in the morning when I just finished doing something. Guys were carrying decks, IBM [International Business Machines] decks, over to where the computer building was from Building 30. I knew those guys knew they had to finish that program development. That was what was funny in those days. We fed the programs with all those cards, those IBM cards. Remember the hanging chads? Well, that's what they were. They would carry a deck that's about three feet long. Can you imagine if they dropped that? All those had to be in a certain sequence. Sometimes a guy would drop a deck and then they have to put them—oh, God. But that's what they do in development is they run the program, say a three-foot deck, and this 28th card here has an error in it. So they put a thing in, take out the 28th card, repunch it, and put it back in. All those cards had to be in the right sequence.

But those guys worked hard, and I knew the ones that worked hard, I knew the ones that didn't. Some guys were dumb but they worked hard and overcame their dumbness. Some guys were really smart and they didn't do much of anything. For the most part the really smart guys worked hard though. We landed on the Moon because everybody was conscientious. They really and truly wanted that to succeed. I was one of them.

Let's go on. I worked on Apollo up through Apollo 13, and then I got caught in that RIF, reduction in force. I wasn't kicked out the door. Reduction in force means they have to eliminate certain jobs. Congress said that. That was a congressional mandate. I think it was like 400 jobs,

but the first RIF did not take 400 people. I think it was more like 110 or something. I was one of those 110 that got affected and went back to MPAD. My final job there—interestingly—I told you I had a personality conflict with John Mayer. There were several reasons why he suddenly changed to thinking from I'm Einstein to he hates me. He always wanted me to do what's called contract engineering. Well, contract engineering is where you manage a contract, a small contract with some organization, usually a school, a university, or a very small company. I remember one of them was Booz Allen. Philco [Corporation] had a contract with MPAD which had maybe a half a dozen, maybe even a dozen, small contracts to help them do what they do. A lot of it was advanced stuff, advanced planning stuff.

He also wanted me to do that. Quite frankly you didn't have to have much of a technical background. So I just said, "John, that's an insult. I've got two degrees in aeronautical engineering. I don't want to be something a high school kid can do in managing a contract." That's all it was. Just to make sure they met the objectives and you gave them the money. So every time he asked me to do that I always said no. But then when I got RIFed back I had no choice. It was either that or go out the door, so I said, "Okay, John." For two years I did contract engineering. I hated it. I will make a comment in this time, because it doesn't embarrass me now. But then I would have been embarrassed. I wrote three books of poetry in that two-year period and published them. I started building a house in Colorado. So I started that in fall of '71 and I published the poetry in '71 and '72, so obviously my heart was not in my job. I was doing things outside of my job. But I did whatever they asked me to.

That two-year period was just kind of coasting until I went out the door. I was RIFed out the door in June of '73. I knew that was going to happen. It had nothing to do with ability at that point, because people were tired of NASA. People were tired of Apollo. People didn't care

anymore. The interest, the public interest, wasn't there. Well, as soon as the public interest goes down, the representatives in Washington say, "Well, we don't need to fund that anymore. We don't need to do that anymore." I knew I'd probably eventually go out the door, and it turned out it was a good thing, because I went off and did other things. But I was RIFed out the door in June of '73. So that was the end of my Apollo experience.

WRIGHT: Would you like to talk about some of the managers of Apollo? You mentioned you wanted to talk about Bob Gilruth.

BOYNTON: Let me say the meaning of Apollo and then—because I want to cover that. This is a good place to cover it. Then we'll talk about some of the managers. Apollo showed us a lot of things. The number one lesson was technical teamwork. If you look at it objectively and qualitatively, technical teamwork. I think of the pyramids and the Panama Canal, two huge technical achievements. The pyramids certainly, when you consider when they were built, unbelievable that they could build something that big with those huge rocks. As you know, it took thousands and thousands of slaves, and they died in the process. But it was teamwork. The Panama Canal when it was built, a lot of people died in that, because it was so incredibly difficult, and it was an amazing feat that they did. But we went to the Moon and we had at one point people said 500,000 people working on it. Well, give or take 50,000. That's still a lot of people.

So a lot of people could say, "I had some small part to do in that." Some of them as little as a screw, a stainless steel screw, and some of them were whole systems. That's the number one lesson, is that we could do that. Now the Manhattan Project, as you know, was secretive. I don't

know how many people worked on the Manhattan Project, but it wasn't more than a couple hundred. So suddenly we had all these people realizing what you could do.

Number two, we could capture the national and even the global vision. When [President] John [F.] Kennedy says, "We're going to go to the Moon and we're going to come back safely before 1970," a lot of people said, "How can we do that?" It's such a big jump from what we were doing at that point in aviation. We had jet planes. By the way, the airlines were just starting to use all jets, pure jets. We had prop [propeller] jets, and before that we had propeller aircraft. So when we went to a prop jet, that was quite a thing right there. Even though we still had pure—the 707 I think came out before the prop jets. But there were a lot of prop jets because we had to get in and out of small airports. But the 707 and the 727 were in the '60s. So we're saying, "We're going to go from a fairly fast airliner, a subsonic airliner, to landing on the Moon." We captured the imagination and vision of the American people. Not only that, people around the world said, "God, if the Americans can pull this off, they're really something."

That was my second lesson from Apollo, is that we could capture the imagination and then the third one is the can-do attitude. I don't think we'd ever had anything quite like the can-do attitude—except in World War II. When we finally won World War II—and I can remember that, because I was 11 or 12 years old—it was by God, if the United States sets out to do something, we can do it.

Then finally the astronauts. I want to say the astronauts were simply regular people doing unusual jobs. I think of the first seven being just absolutely regular guys. There was nothing really really outstanding about any of them except maybe John Glenn being such a pure-hearted individual. He was very religious, very Christian. But the other six guys if you take Glenn out of that picture were just plain old ordinary guys you'd meet on the street. But they happened to be

test pilots. They were good at what they did. But if you didn't know what they did you wouldn't know that they were any different from the guy working on your car. I got to know almost all seven of them. I didn't know Cooper very well, and I didn't know [Donald K. "Deke"] Slayton very well. But I knew the other five.

I'm going to tell a little story about each one, but the point I want to make is that we found out that astronauts are just regular people. They weren't the gods that we wanted to make them, like we made [Charles A.] Lindbergh. Glenn really didn't like the idea that they made him some kind of a god, because he was an ordinary good guy, but he was able to go out and speak to groups and say, "Look, what I did was because of a lot of other people." I really liked John Glenn.

But let me say a little story about the five that I know besides Glenn. I can tell you Glenn right now was a straight shooter. Didn't swear, didn't drink, didn't smoke. He was a God-fearing Christian. But I'm going to talk about [Virgil I. "Gus"] Grissom first. I got to know Grissom the best because I worked on his report after I came to NASA, even though it was after the Glenn flight. We were still putting out reports on these previous missions. So I remember working on Grissom's report and realizing that he did a mission that was just a repeat of [Alan B.] Shepard's. Shepard's was a suborbital flight that didn't achieve very much because the Russians had already put a guy in orbit. But at least we got a guy into space. Grissom was just flying that mission over again. A lot of times people said, "Well, that's a waste of time." But NASA had this theory, this part of the culture actually, "If we do something, let's make sure we can prove it's not just luck. We're going to repeat it." So that was the reason for MR-2, which was Grissom's flight. But I got to know him at the Cape, because whenever I had to write a pilot's report—like in Carpenter's case and Schirra's case—they had to take off to do public relations stuff as soon as they scribbled

out this report. I had to edit the thing. Grissom was down there, and he would help me edit it. I got to know him.

He was a fairly quiet guy, very nice, very caring. He was not the abrasive person that people made him out to be, because he had an incident with his hatch on MR-2. I want to make a comment about that. Gus was the kind of guy that would never tell a lie. When the hatch was blown on MR-2, that caused them to lose the capsule, because it filled up with water. The helicopter had to let it go. By the way, Gus almost drowned. He's in there, treading water, treading water.

