ORAL HISTORY TRANSCRIPT

THOMAS P. STAFFORD
INTERVIEWED BY WILLIAM VANTINE
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[This oral history with Tom Stafford was conducted in Houston, Texas on October 15, 1997. This oral history was conducted by William Vantine and Michelle Kelly for the Johnson Space Center Oral History Project.]

STAFFORD: I was, in a way, interested in it when the Mercury Program got started, but I was ineligible because I was just a student in school. But I always liked to fly things, to go higher and faster and fly the latest things. Then, particularly after [President John F.] Kennedy made the challenge to go to the Moon, I said that's got to be a great challenge, and I wanted to do that. We didn't know when we'd have another selection of astronauts.

So the first group was selected in '59, when I was in school. I was in school class at Edwards, class '58 Charlie, which graduated in the summer of '59, after the first group was on board. So when there came calls for the second group of astronauts, I applied for it and then went through Air Force screening and then through NASA screening. In the interim, I wanted also to continue my Air Force career, and I always said the Air Force had good technical ability, but their big problem was management. So instead of complaining about it, I wanted to do something positive, and I applied and got one of the three slots that the Air Force had at Harvard Business School.

VANTINE: So you were at Harvard when you got the call?

STAFFORD: Yes. I hadn't been there very long. I stopped in my home in Oklahoma, saw my first wife's parents, and I drove down to Houston for a final interview, went back, and meanwhile I had all my things shipped to Boston. I'd gone up there already and rented a house near Harvard, a duplex, and got there. I told the dean of the business school that I was in a selection process, he understood that, and if I was selected, I would resign from the B School. I'd been there for three days and seven case histories when Deke [Donald K.] Slayton called me and said, "Are you still interested?"

I said, "Absolutely." And I told him I'd be resigning tomorrow. So I had the notoriety of being the first dropout of the class of '64 at Harvard B School.

VANTINE: [Laughter] No hesitation there.

STAFFORD: In fact, when the packers came, I says, "Don't unpack yet." I was kind of optimistic I'd make it. I says, "Don't unpack all the furniture, just some of the basics, because you may be packing up."

VANTINE: Had you applied for the first class, or were you in the first class running?

STAFFORD: No. In the first group? No. The first group, you had to be a graduate of test pilot school, and I was just a student in the test pilot school. I wasn't a graduate.

VANTINE: Interesting. When you went on after on to Gemini VI—I was taking a look at that—Gemini VI has a couple of notorieties involved in it. One of them was how fast they turned around when they launched VI and VII.

STAFFORD: Well, there's more to it on Gemini VI, yes. It was decided that the approach to landing on the Moon would be a lunar orbit rendezvous. That was the basis of how we'd go to the Moon instead of going to the Moon direct and back, because it would save you a lot of weight. So we were sizing the lunar module, sizing the command module, sizing the giant Saturn V booster, but nobody had ever done a rendezvous. So it came out to Wally and I to prove that. But in the training—and also we had a computer, we had a platform, we had a radar, and we said, "What's going to happen if we lose the radar? Can we still do the rendezvous? What happens if we lose the platform? What if we lose the computer?" Or, you know, different combinations.

So from that we developed an on-board—really a rudimentary-type thing. It was made out of cardboard and plywood that had a couple of displays and some software in the basement of McDonnell Aircraft in St. Louis, and from that we worked out backup charts and worked out procedures to do it. In fact, many of the techniques we worked out are still used today on the concentric phase of rendezvous.

So we got all squared away and ready to go and got in the spacecraft and the Atlas Agena, we could hear it thunder off down the pad, Pad 14, but it never got to Ascension Island. It turned out that the Atlas did all right, but when the Agena lit off, they had made some changes to have an oxidizer fuel lead-in change, and it did it wrong, and the thing lit off and blew up and blew all over the Atlantic Ocean.

So it was decided to put a transponder on Gemini VII and launch us in a fast turnaround. So we couldn't dock, but at least we could do a rendezvous, and we briefed—to get the maximum thing on the crew I explained to [James A.] Lovell [Jr.] and [Frank] Borman, as we were coming in the terminal phase, I'd call every five degrees that we were pitching up above the horizon, I wanted them, as they were going backwards, to pitch down so they would get maximum return on the radar.

VANTINE: From an operations standpoint, what enabled them to ready the launch pad so quickly and turn that around so fast? How did they do that?

STAFFORD: Well, they started this whole procedure, and they pulled Gemini VI off the pad, had it already on trailers and everything and to turn around and go. But they'd never done it before, but they'd worked out the procedures and the techniques. See, the Air Force was responsible for launching it; not NASA, the Air Force. It's a Titan booster on an Air Force pad. That and the Aerospace Corporation and Martin and also McDonnell. So they worked it out, and I think they had it worked out where maybe the Gemini was still attached to the second stage—I'm not sure—versus bringing it up separately and attaching it.

But anyway, that same day that Gemini VII launched, that afternoon, the first stage was moved from the second stage and moved right down to the pad and started to be stacked.

VANTINE: Were they prepared beforehand? Had they talked about the idea of having two spacecraft in orbit at the same time? Because you had VII and VI at the same time, and they were monitoring both.

STAFFORD: No.

VANTINE: Was that a real-time "get ready to do it"?

STAFFORD: Well, in other words, we'd never done that before, had two spacecraft go, and how do you look at the telemetry signals and all this, how does it feed into the control center? So that was a real chore, how they we that.

VANTINE: That's tremendous, tremendous. Was it VI when you were supposed to launch and you didn't launch, it didn't go off, and you weren't sure what was going to happen there?

STAFFORD: Well, anyway, we got through all the procedures and everything, and we got all set to go, and at T-minus-three seconds, the engine shut off, and exactly at T-zero they shut down. We still have the all-time record. The shuttle shut down a couple of times, but nothing like we did. And we had the liftoff signal. But we knew in the seat of our pants and all the training we had, we hadn't lifted off. Furthermore, the only one who can call liftoff is a fellow astronaut looking at the base of a booster, you know, on a TV screen, and when he sees first motion, he's the only one that can call liftoff. It was Al [Alan L.] Bean, and he didn't say a thing, and that's exactly what he should have done, is not say a thing. He didn't see anything.

VANTINE: How come y'all didn't eject?

STAFFORD: Well, we knew Bean hadn't called liftoff, we could tell in the seat of our pants we hadn't lifted off at all, but also we had a dead man's curve of at least a second, because by the time you pull the D-rings and fire the pyro-trains [phonetic], reaction time—they had us calibrated and—I think my reaction time was point-three-eighths of a second from the time I'd see something and start doing it. But then the pyro-trains have to start firing and start working. So it turns out what we would have seen, had we had to do that, would have been two Roman candles going out, because we were 15 or 16 psi, pure oxygen, soaking in that for an hour and a half. You remember the tragic fire we had at the Cape.

VANTINE: Right.

STAFFORD: Jesus, with that fire going off and that, it would have burned the suits. Everything was soaked in oxygen. So thank God. That was another thing: NASA never tested it under the conditions that they would have had if they would have had to eject. They did have some tests at China Lake where they had a simulated mock-up of Gemini capsule, but what they did is fill it full of nitrogen. They didn't have it filled full of oxygen in the sled test they had.

VANTINE: Talking about the Apollo 1 for a second, going back, originally when you were getting ready for Gemini IX, Elliott See [phonetic] and Charlie [Charles A.] Bassett [II] were the prime crew for that, and they were killed in the T-38 accident. How do the astronauts versus the American public versus the media, how do they look at the Apollo 1? Obviously when an astronaut is killed in the line of duty is viewed differently than Elliott and Charlie when they were killed in the T-38.

STAFFORD: Well, I think, because you pick up a paper and every week or so there's a light plane crash, somebody is killed here, somebody is killed here, occasionally an airliner goes down, in those days there were lots more military crashes than we have today. So, you know, plane crashes and fatalities were somewhat familiar, even though it was an astronaut in a plane crash. We'd killed one earlier, a man named Ted [Theodore] Freeman, who came on as secondary. He got killed. He'd been on board, I think, about a year.

VANTINE: Was there any pressure after Apollo 1 fire to slow the program down like there was after *Challenger*?

STAFFORD: Let's go back to the Gemini—

VANTINE: All right. Okay.

STAFFORD: —and work through that. Yes, there was. We launched and we had double failure that morning. There was supposed to be fifty pounds of pressure to pull the plug that started the computer clock and the timer that showed we'd lifted off, and it turns out they just kind of rattled and fell out, and that really saved our lives, because when they looked at the telemetry of the thrust chamber pressure, you saw the thrust chamber on both chambers build up, and suddenly one dropped and the other got the shutdown signal. But what happened to the one that dropped? So they said something was wrong with that thrust chamber. It started losing thrust before the shutdown signal.