He's treading water, and he's got this heavy suit on, which is now full of water, so it doesn't have any buoyancy anymore, it's heavy. He damn near drowned. The helicopter is worried more about the capsule. He said, "No, I didn't punch it." They said, "No, you were scared." He was in a heavy sea state, which means he was rocking back and forth. The people who didn't know him said, "You must have been really scared in a heavy sea state. You popped the hatch so you could get out of there, didn't you?" Well, first of all, Gus wasn't stupid. He wasn't going to jump out into the water with his helmet off and risk drowning. So that's one reason you could tell he didn't do it. But he didn't have any marks on his body which indicated—if he had hit that plunger, it recoils back. That's the way it's designed. It would have left a red mark. He didn't have any red mark. So he carried that to his grave, this stigma that he was the one that purposely blew the hatch because he was scared. I can tell you right now he didn't do that.

We couldn't get the capsule back to check things out, because it sank. But I got to know Gus real well. I was one of the people thoroughly affected by the fire, because that was something. They had no way they could get out of the capsule. He died in the fire.

Schirra I got to know because I was down there when he was practicing for his flight. I was down there after Carpenter's flight. I got to know Wally. We'd have breakfast together. He had a sports car like mine. I had an Austin-Healey and he had one just like it. So Wally was just a great guy. Easy to get along with, funny, but you didn't want to cross him. If he got mad you knew he was mad.

Carpenter I've talked a little bit about. Cooper, I didn't get to know him very well, but he was lighthearted and worked very hard at his job. I did know that. I think the image that Dennis Quaid portrayed in *The Right Stuff* gave a perfect depiction of him.

I didn't know Slayton at all, but I do know that he was terribly upset that he couldn't fly and they told him that he had this heart murmur I think was the deal. Then ultimately he got to fly in Apollo-Soyuz [Test Project]. But he was made head of the Astronaut Office as a plum. "We'll give you this little plum so that you won't feel like we're leaving you out." But that was terribly disappointing to him, that he wasn't going to get to fly. Of course he ultimately did.

Shepard I didn't know very well, except I knew him peripherally, because I had a Jaguar sports car, an XKE. They're beautiful, most gorgeous sports car ever made. As far as how it looked. It would go very fast. The astronauts after about 1963, pretty much when Mercury [Program] was getting over, they had a deal with one of the auto dealerships down in Florida where they could buy a Corvette at cost. They could get on it whatever they wanted. They could trick it out, so he always had a new Corvette every year. We would race on the Gulf Freeway coming down to NASA, because he lived somewhere up the Gulf Freeway, and I lived always up the Gulf Freeway. Whenever we came into work at the same time, which was usually 9:00 or 9:30 [am] we both came in late, he would see me, I would see him, I'd hit the gas, he'd hit the gas. We raced for about three, maybe four years. Each time I always beat him, until the last year that we raced.

I remember he got that new 427. They had that 427 cc engine. Huge engine. He hit the gas and I hit the gas, and we were going side by side. I looked at my speedometer, and I was doing 133 miles an hour. The front end of my car was starting to float like I'm not sure I've got control of it. A car was way up ahead of me and it was coming like this at me, because I was coming up on it. I backed off the thing, he went shooting on past. So he never did beat me, but we were tied at that point. I used to race Al Shepard. That's how we lived, 100 miles an hour all the time.

A lot of people don't remember, but he [Shepherd] actually took a golf ball to the Moon. He had a special golf club made. It wasn't like your regular thing you have at the golf pro shop. It was made so he could assemble it on the Moon. It had this little head. Unfortunately he whiffed the thing. He just didn't hit it very well at all. It went about 40 feet. But if he'd gotten a really good whack on that thing with the one-sixth gravity it would have gone 600, 700 yards. That's what he was hoping he could do, because he was a golfer. So that's the end of my stories about the Mercury astronauts. But they were all regular guys. I respected the hell out of them.

Let's talk a little bit about NASA public relations. If I have a criticism of NASA as an agency it's the fact that they've handled the public relations poorly. Now I remember [John A.] "Shorty" Powers. Shorty Powers was an ex-Air Force guy who came on to be our voice on NASA, the NASA voice. Unfortunately Shorty wasn't as smart as all the people that worked it from the journalism side. We had some really great people. As you know, [CBS newsman Walter] Cronkite was one of them. The guy with ABC, [Jules Bergman]. Anyway, they were really good people. Shorty was just happy-go-lucky. He was the one that supposedly came up with the term A-okay. But aside from the fact that we gave this little smiley image of Shorty Powers during Mercury and the original seven astronauts, we didn't do very good PR.

People were interested in Mercury. They followed it. Glenn was a hero. After Carpenter's flight nobody cared. Even though Cooper's flight was a day and a half and it was quite a jump ahead, nobody cared. Now Gemini came back and they did some interesting things in Gemini, but nobody really understood why we had Gemini. I think NASA dropped the ball there, because they could have made it obvious to the American people if they'd done the right kind of things to say, "Well, we're doing Gemini because this is how we're going to fly Apollo. This is what's going to happen when we finish on the Moon. We're going to come up and rendezvous with the Command Module." Let them know that rendezvous was a very critical part. The fact that it was done 200,000 miles away. We're going to have to prove this out in Earth orbit. So Gemini is important. Plus we had two astronauts. It wasn't just one guy going around in a can.

NASA dropped the ball. The biggest thing they did was they didn't really cash in on the enormous public interest that people had. I gave 75 talks to regular groups, organizations, public organizations, like the Rotary Club and the Lions Club. I went to several churches and schools. You name it, I gave a talk to some of those kinds of groups. I enjoyed doing that. First it was Mercury.

I found out two things. I've written this in a letter to Mike [Michael D.] Griffin, and now he's no longer the [NASA] Administrator, but a year or so ago I wrote a letter to him. I told him I found out two things from my 75 talks. Number one is that the general public knows absolutely nothing about space, or virtually nothing. They have no technical knowledge. Even some of the technical people, the scientists and the engineers out there in the real world, they really didn't know much about space. The other thing I found out was that the average person on the street was intensely interested. So you take those two facts. That means there's a whole void that you can throw all kinds of stuff out there and fill and interest these people. We just didn't do it.

Now NASA made piecemeal contributions. They would put things on the Discovery Channel. They had their own NASA channel, which hardly anybody ever watched. But occasionally you'd see something that was interesting, but it wasn't enough repetition that people would say, "Wow, NASA is really a good deal." So I think we really dropped the ball. As a result, after Apollo nobody was interested in doing anything after that. We didn't have anything except [Space] Shuttle, which of course took a long time. We didn't have the funding that we should have had because of NASA doing a poor PR job.

We're still doing the same thing. We're still not really selling the program to the American public. I'll tell you where—and in this letter I wrote to Griffin I pointed this out. They had the first Hubble [Space Telescope] repair mission on TV. They showed these guys out there repairing the Hubble and taking panels off and slow—as you know, when you see EVA [extra vehicular activity] on TV they're doing everything very slowly. It's almost like slow motion. Quite frankly it was fascinating. It's fascinating to me, knowing what I know about space. A lot of the general public watched that first mission and said, "Wow, this is why they have manned missions. Because we have this telescope up there. We found out it had a problem. We send guys out there and they fixed it." Then when it was announced a couple years ago that we were not going to make the final repair on the Hubble, we were going to wait until we put the new one up, and people screamed. Because the general public likes to see that kind of thing.

Well, I wrote that in my letter, that you should reinstate that mission. I'm sure my letter didn't make Griffin do that, but they have now reinstated it. It's going to be delayed for several reasons, but they are going to do it. They're going to repair the Hubble for several reasons. One is, it's going to take a while for the new one to get up. I think it's called the [James E.] Webb Observatory, but anyway it's a brand-new telescope. But the American public is going to see that

on TV again. They're going to make it more public, this new mission, this next mission, the final mission actually of the repair. That's going to bring the public back into it.

The other example I want to give there is the enormous success we had with rovers, *Spirit* and *Opportunity*, on Mars. They got quite a bit of that into the television general public. They didn't have enough of it but they had some of it. Quite frankly I watched it on the NASA channel, and it was fascinating. They've gotten so much more from those missions than they planned. It was supposed to be like three months, 90 days it was going to work. The thing has worked for three years. They found out so much more than they expected to. It's just amazing what they've done. Now that's an unmanned mission. So here I am, a manned NASA guy, saying, "Well, we ought to have more robotic stuff." They need to get that on a regular basis and get the networks to agree to do those, even if they don't sell advertising. In other words, we give them the money they would get from advertising to make an interesting story on ABC and CBS. I think we should do that. We should do that now. We're not doing it.

Okay. Future plans then and now. Well, I think I told you that one of my jobs was when I worked for Kraft under Dennis Fielder. We looked at advanced operations planning. For some reason all the time I was there, even right up until I left in '73 I still was involved in advanced planning, which I loved to do. I was on that Trajectory Panel, which went right through '73.

The reason was that we were always asked to tell Congress, "What would you like to do beyond Apollo? What would you like to do?" That's how the Shuttle came about is we said, "We need something that will take people up into space and come back, and we don't have to keep building a new spacecraft." We were able to convince Congress to fund the Shuttle because it was reusable. The bad news there is it cost a fortune to turn that thing around. It should have been designed so it was much cheaper to turn around. I know the heat protection system is one of the

things that was a bad design. It's got all those tiles and panels. They should have redesigned that about halfway through the Shuttle program so that they didn't have to replace half of those panels. It's just a bad design.

So we had future plans. We spent millions and millions of dollars doing studies. We went out to industry and had them do studies like you remember I told you the Apollo study. I was on that. We send studies out. What was it like going to Mars? Lockheed [Corporation] ran a whole bunch of those studies. We spent millions of dollars on contractors to look at future programs for NASA, and then they would end there, because we didn't have enough public relations to where we could go to Congress and say, "Look, the general public wants a Mars mission. The general public wants a lunar base. The general public wants this and that."

The general public did not want the ISS [International Space Station]. They didn't really know about it. The only reason the ISS got funded is we told Congress, we being NASA, and this was after I left, by the way, we went to Congress and said, "Well, look. We've got the Shuttle now. It's flying. It's going to work. What are we going to do with it? We got to have some use for the Shuttle now. Let's have a space station. Let's get these other countries involved." Congress bought it on the aspect that we had to do something to keep our hand in space, that it was a technological mandate that we needed to continue our development of space technology. I know that DoD [Department of Defense] had some part of that. The Defense Department wanted us to keep our finger in it, because what if we had to start building weapons in space? Hopefully we won't have to do that. So we've had all these advanced program studies done and they haven't led to anything really useful. I think ISS is a great program, but the general public doesn't know much about it.

By the way, there's an IMAX movie made about ISS. It's a wonderful movie [***IMAX Space Station***, 2005]. I think everybody in Congress should see that movie. Even though it's way back when the ISS was first starting to be built. It didn't have many modules but it's narrated by Tom Cruise. It's just a really well-done movie and shows how hard they worked on the ISS even up to that point. Well, now we've got four times as much stuff up there. We should do another IMAX movie and then force Congress to see it, everybody in Congress and say, "This is what we've done with all your money." Then we should make something like that available to the general public.

For example, if we made another IMAX movie—if we did—and it was done as well as that one, then we put it into the theaters and we use some names, like [director/producer] "Ron Howard just produced a new movie on ISS, and we're making it available to the public for a huge reduction." Let's say NASA picks up two thirds of the cost, so you can go to the movies instead of for six or seven bucks like you'd pay to see a regular movie, you pay a couple bucks. Well, there are a lot of people that would go and take advantage of that. I would. So get the general public to see something like that ISS movie. But again future planning.

We did a lot of planning that never went anywhere. It's sort of like the city of Houston. I have to tell you one of my real gripes about the city of Houston is they spent millions and millions and millions of dollars looking at mass transit systems and they went to Germany and they went to Disney World and they looked at all these other people doing mass transit. Nothing ever happened. So finally when they figured out they had to do something, they bought buses. Buses come from 1920. It's only recently that we got that light rail that goes out to the medical center. I don't think too many people use that. Now they're thinking about adding—they should have done it 40 years ago. I remember when Kathy [Kathryn J.] Whitmire was mayor and they went on

all these junkets to study mass transit in other places. So NASA is the same way. They've spent so much money for studies that haven't gone [anywhere]—and I was involved in it. That's what makes me mad is I was involved in many of those studies. When I worked for Dennis.

I think [President] Barack Obama, being a new person starting a new era of White House politics, ought to just completely relook at the whole thing. I've written letters to [President] George H.W. Bush about how we should go to Mars. By the way, when I wrote my letter to [President] George Bush it was in '89, right after he got the presidency. I thought he might want to have an initiative like Jack Kennedy and say, "I'm George Bush, and I think we should go to Mars by the year 2000." We could have done that. In 1989 if we'd funded it we could have sent an orbital mission to Mars before 1999. Can you imagine if we planned it so they were inserting into orbit—you know what insertion is where they brake and go into Mars orbit—and that happened at midnight of 1999? How dramatic can you get?

He didn't do it. I don't even think he read it. He's got a place up in Maine. I'm from Maine. I've often wanted to go by their compound in Kennebunk and knock on the door and say, "Hi, I'm a Maine person. Can I talk to you about something?" Well, I wrote another letter to George W. Bush. That never went anywhere either. So I've written all these letters and I just recently wrote a letter to Barack Obama and said, "We need to have a Mars mission." By the way, the thing that I'm pushing—and I wrote a paper on this and presented it a year and a half ago. The thing I'm pushing is to change what we have now from going to the Moon, setting up a base, getting that to work, and then funding a Mars mission, to having two parallel programs. The way to do that is to take some of the money from this Moon mission, Moon program, and put that into Mars orbit, and so that would delay the Moon program. You run it out another five or eight years but you're doing the Mars orbit mission at the same time. What would happen is the public interest

would grow on the Mars thing if they did their public relations right, and the general public would want that funded more. So they would continue to delay the Moon program.

By the way, Glenn was giving testimony to that. You know they had an august panel after Columbia tragedy. They asked a number of people what we should do in the space program. I remember Glenn said the same thing. He said, "I don't think the Moon is all that interesting. I think we need to do some planetary missions first." Very same thing. It isn't just me. If we could capture the imagination and spirit of the American public, they would be behind it, but they don't know about the Moon, and they don't know what we're going to learn. They don't know what all that money is being spent for. We really should be going to Mars. I can tell you this. The major difficulty with sending humans to Mars is long-term duration in space. That causes two problems. What's going to happen to their physiology? Are they going to get to the point where they can't even walk on the Earth when they get back? It really is a problem when you're in weightlessness for that long.

The other thing is long-term exposure to space radiation. A lot of people think well, space radiation is solar flares. No, there's cosmic radiation all the time. By the way, when the astronauts [went] to the Moon and come back, they did get cosmic radiation, although it wasn't anywhere near lethal dose. Airline pilots do. Did you know that? Airline pilots fly at 35,000, 40,000 feet. They're getting a lot of radiation. I'm sure some of them are susceptible to genetic damage when they've flown for 40 years. I don't think they carry dosimeters, but they really should.

WRIGHT: Are these some of the areas that you looked at with your advanced planning?

BOYNTON: I never looked at radiation factors. I did look at duration of weightlessness. I want to mention that early in the space program, the manned space program, around 1960, '61, there were a lot of things we were afraid of. I remember every one of those fears. One of them was what is it going to be like to put a human in a weightless environment. We weren't even sure if they could handle weightlessness right off. You know what I mean? Of course Gagarin went into orbit and he didn't come back dead, so somehow you could take weightlessness. But we didn't know how it was going to affect their orientation or their vestibular function.

I remember all of those fears. It turned out the weightlessness problem was an ill-founded fear, except for what it did to your physiology. We've had what's called calcium mobilization. For some reason when you're in zero G—the calcium that floats around in your body becomes deposited where it's supposed to partly because of gravity, because we walk around. That's over millions of years of development. When you get in orbit that stuff floats around in the body and doesn't seem to go where it's supposed to, so we have bone loss and calcium loss in our bones. Exercise is supposed to help that; that's why these guys exercise on the ISS.