They went back and found that the gas generator—you know, you get spun up by the pyrotechnic, you know, that starts the fuel flowing. Each thrust chamber had a gas generator, that somebody, when it says "remove the dust plugs," you know, you have these orange and plastic dust plugs, well, in the fuel line, somebody screwed the fuel line in on top of the dust plug, so the pyrotechnic spun the turbine, started the fuel into the fuel chambers, hypergolic—you know, it burns instantly—but then as the fuel, as it started up, pressurized the fuel, it came back in, the fuel, to the turbo pump, got stopped by the—got squeezed in. So that was a close one.

VANTINE: Gosh, that would be awfully scary. How long did it take them to get you out of the vehicle on that?

STAFFORD: Then a fire broke out down below, had to put the damned thing out. That's when I was accused of saying, "Aw, shucks." We were up there about an hour and a half.

VANTINE: When you were doing VI and VII, when you were getting ready to do the rendezvous on that, what was going through your mind when you were doing the rendezvous? Nobody had ever done a rendezvous in orbit before.

STAFFORD: Then finally they found out what was wrong, the gas generator, found out about the plug, reworked that. So finally, three days later, they launched. We launched, and I was wondering what would go wrong this time, you know. First launch, you'll never forget. So it was really great. The Gemini was a real hot-rod, riding that thing. It was in orbit in five

minutes and thirty-five seconds. I think in the first stage it goes over five Gs and shuts down in a big—and they had a fire in the hole, the way the Titan was designed. The second-stage engine fires before the bolts blow, so the flame comes up all around top of the top. Whoosh! Like that, and, whop, you fly through it. And then you pick up to nearly eight Gs on the second stage before you go into orbit, and then you got from about eight Gs to zero G in about a tenth of a second. So you pick up 1,500 miles an hour in the last ten seconds. So it is a real ride.

We had to get off right away, because they'd had some of the second stages in the weapons systems blow up for auto-ignition back there in the gas generators. So we got off, got everything going, get the [unclear] from the ground. Then we started in this final co-elliptic phase, and I was using my back-up charts, and with that, I had the solution before either the ground or the onboard IBM computer, to make the terminal phase, you know, where you aim at it. We worked a situation where you just track it, and at a certain angle and distance, you know, you thrust, and it brings it up, and you're really out in front. Well, the inertial angle is like this. Right at sunrise you break out, and here's your target. So if the target moves right, you move right; if it moves left—just like flying an instrument landing system, an ILS.

What was interesting, that wasn't the way we planned to do rendezvous at all to really start with. We were going to do a pure [unclear] energy but far more [unclear]. And some Russian published an article in a magazine in '62 and '63 about the co-centric use of rendezvous. Ed Lyonberg [phonetic], who's now dead, had it translated and decided they'd start working that. So we really adopted the Russian version.

VANTINE: That's interesting. So we learned something from the—

STAFFORD: It turns out they didn't use it, though.

VANTINE: They didn't use it? They'd just written about it?

STAFFORD: Yes. The one time they ever used it was on their anti-satellite program.

VANTINE: Was there ever any issue when you'd be coming in for the rendezvous where you were supposed to keep the sun—did the sun ever get in your way?

STAFFORD: No. Because the sun's over here, and you're coming like this, from below, and the belly of the spacecraft away from you is into the sun. You can still see some of the stars breaking out in the sunlight. So it had a flashing light on it so you can see it. So the sun was here, and it was illuminated, and we were right here. So as you really break, you break in a posigrade mode, you see. Because if we hadn't done anything, we would have done that. So you come up here, and to match that vector you've got to go this way. So our breaking was in a posigrade mode, posigrade and down, because we shot past and around.

VANTINE: So after Gemini VI, then you went on to fly Gemini—

STAFFORD: Yes, we flew in formation there for several hours [unclear], and got within a couple inches of them. One thing that's interesting we determined about anthromoric measurements, the original Gemini mock-up at McDonnell Aircraft—a Gemini mock-up, and it had two big round rings that went around it. You'd get into your suit, and it would rotate in a ninety-degree

position. When they did that, God, my back and my neck started to really ache, and I couldn't figure out why. [James A.] McDivitt had the same problem. Couldn't understand it.

So they built just a plywood mock-up and started to check in our measurements. And, you know, gravity pulls down on you all the time when you walk. That's what makes you—older people, your nose grows, your earlobes grow, your breasts sag. It's gravity, the increment of gravity. Gravity's working on you all the time. So when I'd rotate like this, you know, there's no Gs on you, you unload, all the spinal column, your neck, and the way the discs and all the tendons unload. So from my buttocks to the top of my head I grew an inch and three quarters, and McDivitt grew two and a quarter inches. I don't know, for some reason it was never [unclear]. People hadn't thought about these things.

So they put a bump on the inside of a hatch, and it started from Gemini VI on. They call it the Stafford bump. They couldn't change the outside mole line for aerodynamics, but they had plenty of insulation. The hatch was about this thick. So they put a nice little bump in there, and that really helped. Of course, once you had the helmet off, but, you know, and Gemini was so small, you could take off your gloves and helmet and put it down there, but you had to ride with one foot on top of the other in the foot well. Of course, in zero-G, you had to. And then to get the food out, it was on a little locker over here, had to pull out like that. Well, you've seen the Gemini. It was small. Less room than you had in the front seat of a bug Volkswagen.

VANTINE: And you're a tall man in the first place. Were you one of the tallest astronauts?

STAFFORD: Of the group, yes. I'm supposed to be about six feet. If I really stand up erect, I'm about six-one or close to it.

VANTINE: Shrink down?

STAFFORD: That rendezvous, then we turned around, then [Eugene A.] Cernan was to be my pilot, and I was commander and back-up on Gemini IX, and we were to fly in Gemini XII, and then going into St. Louis, well documented and everything, I was flying their wing, was briefed that the glide slip was out, but the localizer was in. I'd been to that airport many, many times as a back-up on Gemini III and also prime on Gemini VI. So I'd lived up there a lot at McDonnell Aircraft. I was stacked right in the super. The forecast was 1,500 overcast, three miles' visibility, which is practically BFR.

Well, it wasn't like that at all. The weather really got down. I was flying their wings, their first time as a crew, you know, working together, and he was way fast. He flew the final approach. It was supposed to be about a 155-60 knots. He was about 225, and he missed the runway. I looked around like that, stuck my head in the cockpit, and said, "You missed it." I said, "We missed the runway, and we're going to the far end of the runway headed down." And so he looked around, and so—boom—he broke like that, instead of trying to make a smooth turn to keep—so I tried to follow him and finally said, "Hey, I can't." I missed wing-man approach, and he kept trying to bend around one runway. I could see these clouds practically hanging down to the ground with snow flurries, and I didn't like that at all, so I said, "I'm making a missed approach." I just picked up the gear and added the power and up with the flaps.

Last I saw him, he tried to make the original runway, he missed that, went around behind the tower, and that was the last I saw of him. We went way out. Then our fuel started to

get low, and I said, "Hey, I've got to declare an emergency. You're holding me too long." I guess they shut the field down when it crashed. So he kept trying to bend it in close, you know, full flaps. He ended up slamming right into the building, where they were building the Gemini spacecraft. He hurt about thirteen people. Had he hit about a hundred feet shorter in that building, he would have wiped out the Gemini Program. His wheels dug into the roof. Fortunately, he just head in like that and they dug in and his plane careened over and it killed him, unfortunately. So we took over.

I'd had so much experience with the systems, I told Cernan to concentrate on the extra-vehicular activities, besides learning the rendezvous, because I knew the systems, being a back-up on Gemini III and the prime on Gemini VI and used to fly on a 125-foot tetherless rocket pack as an Air Force experiment built by LTV [Ling-Temco-Vought]. It had hydrogen peroxide thrusters. To keep from burning through the suit he had on, he had steel mesh on his trousers and elbows, a Mickey Mouse idea, but we were willing to try it.

We knew three different types of rendezvous. One is an early rendezvous. We had an M equals 4 on Gemini III, which means you'd cross the nodes four times to go down to an M equals 3, is going to be the standard we'd use on Apollo. Then to do the first optical rendezvous, tracking optically. And then to do an overhead rendezvous to simulate a command module having to come down and pick up a lunar module or in case a lunar module had to abort off for some reason, the command modules, halfway around the Moon, you'd have to go high, you know, and [unclear] and then let it come down from above. So we'd never done one.