But the Russians had a lot of data on that, because they had guys in space a lot longer than we did. But that is something you can get around. By the way, if we went to Mars, there's a thing called artificial gravity. All it is is if you take two components of a spacecraft and separate them, say with a cable or a big long tube, and then you start spinning that thing around, then you're going to create gravity because of centrifugal force, okay? That's called artificial gravity. Then there's a thing called Coriolis Effect, which is bad. That's a negative thing. That's the only thing negative about giving gravity like that, is that you're going around in a curve. It isn't like you're standing on the flat Earth, so the longer you make it, the less Coriolis Effect. Well, when you're going to Mars, if you're going to be gone nine to 12 months getting out there, you could extend the thing

out on a huge long cable, 500 feet, and just very gradually swing around on that. It's something we could solve. Unfortunately you can't do a burn. If you wanted to make a midcourse correction you can't do that with cables. But I think the zero gravity thing we could definitely solve over a long period of time. Mars mission is roughly two and a half to three years by the way.

The radiation problem, that's a little hairier. I stopped at Brookhaven Lab [Brookhaven National Laboratory, Upton, NY], a year ago last summer, and Loyd [S, Swenson] was with me by the way. We were talking to a guy on the NASA contract to study long-term radiation effects on astronauts. It's his job. He was getting paid at Brookhaven to look at it, because they have an atom smasher up there, a cyclotron. I asked him a couple questions, and he gave me honest answers, and the questions went like this. Isn't it true that some people are subjectively more affected by radiation than others? In other words more at risk. He said, "Yeah, that's right." As you know, some people smoke all their life and don't get lung cancer. Some pilots fly airplanes for 40 years and they don't get any radiation damage. I'm sure others get cancer from it. Like brain cancer is a common thing with someone who flies an airplane for a long period of time. They have more of a possibility of brain cancer. So it turns out it's subjective, and it has to do with whether you're born with bad genes or not. Now they're finally being able to find things like that. Which gene is it that produces breast cancer? They just found that. So they may be able to find the gene that produces—or the dysfunctional gene that produces brain cancer, and then they only hire pilots that don't have that.

The guy said, "Yeah, that's true." I said, "Well, then why couldn't we select astronauts that were less susceptible?" He said, "That's fine, except the general public would call that discrimination." I think that could be sold to the American public. Look, we don't want to send people that are going to die from the radiation. But the other thing was the question I asked him

was isn't it true that if you told people they were going to go to Mars and come back but they had a much higher risk of cancer or that they'd better not have any kids because their sperm would be genetically altered, wouldn't there be a lot of people that would say, "Fine, I'll go." He said, "Yeah, but again the general public would say, 'Hey, you're sending guys out to cream their kids or give them brain cancer.'"

I'm going to say right here and now NASA has done a lot of things—the DoD especially has done things that they do in secret. They do it because the general public wouldn't understand. I'm going to use one example. If Lee Harvey Oswald was not the only person that knew about killing Kennedy, do you tell the American public that? I don't think you do. If it was a conspiracy and the Warren Commission came to that conclusion, I can see [Chief Justice] Earl Warren sitting there and saying, "Okay, Oswald was a patsy. Do we tell the American public that Jackie Kennedy knew about it or the Mafia knew about it or Castro did it or the Russians?" I actually think Jackie Kennedy may have been involved. I hate to say that, but that's a possibility, because he had a horrible back pain, horrible back problem, and he may have martyred himself. It may have even been Jack Kennedy in on the conspiracy. Isn't that weird? But I do think that there are some things you don't tell the American people. If you're sending three astronauts or five astronauts to Mars and you've selected them on the basis of their lower susceptibility and even then they're going to come back half cooked, you don't tell the American people that.

I'll tell you one thing that was a big concern. I went to almost all those planning meetings where we talked about how we really didn't know what the depth of the dust was on the Moon. We had no way to measure that. You probably remember that we sent Surveyor and Prospector, a couple of those landers on the Moon that were unmanned, but unfortunately they might have landed in a place where there was very little dust. We knew that dust would build up in certain

places and not build up in others. We were actually afraid that there might be up to ten feet of soft dust on the surface and these guys would land in one of those and one of the legs would go down. That's the reason the LM looked so gangly. That's the reason they had those funny round-looking pads on the feet was that even if we did land in ten feet of dust they would have enough time to abort and light the ascent engine and get out of there before the thing tipped over. They really were afraid of that. It turned out that was ungrounded. There was never any dust—some of the regolith, they call regolith; it was maybe an inch thick. You could see—you saw Neil's footprints on the surface. It was not a big deal, but we didn't know that. We didn't know the effect of weightlessness. We didn't know what the effect of radiation was going to be. We didn't know what the dust was going to be. We thought about microbes.

I mentioned about all of the big fears. I'm trying to think if there were any things that happened that we didn't predict. I do know this. We had no idea what to do if all of the electrical power went out in the Command Module, because everything was doubly redundant and we had things backing up other things. But because of the explosion we lost almost all of the oxygen. We didn't have any electrical power and they didn't have any oxygen to breathe; we hadn't simulated that. We didn't know that that would happen on Apollo 13.

One of the things that MPAD did where I worked was we ran thousands and thousands of abort profiles from virtually every situation. We had abort profiles off the launch, near the Cape. We had abort profiles that meant we were going to somehow make Madrid, Spain. All the way around the mission we had profiles. We had looked at immediate returns from going to the Moon. Say we just started out to go to the Moon and we had to abort it, something went wrong and those guys—say the oxygen system crapped out and they had to come immediately back. We had abort profiles that brought them directly back. We looked at all of those. The interesting thing about

Apollo 13 is it was a little over halfway to the Moon. I forget how many hours, but it seemed like it was 56 hours. If we had had that problem occur say 12 or 14 hours earlier, it would have been relatively easy to have them come directly back. It would have been like a day and a half mission back, maybe two days, no probably a day and a half. But because they had gone an extra 12 hours, they didn't have that option of the immediate return, because what if the engine didn't operate properly? We just didn't want to take that risk.

We had what's called a free return trajectory. It's a figure eight to where even if the engine doesn't burn on the far side of the Moon they continue to come back and they can make small corrections using the reaction control system. We had all that covered, that if the SPS [propulsion engine], the big engine, didn't work, the free return would allow them to come home.

It turns out on Apollo 13—and this was a gutsy move. Because they were low on electrical power in the LM, and because they were low in oxygen, because they had to use LM oxygen when they got to the far side of the Moon on Apollo 13, they made a correction there which brought them back a little bit faster, and they did that because things were tight as it was. Now what if that burn had been partially successful? They would have been dead. So that was a risky maneuver. If it's only a half burn and then the thing shuts out, we lose three astronauts. If it didn't light at all, at least we were on a free return, if they punched the button and nothing happened. But they decided to make—and that was a great decision, because I think they could have died if we'd come back on a free return. It was that close.

WRIGHT: Let's take a look at your notes and see what other things you wanted to talk about.

BOYNTON: Okay. When I started doing talks for the general public, I got to enjoy that, and I wasn't sure that I could go anywhere I wanted to. If I said, "I want to go to Oshkosh, Wisconsin," are they going to send me up there? But some guy told me. He said, "Anyplace you want to go, just tell them you want to go and talk to a high school group." I thought well, let me see. So Christmas of '62 I went to Maine to visit relatives. My sister still lived up there and other people I knew. I stopped by to see my physics instructor in high school, the guy that thought I was [Albert] Einstein and I was super super smart. I said to him, "Look, I found out NASA will send anybody just about anywhere even if they want to just go talk to a high school group." He was still teaching physics at my high school. So I said to him [Ed Barnard], "Why don't you send a request in to NASA, Johnson Space Center, that you'd like to have me come up and talk to the physics class?" Now having been in his physics class, I knew there were only seven or eight students in there. Small Maine high school. But NASA didn't know that. But he said, "Okay, I'll do that." That way I can go to my class reunion at MIT which was the five-year reunion, 1963, at MIT. So I was going to cover two birds with one stone and it was a free trip as far as I was concerned. He said he would do it. I thought they'd probably approve it.