The first rendezvous, we got there, the shroud—we knew that they had a problem. Let's go back. We got all set to go on the Gemini IX, and I'd trained Cernan. He did a lot of work on the EVA [Extravehicular Activity]. And all they had to [unclear] was a little steel platform over

in Building 4, a little smooth steel platform, [unclear], and he'd try to maneuver around on that, and they did some rudimentary handholds on it, and all we had was a little water evaporator with a fan on it. We didn't even think of putting defog on the visor like you do for snorkeling or scuba diving.

So anyway, we were all ready to go and all set. Again, we could hear the Atlas Agena roar off from Pad 14. This time the Atlas got out over the ocean, did a bunch of loops, and Range Safety blew it up. So we scrubbed out that one. So they decided, well, look, they did have a back-up thing. "We want to do another rendezvous and check out some things, do some more things, do these different types of rendezvous."

McDonnell had worked out this thing called the "Augmented Target Docking Adapter," ATDA, in which they took the nose out of my old spacecraft, Gemini VI, the nose section, the reentry nose section, had the twenty-five-pound thrusters, rehabbed it, put on a docking mechanism and a transponder and a battery pack and put it on the shrouds. So we scrubbed out and they recycled then. They were supposed to launch in May, and they put this ATDA in. We were down on the pad, and here was the whole thing, pure black. I talked to the program manager, Chuck [Charles W.] Mathews, had him come down, and said, "You see that black so and so? You want me to try to rendezvous with that? I need some reflected light." The Agena was painted silver and black. This thing was just all black. So he said, "Well, the thermodynamics."

I says, "Bullshit." I said, "Put some silver tape on it. It's not going to overheat that much." So they put some silver tape on it.

I was concerned about how long those twenty-five-pound thrusters were going to last. I think they only had fifty pounds of fuel on each ring, fifty or a hundred. They said, "Well, it

should last you for months," the calculation. This becomes a very interesting story. John [F.] Yardley, who later became associate administrator for manned space flight, he was the Gemini program manager, then later went back to that, said, "Well, it should last months. We can duty cycle it, give it commands on and off." So we got ready to go, and—ZAP—off it went. And so we're ready to go, and we didn't get an update for the ASP [phonetic], so we scrubbed out again.

So, turned around three days later, and meanwhile, it turns out they said they turned it on, within five or six minutes one ring of that fuel was gone. It's only got two. You have to understand it was doing some weird things. It was slowly tumbling and they couldn't control it, and they didn't have a deploy signal on the shroud, either. They didn't know what was going on.

So we got all ready to go and we launched, and it lifted off in June. I remember coming up to it, and you could see the constellation Antares. There was a full moon out. We got up close, I could see this weird thing. I came right up close to it, and it just broke out in sunrise, and here was the shroud, like that. I call it "The Angry Alligator." It looked just like that and inside. And it was slowly rotating.

Once we got over ground station I told them—I backed off, told them to stabilize it. They did, and pow, pow, pow, you could see the fuel coming out. I said, "Shut it off." They shut it off. And I described the whole thing to them. To get an accurate picture, I got the Gemini spacecraft—it was a very maneuverable thing, rotate it, got on my camera and put the telephoto on my little camera in the window, and I just matched the velocities. We rotated. I got within about, oh, maybe a foot of it, like that, and just rotated around. You could see that things were taped and tied. It turns out this was a Douglas person built—Douglas built shrouds, and his wife was having a baby. So he left word with the Mac technician, "Secure the disconnect lanes," which means hook them to the bolts or something. What this guy did was

wrap them around and put tape on them, and there was 300-pound springs like this, and they had kind of a jagged edge for pyrotechnic fire, you know. So anyway, we did the rendezvous right on, didn't use much fuel.

Also, I'd talked to John Welawerken [phonetic], who is the retro officer, working orbital mechanics. We'd been flying out of circular orbits. So we had a new computer loaned to us, started with Gemini VIII, and I said—we'd learned some things—"If we could really fire out of a slightly elliptical orbit, a more down trajectory, it would enter the atmosphere at a steeper angle, and I might be able to really grease it down at an aim point." So I worked that out with them.

Oh, also before launch, with this new computer program, about two weeks before launch, in the simulator I noticed at the very last you could read out what different longitudes you were crossing, because you'd be coming down a latitude, usually, like that, not crossing too much in latitude where we'd end up, right east of the Cape. But the computer said at the last lift vector up, just at the very last, to reduce G load. Well, the G load wasn't that much, three or four Gs at the last. We found out that we could interpret how fast we were approaching it. If we're not going fast enough, we'd have to pull lift vector up, or if it was too fast, we'd split S and roll down.

So I called the captain of the ship, which was the *Wasp*, it was the same one that picked Wally and I up. You've got to remember this was June of '66. We're going from May into June of '66. They didn't have GPS [Global Positioning System], didn't have Loran. All they could do was shoot sunrise and high noon with the sextant. I said, "Look, we've got a beautiful new program, and if the inertial platform's on, I think I can really grease this thing down. At least we

can do it in simulations right down there. So if you could work it out to have that *Wasp* right on the target point, I'll try to put it right there in front of you."

So Captain Hartley [phonetic] said he'd try to do that. And, of course, we had live TV. Anyway, that's just another part. You can edit that back in. These things keep coming to my mind. We worked this out beforehand.

So anyway, we decided to—okay. We had an angry alligator. We decided to go ahead and do the overhead rendezvous, and we sequenced ourselves and came down. I didn't have any inertial needles. So I came down—

VANTINE: What were you using? You didn't have the inertial needles. What did you use? What were you using for a guide?

STAFFORD: Mark One eyeball.

VANTINE: Your eyeballs, huh?

STAFFORD: Yes. You know, the docking site. But, you know, coming in from below, you're trying to hold the inertial angle steady, but you've got the stars up there. So as it moves over, you can move over, you know, so you damp it. Coming down from above, we had no inertial needles. There was no inertial needles in our display. We had crossed needles. We didn't have anything that ever said inertial. So I got locked on, you know. We'd use the back-up charge, ground solutions. So here we come screaming down from above to do this. I remember the target was going right over the Sahara Desert. The difference between looking straight down

like this and looking out like this is all the difference in the world. If you look out like this, you can barely see a little bit of curvature of the Earth, barely. You see just flow lines, just air slowly going past. The more you pitch down, the faster it goes. When you're pitched straight down and holding it straight down, you think you're hanging on your shoulder harness just a couple hundred thousand feet. I mean, you know you're going 25,700 feet per second. Tchoo! It's just gone like that.

And so here I was coming right down, and here was this target, and here was this stuff going past me like that. That's what happened to that commander on the *Mir* Progress, as I pointed out . So anyway, I was trying to integrate, because, you know, we had an orbrate ball, and I needed to keep that going to know where I was with respect to the local vertical, but I needed to know inertial, so I was integrating in my mind what four degrees per minute was and how this was coming as I was closing the break. I did have range and range rate. But it was a real—I got there and I was just sweating. Jeez, I made it, but what a bear.

I came back and debriefed. He says, "Don't ever try that again, looking to do a rendezvous." It's one thing just to fly around, you know, like this, you know, twenty or a hundred feet. It's a different thing to come in from fifteen or twenty miles, looking down, trying to brake the whole time. It was a bear.

VANTINE: Because the Earth is moving quickly underneath you.

STAFFORD: The Earth is right underneath you, seeing the target. Well, had it been nighttime, you'd have seen oil fires or lights as soon as you go on, or a flashing light down there, but trying to get a reference to get a—so you wouldn't have the—at this range, this way you wouldn't have

that. So you need to have a reference zone. I made it in, and I did the only overhead rendezvous we've ever done. And I says, "Don't do that unless you have an emergency." It's one thing just to fly around the station; it's another thing to do a whole rendezvous coming in like that.

So, real fast, what they did do, which helped them coming even from below, they got the software fixed up and they were right between missions so Gemini X, John [W.] Young on that, they had inertial needles. You could call up that mode.

So we did that, and then we separated and did an optical rendezvous, the first optical rendezvous using optical track. We had the radar for a back-up, but we proved out you could do that, you know, with degraded [unclear]. So we did those three different types of rendezvous.

Then came time for Cernan to go EVA, and they wanted him to go out and cut loose the shroud, to cut it loose. I looked at it. I could see those sharp edges. We had never practiced that. I knew that they had those 300-pound springs there, didn't know what else. So I vetoed it right there. I said, "No way."

So we got ready for the EVA, so we got squared away, depressurized, opened the hatch. Now, Ed [Edward H.] White [II] had a hard time getting in on Gemini IV. He nearly didn't make it, the suit didn't. So we put a bar with a piece of cable here so they'd have kind of an over-the-center mechanism with the commander [unclear]. So we depressurized. I'm flying the spacecraft using pulse mode, one millisecond pulse, going local horizontal. And Cernan goes out, and the first thing he does is place the rear-view mirror on the docking bar. He's huffing and puffing. He's torquing the hell out of this spacecraft, and I'm pulsing it back to be sure none of the thrusters fire on him. So we were supposed to out about two hours and thirty-some

minutes, go take this rocket pack and get into it and fly it around and maneuver around just like they do on the packs now, but this is hydrogen peroxide. Okay. So he goes back. He goes out in front and does a few little maneuvers and he's having a very difficult time. There was nothing for him to hold on to. Remember, the Gemini suit was a very easy suit to wear. It was lightweight, twenty-five, twenty-eight pounds, and when it was uninflated, it was limp. Nothing to it, just kind of heavy. When you pressurized, it trimmed to one position to hold your arm. You had to hold them out. Whop, it would go back, where Apollo was a big suit like they have now. It was big, heavy, and bulky. You could move your arm, but you could stay there.

So he's really huffing and puffing. He goes to the back. So he's hanging onto the back end of the Gemini, going through this check-out procedure for the rocket pack. Then he says, "Tom, my back's killing me. It's burning up. It's really killing me."

I says, "What?"

He says, "My back."

I could look in the rear-view mirror, and I could see the sun. Of course, you never look directly at it. I said, "Do you want to get out of the spacecraft?"

He said, "No. Keep going, but my back is killing me. It's burning up." So he finally, just before sunset, gets turned around into the seat. We had two lights back there. One of them burned out for some reason, during the vibration of the launch anyway. We had one light. And then a couple of minutes after sunset, he was strapping himself in. I was down to a couple of steps. You know, at sunrise I would cut him loose. He fogged over. Whop! He could not see. It was just like that, fog. So we did defog on the visor, and he had overpowered that little water evaporator so much, it was unbelievable.

And then we started to lose one way of two-way com. It was real scratchy. So he could hear me. So I worked out a binary system. I said, "Look, if you can hear me, make a noise for a yes. For a no, make two noises." So I'd hear a "squawk," and for "no," I'd hear a "squawk, squawk." So I said, "Can you see?" I'd hear a "squawk, squawk." We were out there. We didn't have any TDRS [Tracking and Data Relay Satellite, used during the Shuttle Program], any tracking, and we were cutting across the Indian Ocean down by Indonesia. I don't think we had an Australia tracking site. I think we went south of Hawaii, then, before we hit the West Coast of the U.S. We went a long time. It was nighttime. We saw the Southern Cross go by. What a hell of a lonely place this is. Here you're 165 miles up, you know, flying, pressurized. Your buddy's twenty-five feet back there. He can't see, and we'd lost one way of two-way com. There's not a thing you can do until you get daylight.

So it came up daylight. He could see it was daylight. I said, "Okay, Gene. If this doesn't burn off fast, we're going to call it quits and get out of there." So after five or ten minutes, nothing happened. So I said, "Okay. Call it quits, Gene. Get out of there." Of course, he'd been through it procedure-wise. He'd had some of the connections hooked up, but he was still on the chest pack umbilical. So he disconnected from the backpack and he couldn't see. He was absolutely blind.

VANTINE: How long could he not see for?

STAFFORD: For 125 feet. It was a long tether.

VANTINE: And how long was he unable to do it? How many minutes was he not able to see for? Was it a long time or a few minutes?

STAFFORD: What?

VANTINE: Was he unable to see? How long was he fogged up when he was out there?

STAFFORD: Oh, hell, you have thirty-six minutes of daylight, and he fogged over in a couple of minutes. So he was thirty minutes of nighttime he couldn't see. We came out in daytime, he couldn't see. He just had this fog over him. So I said, "Stick one of your arms up." I looked in the rear-view mirror and saw this arm come up. I said, "Okay." There was a rail on the top of Gemini. I said, "I'll kind of guide your hand over." So I says, "Move your hand over, start to float up." By then I started reeling in the tether. Is said, "Stick your hand up." I reel left, right. He finally—I said, "Right there." He grabbed a hold of it. Then blindfolded, I said, "Just walk hand over hand." So he walked hand over hand, blindfolded. Then I kept pulling. I had this big 125-foot snake—it was about that big—in the Gemini cockpit. I kept trying to get it down. I was pressurized, [unclear] and work it.

So he finally got close. I said, "Swing your feet around." So he finally got around. I reached up, and I grabbed one of his feet. Of course, I was pressurized. I put him down in the ejection seat and turned his face towards the sun the best I could, and finally I suggested, I said, "Look. Take one of your hands and pull down on the helmet as much as you can and put your head up and see if you can take your nose and rub a hole on it." So he did that, and he could find a little hole he could see.

Meanwhile, we hit the West Coast. I said, "Look, I've called it off. He's fogged over, he can't see. We've semi-lost one way of two-way com. I'm not going to fly the rocket pack." My main thing is to get him in before the next sunset. So we got all squared away, and he got in, and we worked out this maneuver. Still, he couldn't see hardly a thing. So he got down. I helped guide him down. He knew how to feel on this thing. So he came in closer, and I just reached over and grabbed this over-the-center mechanism and slammed it and then reached up, pressurized, you know, and latched it home and dogged the hatch shut and turned up the air flow valve. We was wedged down in the seat. Then as the pressure came up, our suits decreased.

So finally he got back in his seat, raised his visor, and his face was pink, like he'd been in a sauna. He says, "Help me get off my gloves, too." So I helped him get his gloves off, and his hands were absolutely pink. So I took the water gun and just hosed him down. You shouldn't squirt water around in a spacecraft. Turns out he lost about ten and a half pounds in two hours and ten minutes outside. That was the third day.

We landed the next day. By the way, the ride on the carrier, I want to tell you about that. We got the suit back to Houston, and the next morning they still poured a pound and a half of water out of each boot. So they figured he was pumping 4,500 to 5,000 BTUs an hour out there.

VANTINE: What a thought that must have been for him, too, to be out there and not be able to see. God!

STAFFORD: So we said, "There's got to be a better way to train. There's a lot we don't know about walking in space." And after that is when we came up with the idea about training under water.

VANTINE: How did you come up with that idea? How did that come about?

STAFFORD: Well, various people had been thinking about it. We said, "You've got to do something." So they started working on the idea after Gemini IX, because we said, "Hey, we just can't go like this, because you're going to have to walk in space and various things in the future." I think Buzz [Edwin E.] Aldrin [Jr.] finally got in to train on it for XII, and he really worked out the handholds, so he had it worked out pretty good by then.

VANTINE: And they put a defogger in after that?

STAFFORD: Oh, yes. We put a defog on, put defog on the visors. Even though [Michael] Collins and Dick [Richard F.] Gordon [Jr.] had a hard time, they huffed and puffed, but they had lots more handholds and things, trained under water. Buzz Aldrin had a chance to train under water more. Now, they just barely started training. So it worked out. But the whole thing came after Gemini IX, when we said, "We've got to do something different."

Now, an interesting point. When we were suiting up down in this trailer we had on Pad 16, you have the suit tech with you. There's two different rooms. Of course, when you suit up—it wasn't even sophisticated like Apollo, where you could talk to each other, had radios. You couldn't talk till you got plugged into the spacecraft. So Deke Slayton came in. I had my

longhandles on and I had my urine collection device on. I was putting my suit on, and he told the suit tech to get out, he had to talk to me. He came in and shut the door and said, "I need to talk to you, Tom." He said, "Look, this is the first time we've got this long EVA, this rocket pack, and NASA management's decided that in case Cernan dies out there, you've got to bring him back, because we just can't afford to have a dead astronaut floating around in space." We'd never thought about that or anything.

So I thought for a minute, and I said, "Jesus Christ, Deke." I mean, all these thoughts went through my mind. I said, "Look, to bring him back, I've got to have the hatch open because of that cord going out." And I said, "Here I'm going to have to fly it." There's no autopilot to retrofire. You flew it. You flew the retrofire maneuver. You had autopilot for straight forward or straight back or straight forward, but any maneuver you made, you had to fly it. In retrofire, you had to hold it. And you had an autosequence, but you had to back it up. We'd never simulated what all this total mass would do to that Gemini like this. I said, "What will happen to the hatch if the thing's floating around during retrofire?" I says, "Then suppose I get through retrofire and I blow off the adapters and start down, I've got to roll the thing." I said, "You know the spacecraft has got a real low stability coefficient on the thing." I used a few other words, too. And I said, "Then I hit the fireball, and I've got this hatch. What the hell is going to keep that hatch as I roll the spacecraft trying to hit for the aim point with this mass behind me is bumping the hatch open and all that?"