Well, that was Christmas of '62. I came back [to Houston]. I was working hard on still Mercury. I forgot about asking him. I actually forgot. Well, this is what happened. It's really interesting. He went down and spoke to the principal of the high school, a guy named A. Hamilton Boothby. He told Boothby, he said, "Look, Boynton wants to come up here and talk to our physics class. Would you just write a letter to NASA and see if they'll send him?" By the way, I told him to write Johnson Space Center, which then was the Manned Spacecraft Center. Boothby says, "I'm not going to bring him all the way up here just to talk to the physics class." Because again he knew there were only seven or eight students, he said, "We're going to bring him up and he's

going to talk to an assembly of the school." I remember when they used to have those all-school assemblies. So he wrote—and he said, "If we're going to have him come to talk to an assembly of the whole school, I'd rather have a friend of mine write the request instead of me. They don't know who Ham Boothby is up in Rockland High School. I'm going to write a letter to Margaret Chase Smith. She's a senator from Maine. She'll write a letter to the Manned Spacecraft Center." So he calls her on the phone; he happened to know her pretty well. By the way she was a remarkable human being. She would be president today if she were at the proper age today. Just a great lady.

Calls her on the phone and says, "Senator Smith, this is Ham Boothby in Rockland. We got a kid that graduated from Rockland High School, works for NASA now, he's doing a really great job, and we want him to come up and speak to an assembly of the school." She says, "Well, if he's that important at NASA"—I'm telling you all this went on unbeknownst to me, so I'm making up essentially what went on, but I know. She says, "If he's coming up to talk to the assembly and he's a big cheese at NASA, let's have him speak at graduation." The 1963 graduation. Well, it turns out they had moved into a new high school four years earlier. Not the high school that I went through, this old brick building. But they had a brand-new high school so this was the first graduation from the new school. It's still there.

So she wrote this letter, not to Gilruth at JSC, but to [NASA Administrator James] Webb. She writes this letter to Jim Webb. Of course they knew each other because he always went to Congress to get the money. So, "Dear Jim Webb, we got this guy from Rockland, blah blah blah, we would really like to have him come up and speak at graduation." So he writes a letter to Gilruth. Gilruth writes a memo to Kraft. Kraft sends that memo down to John Mayer. John Mayer sends it to John Bryant, the guy that I was working for. He comes in and he says, "We got a letter here

wanting you to speak at graduation." I just almost fell over. Well, I wound up doing that. It turns out—I have to tell you this. I was working so hard, and I was so busy, I didn't even have time to go to my college reunion. But I did go up and give that talk.

I tell you this. I was embarrassed, because I was only nine years out of high school. That's almost the first thing I said to those kids. Bright-eyed kids sitting there looking up at you like a bunch of chickens. I said, "I don't know what I can say that you'll believe, because I'm not that much older than you are, and I'm not the hero at NASA that they've made me out to be. Yeah, I'm doing a lot of important things and it's interesting." I said, "The only thing I can think of"—and I told them to pick goals. That was the whole point of my talk, to pick goals. Even if you don't do that you've learned something on the way. So I gave that talk. Just an amazing story really.

WRIGHT: Let's close up today's session if you would. We know that you worked with a tremendous amount of talented and interesting people. Have you got some thoughts on some of those that you'd like to share at this time?

BOYNTON: I have to confess to something. I have an opinion about everybody. Having graduated from MIT—and again I'm not saying I'm some kind of super genius Nobel laureate. But MIT is a good school. Unfortunately when you graduate from a school like that you expect everyone else to be smart. I've been disappointed many many times. When I worked at NASA I would meet people and work with people and question people and do my job with people, and I would size up what I thought of them. I didn't necessarily tell them. Most of the time I didn't. But whether I respected them, whether they had technical ability, whether they had interpersonal ability. So I'm

going to talk about some of the people. I want to start off with Bill [William M.] Bland and Kenny [Kenneth S.] Kleinknecht because Kenny was the project manager—and by the way I want to bring a distinction right now. Mercury was a project. I think it was only a project because we built the spacecraft and the booster was an Atlas ICBM. That was from another program. So we had the project to put a guy on the top of the Atlas and put him into space.

But Apollo was a program and Gemini was a program. So we always made it very clear that Kenny Kleinknecht was a project manager and I'm making that distinction. Bill Bland was his right-hand man. You could say he's assistant project manager, but it didn't make any difference. Kenny made all the decisions, but Bill was the technical person. He was really good and I respected Bill a great deal. Kenny was the kind of person that would tell you, "I'm not the best technical person around, but I do know how to lead people." He was very good. Mercury was successful partly because of Kenny Kleinknecht. I actually think Mercury was successful because they complemented each other so well. Bill really knew what was going on. Whenever I wrote reports and I had a question about some system performance I would go ask him. He almost always knew the answer or could find it.

I had great respect for both of them. Bill Bland is someone no one has ever heard of. I'm sure if anybody reads this transcript or listens to the tapes in the future they would say, "I've never heard of Bill Bland." But he was a very important person. Let me say one other comment about the Mercury Project Office before we leave that. The Project Office was full of a bunch of people who are what I call baling wire and Band-Aid engineers. They did whatever it took to make it work but they were not the most brilliant people on the planet. They didn't act like they were. They didn't go around saying, "Well, I got degrees from this and I can do that."

We had the Little Joe Program, the suborbital program was Little Joe out on Wallops Island. [Edison M.] Mac Fields was the guy that had my job before I took it over, the postflight reporting, because he didn't want it. He just was not that kind of guy. So I can't remember anybody in Mercury that I would call a super technical person with the exception of Bill Bland. But they all did their jobs and they all worked hard. I have immense respect for every one of them. Joe [W.] Dodson was one of them.

The last thing on Mercury I want to say is there was a guy named John [F.] Yardley. I don't know exactly what his position was at McDonnell [Douglas], but he could have been a vice president for technical. It was that kind of level. The highest level at McDonnell. As you know, they built the spacecraft. He was always at the Cape whenever we did the postflight evaluations of what went wrong and why did it go wrong. I really think he was the smartest technical guy I ever met, because he knew a little bit about everything. He worked on Gemini, but I know that he was very very very instrumental in getting Mercury to continue to work because of systems problems that we overcame. I remember him at all the meetings at the Cape. So that finishes with Mercury. It was a successful program. We were able to cut it short because of its success. Cooper's flight was 9, and we were supposed to have three more flights after that, and they were canceled.

Now I want to talk a little bit about Apollo. I had almost nothing to do with Gemini, so I'm not going to sit here and talk about Gemini. I don't pretend to know that much about it. I do know it was an important program. But in Apollo the Program Office had a variety of people heading it up. They had so many program managers. I'm sure you had people talk about some of them. [William F.] Bill Rector came here from GDA [General Dynamics Aviation]; he was the head of the study that I was on out at General Dynamics. He came here hoping to be the program

manager for Apollo. He didn't quite make it. I think when he got here Caldwell [C.] Johnson, some of those people were in there. He was like an assistant program—but Bill, bless his heart, did not have a very strong technical background, but he was a good manager. He ran the study very well. He got people to do what they were supposed to do. I'm not sure he understood what anybody was telling him, but at least he was a good manager. If he were here he'd be very offended by that remark, but unfortunately it's true. He went on to get jobs at TRW Inc. and he was really good at self-promotion. He got himself into some great positions but he was not one of the key people in Apollo.

Of these other people, I'm going to name four people that I got to see in meetings. Bob [Robert O.] Piland, George [M.] Low, Joe [Joseph F.] Shea. That's three actually because I had Bill Rector. So of those three the most important person in Apollo in allowing us to go to the Moon was George Low. Very brilliant guy. He came in at just the right time.

Joe Shea was a real go-getter, and technically competent, although not as smart as George Low. But Joe Shea was important. Bob Piland was certainly important but he never wanted that job. He was asked to take it because they needed someone to take over. That could have been right around the fire time. I had respect for all three of those guys, Bob Piland, George Low, and Joe Shea, although George Low was probably the most important person, single most important person on Apollo.

I want to say something about Gilruth and Kraft. Bob Gilruth was always the director of the Center right through Apollo. He came from the original Space Task Group, as did Chris Kraft. Bob Gilruth was not your typical academic. He knew a lot about engineering and he knew about technical things and he had a feel for them, but he wasn't the kind of person that could sit down and design something and it would be really top-drawer. He didn't see himself as an engineer

designer. He saw himself as an engineer manager. By God, in that respect he was the most important person in the entire manned space program up through Apollo. I saw him at so many meetings, and he was the arbitrator. He was the moderator. He was the person that when they started going off on a tangent he got them back on track. If someone was spouting off and trying to toot his own horn he would slow him down. He was really great at managing a meeting.