And I says, "Furthermore," I said, "he's got all these six layers, all this superinsulate. All I've got is this one layer of nylon on top the rubber bladder and I've got 3200 degrees Fahrenheit plasma about three inches from my shoulder. How long do you think this damned suit's going to last?" And I says, "Furthermore, if I get through all that and I come down the drogue, I know

a bunch of that, insulated as he is, and all that, and that cord, that's going to survive. What's that going to do to the drogue chute? Then I put out the main parachute. What's it going to do to the main parachute with all that stuff hanging up there?" I says, "Even if that would hit the water with the damned hatch open, what's going to happen?"

And he says, "Well, what do you want me to tell NASA management?"

I said, "You tell them that when the bolts blow, I'm the commander and I'll make the decision. That's it."

"All right." He left.

So anyway, we get all buttoned up. So we finally—you know, [unclear] he was all ready way before me because this discussion with Slayton. So we get all plugged in, and Gene says, "Hey, Tom," he says, "Dick was in there talking to you quite a while. What did he say?"

I said, "He said he just hoped we'd have a good flight." [Laughter]

And finally, after we did splash down, after the final thing, we're back in the crew quarters having a drink, I told him what Deke said. It was pretty rudimentary in those days, Bill.

VANTINE: [Laughter] That's interesting.

STAFFORD: So anyway, it came everything, so we got finished with the EVA, and he nearly froze that night because of all this water in his suit.

VANTINE: Did he stay in the suit?

STAFFORD: Oh, hell, you couldn't get out of the—

VANTINE: You couldn't get out of the suit?

STAFFORD: No. Hey, I had ride with my feet one on top of the other, and the way you had visibility, you had a window right here in front of your face about this distance. You could get the helmet underneath your knees and the gloves in there.

VANTINE: So he's soaking wet from sweating so much, and he's sitting in that suit all night.

STAFFORD: Yes. That ten and a half pounds, you know, this is—

VANTINE: Gosh.

STAFFORD: Of course, some of it got evaporated a little bit in the spacecraft atmosphere.

But we retrofired and came in. Also, I called the ship as we passed over it, told them to be right on us. I said the platform looked good the best I could tell. We came across at nighttime, we fired the retros right on, really held them. You had a notch about twenty degrees down on the eight ball, over the horizon, and you controlled the retro pattern by hand, blew off the retroadapter, turned upside down, and started our lift factor in. Then I flew the needles. You know, I flew just the roll [unclear] all the way in, and right at the last he was reading out what this little chart we had, what the given longitude was, and the right [unclear] pushing too fast, split S, so I rolled over and pulled the lift vector full down.

And here was the *Wasp* coming and the first time I ever saw it on live TV, and right there we were. In fact, he had to turn the *Wasp* like this and back down some screws, just boom, right there. It was right off the East Coast here. They had five C-band radars tracking us, and we splashed down 0.38 nautical miles from the aim point. That's the closest of any Gemini-Apollo landing, or the first Shuttle landing, because John [W.] Young and [Robert L.] Crippen floated long, you know, from their aim point. So we did that on Gemini IX, 800 yards, 0.38 nautical miles.

VANTINE: That's amazing, from that far out in space to all the way in like that.

STAFFORD: Yes, firing retros, out by Hawaii, hitting down there right off the Atlantic Ocean. So that was quite a—we did a lot on that one.

VANTINE: That was a pretty exciting one. And Gemini played an important role in the preparations for the Apollo.

STAFFORD: Without Gemini, we could have never gone to the Moon. Now, some people said, after Mercury, "Why don't we just go do Apollo?" Well, you know, what we learned on rendezvous and about the orbrate ball, about inertial needles, how you approach it, the problems you can have about walking in space, the docking, the whole thing, a precise touchdown—no, Gemini proved the whole theory out. It was really a great step. It was ten manned missions and two unmanned.

VANTINE: So after Gemini, we went into the Apollo Program.

STAFFORD: Yes, and we started out with various crews. You have to look at the history on all that. One time—I was on the crew with Frank Borman, they changed crews around, and I ended up as a back-up commander for the second mission of Apollo, which was to have McDivitt, I think [David R.] Scott and [Russell L.] Schweikart and I had Cernan and Young. I was running the test out in spacecraft O-14, a Block I spacecraft, at the same time that White, [Roger B.] Chaffee, and [Virgil I. "Gus"] Grissom were running the final countdown demonstration test at the Cape on 0-12.

Now, we had oxygen in the suit, but you didn't have oxygen in the spacecraft. That's the only difference. I mean, there was electrical shorts. Coolant loops were leaking water and glycol. It was just a mess. I remember John Young said, "Go to the Moon. This damned thing won't even go to Earth's orbit." We had this inward sealing hatch that a bunch of us had griped about, versus an outward opening hatch. And then Young dropped the hatch on his foot while getting out. He got out.

I remember Al [Alfred M.] Worden was one of our support [unclear]. I'd heard about the—I was up on the gantry and the other two guys were still in the spacecraft. "Have you heard about the accident at the Cape?"

I says, "No. What?"

"We had a fire on the pad."

And right away, fire on the pad, I thought about the booster. I said, "Was the crew hurt or anything?"

He said, "They're dead."

I said, "How?" I couldn't figure out the spacecraft was on fire. I didn't understand it. So I leaned down and said, "Hey, guys, get out of here quick. Come on. Let's go. Forget any debriefs." So I got them down on the floor, and I told them what Worden had relayed, and didn't know any of the details.

Of course, the spec they had was five pounds per square inch pure oxygen, was what we flew in space, that things would not auto-ignite at 400 degrees. Well, it turns out gasoline passed that spec. At 400 degrees pure—you know, gasoline, five pounds per—but all it takes is a spark, and the center of that spark is about five to six thousand degrees, the center of an electrical spark, and that sets off things next to it and—BANG—you're off to the races.

You know, huge stand-down. Lots of people said we ought to cancel the Apollo Program and all this.

VANTINE: Was there a lot of political pressure at that time or pressure within NASA?

STAFFORD: Well, LBJ [Lyndon B. Johnson] was President, and he had Democratic control of Congress, and they used to have a lot of horsepower. It was still the Russians were pushing. The Russians still had a head of steam. So there was a few detractors, but the main thing was, when you fly, be sure it's done right. Even though they said at a meeting, I think there was a lot of pressure, you know, for schedule pressure at the time.

VANTINE: [James E.] Webb was the administrator at the time.

STAFFORD: Yes.

VANTINE: How was his response, do you think, different perhaps later on than when [Dr. William R.] Graham was the administrator after *Challenger*, or were there just different times? How did Webb respond to the accident perhaps differently than Graham did, or at all?

STAFFORD: Well, Webb was devastated, but he said it would be thoroughly investigated, would be explained to everybody, and we still had a destiny to go on to the Moon, but we wouldn't go until it was done right. So one of the great guys we had, now dead, General Sam [Samuel C.] Phillips. In fact, before that, he wrote the famous Phillips Report about 1965 or '66, said that North American was very sloppy in their procedures and that they had all types of process problems and everything else. Mueller, George [E.] Mueller, was pushing a little bit, but Phillips would listen to us.

I think that in the end, they looked at all the recommendations, and so we delayed. That was in January of '67, and we finally had our first orbital flight. They went to a Block II spacecraft, to change the configuration, but they still flew a modified Block I, and that was Apollo 7. I was the back-up commander for that. They reshifted the crews, then, around, and I became the back-up commander to the first flight, to Wally [Walter M. Schirra, Jr.], and I had Cernan and Young with me.

VANTINE: I'm curious. When they were assigning the crews on that, were the personalities important? Who was assigning the crews and what were the characteristics they were looking for?

STAFFORD: In crew assignment, you assign a commander. It was Deke and Al [Alan B.] Shepard [Jr.] getting together, really. The commander had his, I guess, first right of refusal. They wouldn't make anybody fly with the commander if the commander didn't want.

VANTINE: So they'd give you your choice, or they'd tell you, "These are the guys we're going to put on," and you'd get veto power?

STAFFORD: Yes.

VANTINE: So then you went on and flew Apollo 10.

STAFFORD: Right, after we had 7. Then we thought the Russians had flown just a free return trajectory around with kind of a Zond spacecraft. So they wanted to try to push them. So they hurried up, and it was only the third flight of the Saturn V and the first flight of a Block II spacecraft. I don't think NASA would do that today. But George [M.] Low sent Apollo 8 around the Moon, did an orbit of sixty miles for ten revs, twenty hours, and came back.

Then 9 was an Earth orbit with a lunar module. And then I flew 10 out there. My lunar module was too heavy to land. They gave Grumman $10,000 a pound for every pound they could cut out of the spacecraft. Originally I had Lunar Module 5 and Neil [A. Armstrong] had 6. That one was the first one to land. We knew that we'd take about five crews and rotated them through, and somebody will land, because there wasn't any designated crew from the start that would land.

VANTINE: There was no designated crew? Was there any talk about moving Apollo 10 up and that being the landing crew?

STAFFORD: They wanted me to—but first we looked at the weight. I had a heavy weight lunar module, number one, and number two, they also didn't have the software all worked out for that power descent. So, there's no way I could have done it.

VANTINE: So it could have been any one of a number of crews that landed on the Moon?

STAFFORD: Right. It could have been me. It could have been Armstrong. It could have been [Charles C. "Pete"] Conrad [Jr.]. It could have been McDivitt.

VANTINE: So when they first assigned them, was that known, that Armstrong would be the commander?

STAFFORD: No.

VANTINE: When did that decision end up being made? When did they make the decision for 10 that you wouldn't land?

STAFFORD: Well, the main thing, they said we'd have these various flights. They didn't name Neil to that flight until after Apollo 8.

VANTINE: So you went and flew Apollo 10.

STAFFORD: Right, in May of '69.

VANTINE: And how did that mission go? How was it?

STAFFORD: Good. We flew the first lunar module out there. Interesting little things, how if you change a process, how it bites you. In the old days, we would pressurize our suit in the suiting room. We'd suit up. Then we'd get in the spacecraft. Then they'd pressurize them again. When you pressurized them, it would loosen up the harness. The booster that McDivitt had had more payload in that series than what 8 had. What the people in Huntsville had done, they'd carved 20,000 pounds of weight out of the structure of the second stage. So under the G force, it kind of became a balloon.

Anyway, McDivitt [unclear] this huge lunge forward. Well, we shut down. Gee, it was like a giant train wreck. Also, he complained about pressuring the suits and how it kind of plugged our ears up and all this. So on us, we were strapped in. We didn't pressurize the suits in the spacecraft. And when that first stage shut down, we're out here. It was like a train wreck. [Demonstrates] Like that. Jesus!

But also, another thing, it amplified. We had a steel bar that was a ground support attached to the couch, and the last thing the tech was to do before we shut the hatch was to take that and store it. He didn't do that, and so here you have this—see, when McDivitt's harnesses are loose, he just kind of got—what we got was a high frequency. We got this thing plus it's

kind of like a cantilever [unclear] with that brace there. And then we got the same thing when the second stage shut down, it was compressed, you know. Not as much.

But also we pioneered—I'd been in space twice before, so all we had was a black and white TV camera. The first flew on Apollo 8—I mean Apollo 7, 8, and then 9. I said, "We can do better than that." So I started the skunk works, got Chris [Christopher C.] Kraft [Jr.] to back me, George [M.] Low, and we got a low light level videocom that had been used in Vietnam declassified. We got a rotating color wheel with an actuated motor off a Minuteman missile and got three lenses from France. For some reason they also had the dynamic range, and they hand-built here three color TV cameras. We put them on board about a week before launch. The first time you ever saw color TV from space was when we did that on Apollo 10. We had more prime time on Apollo 10 than we did on 11 or any of the others.

Everything was squared away. We went around the world one and a half times. Then we started to kick on the third stage over Australia. We broke out in—you're upside down so you could look out for—

If you're like this and you start to climb, you'll lose the horizon reference. So we're upside down. As it broke out in sunrise, you could see the Earth, lots more round than we'd ever saw it before. We started climbing out in space, but as we neared the end of the burn, the whole thing started to really shake and rattle. I called over to John, I says, "Damn, John, it feels like flooding." I had the abort switch. I mean, it was shaking, the whole thing. I couldn't figure out what was the forcing function doing this. I'd never seen that before. The instrument panel was going like that. [Demonstrates] I had the abort handle here. I figured, you know, hell, we were up around 31,000 feet per second. I said, "I've gone this far. If it blows, it blows, you know." [Laughter]

So it finally shut down right on time. I said, "Hey, go back." So we shut down, go back, and check that telemetry. We had one hell of a ride, that vibration. We couldn't see the instrument panel. It was going like that. [Demonstrates] So what they determined was, the third stage is pressurized by helium bottles, and they had vent valves, and the vent valves were set too close and they started oscillation, and that oscillation, the pressure, was feeding into the engine. So it started this chugging. Then, on top of that, we still had that bar hooked to our couch. That gave us like a cantilevered thing. So you look at all that. So you keep running into these unexpected things.

The most impressive sight, I think, that really changed your view of things is when you first see the Earth. Of course, we shut down and maneuvered over to an attitude where the sun would be over the shoulder, and then we switched seats, and John Young got in the left seat, because he flew the entry and he had to fly the docking. So we counted down. We had to pressurize the tunnel, pressurize the lunar module with pressure and then hook up the cables. It took us about three hours. Of course, you really move out real fast.

We then, at the right time, exploded off the command module, turned around. We had docked with the lunar module, and finally, at the right time, we undocked the lunar module and moved to an attitude where we're ninety degrees to the Earth, Moon, Sun, because then we go into a barbecue mode for heating. We'd rotate it one rev every twenty minutes. So you don't fly to the Moon; you barbecue to the Moon. You can stop for two or three hours to do a star sign. You have super insulation, but after that one side heats up too much, the other one cools down.

So anyway, we left the third stage and hit the digital autopilot and started maneuvering over this attitude and looking around, and finally we saw it. It was awesome. I won't repeat

what we said here on tape. [Laughter] By then, when we saw it, it was about the size of a basketball, and it was just shrinking and going away. It was a real funny feeling.

VANTINE: Gosh.

STAFFORD: But then later you get used to it. At the end of the day, it's down to the size of a soccer ball. You wake up the next morning, and it's more like a big grapefruit. Finally, by the time you get out to the Moon, it's about the size of an orange.

VANTINE: And the Moon was getting bigger in front of you.

STAFFORD: That was weird. We were told that because of the trajectory we would fly, we would not see the Moon until we got there. And that's kind of weird, looking around. You see the Earth go by every twenty minutes, see the Sun go by. Where in the hell is the Moon? And the way the trajectory was and everything, the Moon was eclipsed. Finally, we got—well, a few hours out from the Moon, you could maybe see one little rim of it, hardly a rim. But most of the way to the Moon, we never saw it. Now, we saw it all the way back. Then the Earth started to be eclipsed, and just before we came back to see the Earth, all you could see was a little thin blue line of the Earth. So it was kind of unique.

VANTINE: What was it like when you were going around the back side of the Moon and the Earth was no longer in sight and you were on the dark side of the Moon? What was that feeling like as you were doing that?

STAFFORD: Well, we'd been out in daylight for three days, and you don't see any stars with the naked eye until you get about 80 or 90,000 miles out. There's so much reflected light from the Earth. So you don't see stars in the daytime ever with the naked eye. You can see it with optics, but not with the naked eye. Of course, at nighttime you see far more, just two orders of magnitude more.

So we went to get squared away, and right within a second—BOOM—the Earth goes down. The Earth disappears. There's this big black void. Down below the Earth, when it goes nighttime, you always see lights and cities and gas fires. There's just all kinds of lights around, and lightning all over. Just a big black void. So we left the Earth. It disappeared. It was quiet.

Got turned around, and suddenly—couldn't see anything, and suddenly, about sixty seconds, we were all set, just counting down. Right below us, here comes the Moon, right out in daylight. So it was a real funny feeling there. It really looked weird. And to me, the color of the Moon in early morning and late at night always looked a little reddish tinge on the top of the mountains. Some people say it's always white and black. I thought it was reddish, with maybe some charcoal grays and tans.

I made the maneuver and then pitched around for the attitude, got the TV on and everything, and here comes the Earth up. We showed that on TV, what an Earthrise was. So it was two hours as orbit, velocity, and period around the Moon. In fact, you think you're going to stall out, you're going so slow. Orbit's 25,700 feet per second around the Earth, it's about 5,500 feet per second around the Moon. And 5,500 feet per second versus 25,000, you're just barely creeping compared to the way you're going.

So we went through the procedures, got a little bit of rest, and then got squared away. Cernan and I had already checked out some of the lunar module on the way up, got the rest of it. We got all in there, all set to go, to undock, and John couldn't vent the tunnel. So we slipped it, and we could not vent the tunnel. Now, the one thing we were always concerned about was the docking mechanism on Apollo. You had these three latches on the end of a drogue that ran into a metal thing called a probe, and we had more failures of those in tests. It's unbelievable. So if there's any weak link, it's getting back together on a rendezvous.

So we talked to the ground. We finally decided that, well, here he couldn't vent the tunnel, so we decided, well, we'll give it a try and undock, because that may screw us up, too much pressure. There's a lot of pressure on that at 5 psi. So he undocked and extended it, and the pressure bent it, you know. Then we held and we cut loose, and we showed live TV a picture of the command module. He showed us back and forth. So it was kind of unique.