He always picked the right people under him. For example Chris Kraft was perfect for that job. I've told Chris that to his face. Hardly anybody could do that operations job the way he did. He was just—and Chris, bless his heart. I remember in a meeting he said once, "I'd rather be lucky than smart." He was, he was very lucky. But I had great respect for him in that job. He ultimately went on to become director of the Center. I don't think he would have been as good as Gilruth if they had switched jobs. I'm not even sure Bob Gilruth could have done the operations part. Because Kraft had the respect of his people. I don't think the kind of people that had to be flight ops people would have had that much respect for Gilruth, because he was so conservative. So you see the difference? Kraft was very flamboyant. When he said something you listened to him. Whereas with Gilruth you had to respect him to listen to him. When he was in a meeting they all knew he was director of the Center, so they respected him. But it's interesting how those two guys interplayed.

I want to say something about Max [Maxime A.] Faget. This comes from my MIT background thinking that I'm an expert engineer. I don't think Max Faget was that great an engineer. He's gotten many awards. He's gotten lots of awards, and he's been the person that designed the Mercury capsule and then that went on to be like Gemini and Apollo capsule and now the Orion is basically Max Faget's design. Well, first of all I don't think he originally came up with the conical design. I think he was the one that adapted it to Mercury. But I think someone

else had that idea. I don't ever remember anything that Max did in my presence that I said, "Wow, he's really smart." I'm thinking of Yardley. Every time Yardley opened his mouth, that guy is really smart. I was in probably half a dozen meetings with Max. So if anybody is going to sit down years from now and says, "I want to find out the history of some of these important people that were made gods," I want him to look a little harder at Max Faget as to what he really did, do a little more research. Now he might have been. I'm going to leave that caveat, that he might have been smarter than I thought he was.

Now let's talk a little bit about Bill Tindall and Carl [R.] Huss. Tindall and Huss were the two most important people that worked with John Mayer. I wrote a letter to Chris Kraft about a year, year and a half ago, because I had invited him to a couple of birthday breakfasts that we had, and he had decided not to come, and I thought well, he hates my guts. I think there's some stuff he doesn't know about me. I wrote him this letter to try and clear that up, because I know John Mayer had said some things about me that probably discouraged Kraft as to whether my contribution was all that important. I think that's why I was probably caught in the last RIF, if you really want to know why I went out the door. So I wrote this letter to Chris, and I told him that he was lucky that John Mayer had the people working for him that he did, because I didn't have any respect for John Mayer's technical ability at all.

Quite frankly nobody in the Division did either but he was the guy that Chris wanted in that job, and they respected Chris enough to say, "Okay, let him do that." But John was not a good manager. Technically I don't think he had the foggiest idea what his people were doing but he had some really good people under him. Morris [V.] Jenkins, Bill Tindall, Carl Huss, Pete [M.P.] Frank. He went on to become a flight director like Gene [Eugene F.] Kranz. I think he's the best one they ever had. Pete Frank used to be in MPAD. By the way Glynn [S.] Lunney was too.

Lunney came from MPAD. So those two guys were technically competent. Frank was better than Lunney. He had some really good people.

Let me tell a story about Carl. Carl would be the first to tell you that he's no genius, but he knew how to get people to solve problems. He was really good at that. He understood enough to say, "Why don't you do it this way?" Carl eventually became division chief I think when John retired. He was always the acting division chief. Carl did me a favor I want to put on tape, because it's so important to me. I think I told you that during the flights I didn't have anything really to do. I felt like a fish out of water if you really want to know, because I was always so intensely involved before the flight, making sure they were meeting objectives and meeting my flight plan and all that. Then after the flight of course I worked my tail off to figure out what went wrong, so during the flight I just had to go around and find things to do. I told you I worked on the radio. That was one of the things I did during Apollo 11 was I was on the radio but I wasn't on the radio all the time.

When they were landing on the Moon I was not on the radio so I went over to mission control and I was going to try and figure out some way to sneak in. Now they had beaucoup security all over the place because they thought the Russians were going to sabotage our mission. They were very careful about who they let into the [Mission] Control Room. Now I could get into Building 30, because that's where I worked, but the Control Center is an adjunct to Building 30. This is again serendipitous spirituality, whatever you want to call it, I wouldn't have thought of that then but I do now. I walk into the passageway between 30 and the Control Center. There's this passageway. In fact it has "gnashing teeth." Carl is sitting there writing something to the security people sitting at a desk. He wouldn't normally sit there, but the security guy wanted him to sign something. So I walked up to Carl, and I said, "Carl, would you do me a favor?"

He said, "What?"

I said, "Can you get me approved to go in just for this burn? Please?" I said, "I've worked on this mission for a long time, nine years. Let me in."

He looked at me like this. He said, "I'm going to get in trouble for this." But he wrote me a pass to the recovery control room. Now the recovery control room is a small control room off to the side, off to the right. Has a glass window. It's where the people sit when they're getting ready to reenter and come in. They have to control the ships and all that stuff out to sea.

They had to know what was going on flightwise. Then of course once they splashed, then the recovery control room actually took over and all the flight controllers took off. So during the burn to land on the Moon, there was nobody in the recovery control room that was needed. It was basically an unnecessary room. It was packed with people that wanted to be a part of that experience. I got a clearance to go in there. Of course we were like sardines.

But the great thing about that experience—and Carl did this for me. Again I've told you I worked on it from day one. It was especially rewarding to me. I could see the tension in the room when they're going through that burn. I could hear the air-to-ground voice and I could hear them say, "What's about this alarm?" It was part of history. I wasn't a part of it in the sense that I was doing anything. But I was an observer. I was right there. The only closer I could be is if I was in their capsule. Because no one's closer than—and I saw Chris Kraft and I saw Bob Gilruth. They were all in that top row echelon of high cheeses. I saw Gene Kranz. Just an unusual experience. I will never forget that. Chris has been famous for saying, "We're all holding our breath. We can finally take a breath now." He did say that. You could cut the tension with a knife. So Carl did that for me. He could have very easily said, "No, John, I'll lose my job, sorry, get out of here." I'll forever be in debt to Carl.

Then I've told you how much I respect Gilruth and Kraft. Let me say a little bit about some of the astronauts. Then we'll just go on to something else or finish it up. The astronauts I want to mention. I didn't know Lovell very well, but I did know that he was a pure test pilot. He had the attitude that this is what I'm supposed to do and I'm going to do it. He's such a nice person. I've met him to say, "Hello, I'm John Boynton," and he said, "Okay, what'd you do?" and I tell him what I did. But he's been asked at least a thousand times, "When you were coming back from the Moon in that LM were you scared?" He always has to give them the same reason. "We had a lot of things we had to do. We had to plan on our entry. We had to think when we'd do our midcourse correction. We had to make sure that we were not consuming"—he had a lot of things to think about. He was the commander. He said, "Quite frankly I didn't have time to be scared. I knew the ground would do everything they could. If they didn't succeed they didn't succeed. Wouldn't be their fault. No, I wasn't scared." So I knew that was true. I knew he didn't say that for the benefit of the press. I want to say that about Lovell. He was the brave guy that they made him out to be in the movie.

Cernan I got to know real well because I'm a Phi Gam from MIT. Phi Gamma Delta. He was a Phi Gam at Purdue [University, West Lafayette, Indiana]. So I was active in our Phi Gam graduate chapter where the people that have—and so we would get him to come over and speak about once every two years. I was program chairman one year and so I got him to come over. I remember one time he was showing a film and I actually got the projector to work because he couldn't get it to work because I used to be a projectionist. I got to sit beside Gene and talk to him quite a bit.

I want to tell a little story about Gene that I think is interesting. When I was in MPAD—let me see. When was it? Oh, the second time, just before I went to work in the Program Office.

It was right around early ’68. Some guy came from Germany. There was some kind of an institute in Germany called the Institute for Eastern Culture and Western Science or something like—I think that’s what it was. Very close to that. It was a marriage between how the West thought and the East thought, the Hindus and the Confucianism and all that. Anyway, it was an interesting place. This guy came over, very nice German gentleman, spoke pretty good English. He had come over and wanted to talk to some of the astronauts about their spiritual experiences in space, if they had any. Since I knew several of the astronauts that had already flown I was commandeered to do that. They didn’t want to waste anybody else’s time.

So I took this guy around and we talked to about six or seven astronauts. One of them was Gene Cernan. I tell the story because every astronaut that I’ve ever talked to, or every astronaut that I’ve ever read about, that was asked about spirituality, to a man they all said their spaceflight experience made them a different person when they came back. Now I remember Cooper was especially vocal about how it was such a moving spiritual experience for him. He wasn’t a Jesus freak or a born-again Christian but just being in orbit for a day and a half and looking down at the Earth. You can imagine what it was like for Glenn. He was a Christian. Ed [Edward H.] White was a Christian. I can’t think of anybody who said that it wasn’t something important spiritually. Except for Cernan. Cernan had not gone to the Moon at the time.

Here I am talking to Cernan. He’s flown Gemini. Yes, he’s flown in Gemini, and that’s it. He didn’t fly Mercury. So we go in, and he recognized me, because I knew him from the Phi Gam stuff. I said, “Gene, there’s a guy here from Germany. He’s interested in what your experiences were in space, particularly anything you had that was maybe of the spiritual nature.” He said, “I know it affected all those other guys. But it was no big deal for me. I don’t know why they go through all this BS. They’re saying prayers and all that.” He was trying to be Mr. Tough

Guy. The German guy is sitting there, okay, and he's asking him questions and writing down. I thought that was kind of cute, because Gene was hiding behind something. He was embarrassed to say that it was moving.

It's possible that his Gemini experience wasn't. Well, it's even possible when he went on [Apollo] 10 but didn't land that it wasn't that big a deal. Although I would doubt that, because you're way away from the Earth, you see the Earth as a little globe. I can't imagine anybody not being spiritually moved. But after he was on the Moon and the last person to walk on the Moon and he stepped off into the capsule and rocketed off and that was it, he said to people, "When I stood on the Moon," and I remember him saying this on TV because he was one of the people they had for color commentary during all the Shuttle flights and not ISS but Apollo-Soyuz, he became a media guy. He said, "I remember standing on the Moon in [Apollo] 17 and putting my thumb up and I could cover the Earth with my thumb." He said, "I just knew then that this all had to mean something. There was some greater meaning than us just walking around on the Moon."

See? So he changed his tune. I'm telling that story because he was the one holdout. I honestly don't think anybody, including the current crew that go up on the Shuttle and go in the ISS, I can't believe that they don't have a different view of mankind. I'll tell you this, and this is all I'm going to say about it. I'm a pilot, and I started flying in '64. I used to fly a Beechcraft Bonanza. Nice thing about a Bonanza is it goes up to 16,000, 17,000 feet without—you don't have to do oxygen. I used to fly at high altitude because it was so much smoother. I remember looking down and seeing all the little towns and the little cars going on the freeway. It always looks so peaceful. By the way I've had a couple flights in military jets too, so even higher.

It's hard to look down at the Earth and know that there's a couple fighting and one of them beating the crap out of the other one and kids are stealing and people are doing drugs. You just

don't see that from 10,000, 15,000 feet. Well, from space it's got to be—and it is remarkable. That's what most of the astronauts that went to the Moon said is "I could see the Earth and all the people and it looked peaceful and so inviting."

I want to say something about Al [Alan L.] Bean. Al Bean I got to talk to because I remember him writing a pilot's report for [Apollo] 12. I remember going over to his house in Nassau Bay and he was building a Heathkit. I got to know him pretty well as we worked on the pilot's report for 12. Then he got a divorce. I was single at the time so when I left NASA in '73 I would go to all these singles functions. I was single for 25 years. I went to thousands of them. I would go to some of these church singles groups. Al Bean would be there. It'd be like a dance, and the lights were down, and I'd be talking to a girl. I'd say, "See that guy standing over there?" "Yeah." "He's actually walked on the Moon." Of course nobody knew who he was. He's standing there. Well, I told him that one day when we were talking on the phone about something else.

He said, "I married one of those girls." He said, "I'm still married." So they've been married 25 years. That happened back in the early '70s. Al, as you know, has gone on to become a very famous artist. I bought a couple of his art pieces. The great thing I want to say there, because it probably won't be on anybody else's tapes, is the neat thing about him is when he's having an art show and they look at his most famous painting, which is the guy in the spacesuit with the reflection and the guy is taking the picture, and they'll say, "That looks so realistic. How could you possibly have done that and known all those angles and lighting?" "Well, I was there." He can just say—"I was there. I've been there." People say, "What?" So it's one of those unbelievable things that he can say, "Yeah, I've actually walked on the Moon." That's all I'm going to say about Al Bean.

Lovell I've talked about. Cernan I've talked about. Let me just talk about Ed White and John Young real quickly. John Young, I want him to go down in history as being the test pilot's test pilot. Of all the people you can think of, Glenn is a good example of someone who did a lot of test flying, and he was famous before he came on the program, because he flew some transcontinental record. They all were good test pilots, most of them, until you got into the scientific type people. Lovell, Borman. But John Young was the kind of guy you'd want if you had to test an airplane and make sure it worked. He was just really good at what he did. All the astronauts respected him for that. He never got any guff from anybody. The others were given a lot of trouble and guff and Cooper especially. But I want to say about John Young if you had to pick one guy and say who was the most representative test pilot, not the smartest guy, but the best test pilot, it was Young.

Ed White died in the fire. I didn't ever meet Ed White, but I wish I had, because one thing I can tell you about Ed White is nobody was more Christian than Ed White. He really followed his faith. He told people about it. He was never embarrassed about it. He said he prayed and he said what he was doing was meant to be and all that. You couldn't laugh at him for any of that. Now Glenn was very Christian, but he didn't talk about it, and he didn't say, "Well, I'm here because God told me, I'm doing God's work." He kept his Christianity to himself. But he was a devout Christian. But Ed White. If you think of anybody that's going to die, you don't pick Ed White, you know what I mean?

So I got to say something right now. There's a reason for everything, there is a reason for everything. One of the life lessons that I've had myself is that nothing is all bad or all good. Nothing is all bad or all good. Cernan is the first person to say—and he's given this talk to many people—the Apollo fire was a tragedy, three guys died, and it was a horrible situation, they

couldn't get out of there. But because of Apollo 1 we redesigned the capsule, we did some things that we should have done anyway that we didn't, and the spacecraft that we flew to the Moon was a lot better than the one that burned up.

Because of those guys dying we got people to work on what we needed to work on. So Cernan—and I believe him 100%—is that we would not have landed on the Moon by 1970 if we had not had the Apollo fire. If you think about Ed White's purpose on this Earth, maybe that was part of it. If you had three bad guys that were living life sentences in prison and they were in there it wouldn't be the same thing, you know what I'm saying?

Now let's finish up with the NASA culture. I am going to shorten it as much as I can. But this [culture] is a new word. I didn't hear that term until Columbia. No one ever talked about the NASA culture around [Space Shuttle] *Challenger* [STS-51L] or the Apollo fire. But it's a good term, because you think of culture, you think of ballet and symphony and rock music and that kind of thing but culture is the way people live their life. That's what culture is.

From '62 to '73, the years that I was there, and I can speak authoritatively, NASA Manned Spacecraft Center was very conservative. What little I knew about Huntsville, they were conservative too. Conservative in the sense that they were very image-conscious. They did not want to make a mistake—not so much because it might kill an astronaut, although that's a horrible thing. If you said, "What's the main reason you don't want to make a mistake?" it's because we don't want to lose our funding. We don't want the Congress to say, "Oh, my God, you guys don't know what you're doing. We're just going to cancel the whole thing." They always had that fear when I was there.

I think I told you in our first session there were a lot of things we had to cover up in our reports. They were basically cover-ups, because if the public saw that they would say, "Oh, these

guys don't know what they're doing." There was a horrible paranoia about being canceled. By the way, you can knock Carpenter for not telling the ground that he had a problem, it's the same thing we were doing with the general public.

There was a highly conservative culture, image-conscious. But the other part of the culture—and I don't think this has been true since, I really don't—and that's that everybody worked hard. The dumb people worked hard, the smart people worked hard. We landed on the Moon because people were dedicated. That was a part of the culture that I don't think has been present since 1970. By the way people stopped working hard pretty much after Apollo 12, because all the engineering work was done. Just operations.