We got all squared away and started our maneuver to go down to about nine miles above the mountains and do two low passes, check out the landing radar, because if the landing radar doesn't work to update your state vector, you couldn't land. And it turned out the radar locked on to the lunar surface way in excess of spec, which was good. So as to what we did, we undocked and went way up high above him and came down low to get phasing behind him in case we had to abort to come up. So we did that, went down.

What always amazed me was the size of the boulders. They were awesome, these big ones, you know, huge things. Some of them are pure white with black striations up on the side of these gigantic craters. I said, oh, they'd have to be as big as a two- or three-story building. It's hard to judge distance. Here on the Earth, even from space, you can still see some roads and you can see cities. You can kind of judge some distance. No roads up there. No section lines.

So anyway, it turns out those things are bigger than the Astrodome, those boulders. I mean, they were awesome pieces of mass.

[Chuckles] What I didn't know, I remember we came by this great crater Sinserinus [phonetic]. This really is a—white [unclear] and all this, these giant boulders. After I got back, Jack Schmidt, who flew on 17, was a geologist, he says, "Hey, do you know what you said, Tom, when you went past Sinserinus?"

I says, "No. What?"

He said, "'Hey, look at that. There's Sinserinus, bigger than shit.'" [Laughter]

So the people said, "What did Stafford say?"

Jack Schmidt said, "There's Sinserinus, bigger than Schmidt." [Laughter] So there was all kinds of jokes like that.

Did the second little pass, came back around. All set to stage off, and I notice the thrusters started to fire. I looked down and I could see I had a yaw rate, but I could tell by the eight ball I wasn't yawing. So I talked to Cernan, and started firing again. We were all buttoned up, and I started troubleshooting, went to the AGS [phonetic] position and all that, but the first thing you know—BOOM—the whole damned spacecraft started to tumble and tried to rotate like that. And real fast, I just reached over and just blew off the descent stage, because all the thrusters were on the ascent stage, get better torque-to-inertia ratio, because we're heading over towards gimble lock on the main platform. See, it was designed—we had two separate types of platforms. We had a three-gimble platform. We'll never have three-gimble platforms again, you know.

So I got it around there, and we got it squared away in about twenty seconds and got ready and lined up, but during that period of time we forgot we were on hot mike, and Apollo

10 became X-rated. [Vantine laughs] But we did the burn down close, because the lunar gravity is so low, when you're down like that, you want to make sure, if you make a few-feet-per-second maneuver, you want to make it in the right direction or else you're going to be going the wrong way in a hurry. And we did that and came back up, did a perfect rendezvous and got all squared away, and we decided because the lunar module, at least the ascent stage, is so light, the command module has more inertia and he has a tighter deadband, we'd come up line it in place, then let the command module dock, and that's what we did.

We got all squared away, hooked up, pressurized, did the garbage—you know, put all the stuff back there. Then we got the hatches all sealed up, couldn't vent it again, but then we had to put on our pressure suits, all buttoned up, then we fired explosive bolts. That took off like a bat out of hell because you had 5 psi in there plus the explosive thing. Snoopy was the lunar module. And then later the ground commanded it off in a propulsion test. Did it leave the Earth-Moon system? Anyway, it's going around the sun.

And after we got back, we found out, as they examined the part of the command module, it shows that for the vent it had a valve here, it had a non-propulsive vent, just a line that went up that had a nut on top of it, and it had these dash holes where a tech was supposed to drill the holes. Didn't drill them. So that's why they couldn't vent.

VANTINE: Small little things.

STAFFORD: Yes.

VANTINE: When you got back, would you debrief the next crew? I mean, would you debrief 11? And what were some of the lessons that you passed on to them?

STAFFORD: Lessons learned. The way we could streamline the procedures, what to expect on the rendezvous, the descent, everything. We concentrated on that. So really Neil and Buzz [Edwin E. Aldrin, Jr.] concentrated on the power descent down on the EVA on the surface, and the ascent, because we did everything else. We had all the procedures worked out.

VANTINE: Come back and tell them about it, what you learned, etc.

STAFFORD: So two months later they went the last nine miles we didn't go. Then after that, after Apollo 10, I replaced Al Shepard as head of the astronaut group.

VANTINE: So then you were in charge of selecting the next crews?

STAFFORD: Yes. See, by then they'd already selected through 14 or 15, so I was in charge of 16 and 17, and starting the first Skylab group. Then after Shepard flew, he wanted to come back to the astronaut group. We never filled the slot of deputy director flight crew operations, so I moved up there.

VANTINE: And then you went on, obviously, afterwards and after Apollo was over, and we went on to the Apollo-Soyuz Program.

STAFFORD: Right.

VANTINE: How were you selected? How were you named the commander of the Apollo-Soyuz Project?

STAFFORD: Well, that was, I think, primarily Chris Kraft. Chris Kraft was by then center director, was Chris Kraft.

VANTINE: And because you had had rendezvous experience, or what was he looking for?

STAFFORD: Well, I'd had three missions before me, you know, and had more rendezvous than anybody.

VANTINE: What was it like as you prepared? How much time did you have to spend in Russia? What was the preparation like?

STAFFORD: First I went on a negotiating trip before I was named to a crew, for two weeks, and then we spent five periods of time for a month to six weeks at a time in Russia, and the cosmonauts spent about an equal number of times here in Houston, training.

VANTINE: Did you receive intensive Russian language training?

STAFFORD: Well, what happened, we started out, when we first got named, the Russians didn't want to name the crews until six months before the mission. We said, "Hey, this isn't going to hack it." We insisted a minimum of two years. We even jumped them on that, so we named our crews in February of '73, and the Russians didn't name their until the Paris Air Show at Le Bourget in June of '73, and then they came over right away and started training. We needed every bit of that, but originally we'd have a lady come down from the State Department—that was in their language training—and teach us Russian.

So we kind of leaped ahead of them, because all the Russians of that vintage had never studied English in school. But in the old days, you know, Stalin just hated the British, he hated Americans, so the only English taught was in the universities, and not much of it then. But within a couple of years after the death of Stalin, English started to be the major language taught in the schools, so the very youngest cosmonauts could speak it very good, had a pretty good background.

So we started out ahead of them, and then by Christmas we were over there, of '73. Each one of them had a private English professor with them all the time, and they were skunking us, and I knew that I had to speak Russian as well as he spoke English when we opened that hatch. So I called back to Chris Kraft, put a call, says, "Chris, we got a real problem here." And I talked to Glynn [S.] Lunney, who was also the program director. I said, "I need at least four professors full time. We need them from early morning till late at night, no union rules, Saturday, Sunday, if I'm going to make this a success."

He says, "We'll do it, Tom." So we got four profs in here in the office, and they were with us just about day and night.

VANTINE: We were at the height of the Cold War then. When you would go over there, how would you be treated?

STAFFORD: We got VIP treatment then. In fact, at times they wouldn't let other people off the airplane until we got off the plane. We never went through Immigration. We'd just be up in the VIP lounge, and we'd have to have drinks of vodka with them, all that. We always got personal escorts. We lived in the Rossea [phonetic] the first time, that old hotel. They say it's the biggest hotel in the world. They're so proud of it. It's right next to the Kremlin. I complained about it, so they put us up in the Intouriste [phonetic] next time.

But every morning we'd go out to Star City to train. We'd have a bus. It was about half as big as a big touring bus, and we'd have a American and Soviet flag, and we'd have two police cars, kind of like Volkswagens. Here we'd get out the bullhorn, yelling the peasants off the road. We'd have police escorts out in back.

So we stayed there at the Intouriste a couple of times, and finally in July of '74—we saw in '73, when we were over there, they were building this hotel by a little lake. It was built in Star City. So we were the first ones in this hotel. It was about a two- or three-story hotel. That's where the crews stayed for quarantine now before or afterwards, all that.

VANTINE: Would they follow you? Did they monitor you, the KGB?

STAFFORD: You mean the KGB?

VANTINE: KGB.

STAFFORD: Oh, sure. Yes. And I had this professor, [unclear]. He was a Russian, but his father and grandfather were in a prison camp, but he was up in the northern [unclear]. When he got out, the Germans brought him back—the British brought him back, and so, unfortunately, he was in a British cell, and so when [Franklin D.] Roosevelt repatriated, had the people go back who were prisoners, and Stalin, you know, killed most of them or put them in labor camps. So he finally got to the States. But he had a lot of relatives back there. There were some kind of liberals, and they called them *refuseniks* and those people back there, and he wanted to go by and see them occasionally.