Now pre 1969, if you take that period from '62 to '73, if you break it into pre '69, before Apollo 1 and after Apollo 1, the NASA culture changed because a lot of people felt ashamed of what happened in the Apollo fire. A lot of people wanted to blame themselves, particularly guys that were working on the consoles when that happened. That was called the Flight Readiness Review and they were trying to see if the spacecraft could go through an end-to-end check. A lot of the guys that were working the consoles felt personally responsible for that because they didn't get the guys out, they didn't see it happening. There was a change in the culture because of the Apollo fire. I remember what I was doing. We were going to go play poker that night. John Zarcaro and I were working for Kraft then, so I wasn't directly involved in Apollo at that point, but we were going to go play poker. The guy who was hosting it that night was a guy named [Manfred] "Dutch" von Ehrenfried. Zarcaro and I didn't have that much to do, so we went to his house about 3:00 in the afternoon. It's important, the time is important, because we left early. We went to his house and had a couple drinks and sat around and talked. Then at 6 [pm] we went over

to von Ehrenfried's house to play poker. When he answered the door his face was ashen. It looked like he just lost his wife and kids.

We were in a high mood, a couple drinks, hey, ready to play some poker. He said, "You didn't hear about the fire?" We said, "What fire?" I don't want to tear up, but he said, "We had this fire on the pad and the three astronauts died." We couldn't believe him. It just seemed so far-fetched. Really? Of course the poker game was canceled. It was a horrible, horrible experience for those of us that had been on Apollo since day one. Dutch had been a longtime flight controller so it took me a long time to get over that, particularly since I knew Gus. It was a horrible thing but again I look at it in two ways, that without the fire we would have not landed on the Moon. We wouldn't have achieved that, so the culture did change because of the fire, because it was a horrible thing. Everybody was touched by that.

Now let's look at post '69, pre *Challenger*. Horrible event. Oh, *Challenger*. I'll tell you how I felt about *Challenger*. We lost seven people. Six of them were NASA astronauts. The seventh one was an astronaut by definition but she was only an astronaut in name, and that was Christa McAuliffe. I felt really bad for her, because I understood the test pilot mentality, and I knew that every guy that had flown in space up to that point knew there was a risk and knew that there was a distinct possibility they could die. But Christa McAuliffe was not of that culture. She was a teacher and she gave her trust to NASA, [thinking], "you're going to fly me and bring me back, and I can tell the world what it was like," and then she died. I felt really bad about that and I had left NASA at that point. I came back. I remember [President Ronald] Reagan coming down [here] and speaking to the NASA community. I remember sneaking in. I still had my old badge so I showed them my old badge and sneaked in. I cried like everybody else because the jets flew over in the missing man [formation].

It was a bad bad thing. *Challenger*. I think if we ever came close to canceling the space program, that was it. Because with *Columbia* we weren't going to. ISS is flying. But with *Challenger* it would have been a time when we said, "To hell with the Shuttle. If you can't design a Shuttle that will keep from killing people." We came real close to getting Congress to say, "Okay, that's it." That's the thing I told you earlier. We had a culture of being afraid. So after Challenger the culture made a definite change about. We can't do that again. That's really bad. Of course those guys lived for two minutes because they came coasting down —they didn't die until they hit the—so everybody woke up. That was a wake-up call. I don't think anybody took that lightly.

But I do want to say one thing about the astronauts before we get off the *Challenger* and get onto *Columbia*. None of the astronauts were permanently affected by either Apollo 1 or *Challenger*. The reason is that they accepted the risk. They know that humans make mistakes. Now I want to say one thing about the Flight Readiness Review. I don't know how many people you interview that are going to talk about that, but the Flight Readiness Review is a test on the Cape of the countdown. A test that we can make sure we can fuel the thing and all the checkout systems work. It's basically a test of the preflight procedure, that's what it is. That's why they call it Flight Readiness Review. It involves the Control Center so it's a training mission for the Control Center.

[With Apollo 1], the mistake they made there was they had 5 percent psi oxygen overpressure. Well, in space they're at 5 psi, which means you don't have a lot of oxygen in there, because it's reduced pressure. On the pad you got 14.7 psi of atmospheric, so you have to crank in another five. So now you got 19.7 psi oxygen, pure oxygen. It's a wonderful environment for fire. You can't burn oxygen, but you can burn everything else if oxygen is around. A lot of people

don't understand that. Oxygen itself is not flammable; it was an invitation to a fire. I can tell you right now, whether anybody else is going to mention this, the reason that we didn't have the hatch that could open quickly was because Max Faget and some of these other very conservative people said, "We don't want a hatch that you can open easily in space, because it may open unexpectedly." We wanted these guys to be able to go to the Moon out of their suits. That's a horribly restrictive thing. They might take off in their suits, but then they'd get out of them. You've seen *Apollo 13*. They would be able to float around. By the way, the Command Module wasn't all that big either.

That was the deal. Here they are without their suits on, what if the hatch just went off like—in fact it's interesting. Gus Grissom's problem with his hatch [MR-4] probably caused his death. Isn't that interesting? It was the fact that they think his hatch blew inadvertently that they did not design the Apollo hatch to blow off. That's an interesting irony right there. I don't know any of your people are going to mention that, but it needs to be mentioned.

We did not have to have five psi overpressure. We could have just had five psi air overpressure, didn't have to be pure oxygen. That was a bad mistake. Now whether it would have prevented the fire I don't know but it certainly accelerated it. By the way, there were ways that the ground crew could open that hatch and get those guys out. But I think it took like two or three minutes, by that time it was too late.

The only other thing I have left here, and we can just finish up with this, is after *Challenger* the culture was—and this is really sad—we had been so successful in all our flights with the exception of *Challenger* that we began to take success for granted. I don't know how much of this got into the public media, but when they talked about the problem with *Columbia* and the pieces of foam breaking off, the only thing the engineers could say—and by the way they had some good people working on that. Is that we had seen that so many times before. It wasn't that big a deal.

We'd seen foam pieces break off before. While this isn't exactly what's true, it'll exemplify what I'm saying. Let's say the first time a piece of foam broke off it was only fist size and they looked and said, "That didn't do any damage." So then the next one that broke off was two fist sizes, and it kept getting bigger, and each time they kept saying, "We better do something about that," but then they said, "Well, that didn't do anything, we'll wait till a bigger piece, maybe we'll see something." Well, unfortunately they waited too long.

I frankly don't think it was the foam that did it. I'm one of the few people that don't believe it was the foam. I think it was something in space. There's all kinds of debris flying around in space. I hope it's not a cover-up where they did know it was something in space but they didn't want to tell the American public. I hope that's not true. I frankly don't think the foam had enough energy to do the damage that it did, but I can't prove it.

I do know this, that the culture, if there's any criticism of the NASA culture it's that you get to take success for granted. By the way, Mercury and Gemini were immensely successful programs. Apollo was immensely successful except for that one little problem with the tank on 13, and we didn't kill any astronauts. From Mercury right through Apollo we never lost a guy in space. I think that's what caused the *Challenger* mentality, well, once we get them off the pad they're fine. Then of course *Challenger* blew up.

So *Columbia* has reversed that culture, and now I think they're actually too conservative. I'll tell you why. This is a criticism of what's going on right now, but I have a right to have an opinion. Now every flight they go to the ISS with the Shuttle they do a complete inspection. So they're not actually busy for two days. They basically waste two days because of their conservatism. I'm going to tell you right now a lot of it is done for what they do for the American public because there are two kinds of failures that could happen during launch. One is that maybe

something did break off and cause a severe problem, and the other is it didn't. Now they've already found—I read Mark Carreau's article in today's paper [***Houston Chronicle***] and it said that they found three small problems with this Shuttle. But they're okay, they're cleared to come home. So it either falls—now what if they do get a huge chunk, it falls out. I don't think they can fix it. I think they would have to come back in the [Russian] Soyuz [TM] or somehow crowd guys in. I don't know what they would do. Or send another Shuttle up. I know there are going to be problems that they can't fix.

So the space program is important. We need to do better public relations. We need to reorient our initiatives and I hope we do that, I really do. I'm through.

WRIGHT: Okay. Thanks.

[End of interview]