So we'd always hang out in the Marine bar in the embassy, and they'd always give me a car and a driver, and I'd have him with me. One time we'd been drinking up at the embassy, having a social hour. [Chuckles] Okay. So he wanted to go someplace [unclear], so we looked back, and we noticed this car was behind us that had one headlight out. Obviously they didn't know they had one headlight. I told Anatoly, I said, "Look, tell this driver [unclear] fast!" He'd turn and here this one-eyed car kept after us. Ah! Okay. So he stopped and talked to [unclear]. We were feeling pretty good then, so "Let's have some fun with these guys." Don't worry about the language, okay?

So we got in this Moscow ring called the Garden Ring. So we were giving him maneuvers. There were a lot of cars back and forth. Pretty soon we got them boxed in, and they had to slide up alongside of us. So I pulled right up alongside, you know, and here was a guy. It looked like the cops. They all had topcoats on and hats. There was two guys in the front and a man and a woman in the back. I reached over and knocked on their window, like

that. I says, "[Russian phrase]!" which means, in a polite sense, "Comrade, fuck you." [Laughter] They had their coats up like that. We were always being trailed.

VANTINE: They were always—

STAFFORD: Oh, yes. But in a way, I think—well, for their reporting, but also to be sure that nothing happened to us, too.

VANTINE: Yes. Then you and [Alexei A.] Leonov became quite good friends.

STAFFORD: Oh, very close friends.

VANTINE: Did you hit it off right away?

STAFFORD: Well, we started to, yes. He's a very outgoing guy, and he's like a brother to me now. You know, they were supposed to be atheists. Once after we got to know each other, we were speaking without an interpreter, we were having dinner one night in a restaurant in Moscow, I think the Orugby [phonetic]. That's a famous Georgian restaurant. He told me about when he did his first space walk in space—that was the only flight he'd flown before that—and how the suit had ballooned. He hardly didn't make it back in. He says, "[Russian phrase]," "Thank God I got in." But he's supposed to be an atheist.

VANTINE: [Laughter] Right.

STAFFORD: So we had some wonderful experiences there, traveled in a lot of the western part of the Soviet Union and Russia on weekends.

VANTINE: Do you still keep in touch with him?

STAFFORD: Oh, yes. Sure do. I and him and [Vladimir G.] Titov, [unclear], we had a rehab of the Space Hall at the Air and Space Museum when they reopened it in May, and afterwards I had him come down to Florida. Leonov brought Titov with us, and we spent four days. Had him fishing and out snorkeling.

VANTINE: So as you got ready for the Apollo-Soyuz docking there, what were some of the highlights of that mission?

STAFFORD: Each crew would speak his own language, and the other one would have to understand. They continued to have these little parties for us called "[Russian term]." Sometimes they're called "[Russian term]," usually a U-shaped table with water, vodka, cognac, crab, caviar, bread, fish. I was talking with the back-up commander, Anatoliy [V.] Filipchenko. He'd been a Soviet test pilot and flown once. We were trying to converse, and it just wasn't—we just weren't—it was like ESP [Extrasensory Perception] that came to us both at the same time. I said, "Look, I'll speak Russian to you, and you speak English to me. Maybe we can understand it better." So we started, and, boy, it worked slick as a whistle. So we had a couple more drinks, and it even started working better. [Chuckles] So we said next day at the

negotiating table we'd see about practicing this way, because if you are not extremely fluent in a foreign language, you'll always speak it more distinctly and you'll speak it slower, and that's what I did in space. All the things to them I spoke in Russian. They spoke English to me.

VANTINE: Interesting. Interesting. So then when you docked in space and you went for the mission, that was quite an historic mission.

STAFFORD: Yes.

VANTINE: Was there any apprehension at all about working with the Russians from your perspective or from the JSC [Johnson Space Center] perspective at that time, or were we very excited about it, about the opportunity to work with the Russians? Any concern about technology transfer?

STAFFORD: I think it was a natural follow-on. We'd flown Apollo. That was finished. Skylab had been terminated. And the next thing coming was the Shuttle, but you could tell the Shuttle was going to be a long ways off, and the Russians were still going. So it was a natural extension. It was started by initial conversation between Bob [Robert C.] Seamans [Jr.], the deputy administrator of NASA back then, later Secretary of the Air Force, and also [Mstislav V.] Keldysh, who replaced [Sergei P.] Korolev as head of their space exploration, and he was then head of the Academy of Science. So that's how it came about.

VANTINE: Was it after that mission that you retired, or what did you do after Apollo-Soyuz?

STAFFORD: Well, before that mission, I knew General Sam Phillips so well, you know, who headed Apollo, close friends. I'd stop off to see him, going back and forth to Russia occasionally. He was by then commanding general of Systems Command, National Security Agency Systems Command. I was a one-star general. So we talked. So he called me, said, "Say, I've got a great slot for you. I'd like to have you come back to the Air Force. I'd like you to take over the Flight Test Center." Of course, that's where I left, you know, except for my few days at Harvard. So I said, "Sure." So I went back to the Flight Test Center at Edwards in November of '75.

But afterwards, right after the mission, we came back, we had a tour with our families. I insisted we take our families there, because we'd spent so much time away from them on training on this. So we did and had a tour. We went there in an Air Force plane, a 135. Went to Moscow, all around, meeting with all the people, and we went to St. Petersburg, then down to Kiev, and then out to Novosibirsk, Odessa, ____sochi and Tbilisi. So we had a great time.

Then the cosmonauts came here to Washington [DC] and met with the President just like we met with [Leonid] Brezhnev, and I gave Brezhnev a letter from [President Gerald R.] Ford. Went to Washington, went to Omaha, went to Salt Lake [City, Utah], went to L.A., Disneyland, went to Reno [Nevada]. We were going to go to Las Vegas, but the Russians thought it would be "[Russian phrase.]" It would be anti-revolutionary to have those guys showing that they were in Las Vegas. [Vantine laughs] So we had to go to Reno and Lake Tahoe. So that was all right. Then we went to San Francisco and then back to Washington. It was a great time.

VANTINE: You want to take a break? [Tape recorder turned off.]

STAFFORD: It was run by a very small group of people. If you had a problem, you could just go right to the main decision-maker. [James A.] Chamberlin got it started, I think, but he got relieved. Oftentimes you see a big program like that, the initial program manager runs into a problem, you always end up with a second one. So, Chuck Mathews took it over and he did a wonderful job, and he finished it.

You know we had just a small group at McDonnell Aircraft running it, and at the launch pad you had Lieutenant Colonel Jack Albert, and then you had a Colonel Otto Ledford [phonetic] out on the West Coast as his boss. It was very small. In fact, I think the whole launch pad complex had fifty-five people. So you got to know most of the sergeants, NCOs [Non-Commissioned Officers]. That included Martin and the Air Force and the Mac-Dac [McDonnell-Douglas] people. So it was such a small group that you really got to know all the people. You could solve the problems.

Then going to Apollo was like trying to kick a giant sponge. You hit as hard as you could, and maybe something might pop out on the other side. It was awesome. And also you found that people didn't want to listen in Apollo to what you'd learned in Gemini. They said, "This is all different. We're going to the Moon." Now, some people were anxious to, but some of the leadership at the time was not anxious to hear about the lessons learned in Gemini.

VANTINE: Were they well captured, the lessons learned from Gemini? Could they have been better captured in the Apollo?

STAFFORD: Well, I think so. A bunch of us felt very strong—like the outward-opening hatch and about the orbrate ball so you know where you are in orbit. There's just a whole series of things. There's a lot of things, I'm sure there was, down in the—but also just a very, "That's Gemini. We're going to the Moon." So the main thing right now that you need to do is to be sure the lessons learned from Phase 1 on the Shuttle-Mir gets fed over to Phase 2.

VANTINE: Is there a strong analogy between Gemini and Apollo and Shuttle-Mir and space station?

STAFFORD: Sure is. Sure is.

VANTINE: You were involved in the Shuttle-Mir Program when it was first getting started. Help us understand, perhaps, how that got started. All of a sudden we were doing Space Station Freedom. That got canceled and we entered into [Shuttle-Mir]

STAFFORD: Well, we started around 1992 when [Boris] Yeltsin came over and had his summit meeting with [George] Bush, President Bush. There was some talk about it maybe a little bit with [Mikhail] Gorbachev, but not much really went on. And then when Yeltsin was there, they talked about doing a rendezvous up to the *Mir*, you know, something to repeat, like Apollo-Soyuz was nearly twenty years before that.

So, after that, then [Daniel S.] Goldin went to a trip to Russia, his first trip ever, and so he asked me to go with him. I was the only non-government person to go with him, and all the rest were federal employees from different agencies, mostly NASA. So they just kept asking

me to volunteer, as you know, for all types of work concerning the Russians and other things that I've been glad to do.

VANTINE: Whose idea was it to do the Shuttle-Mir Program? How did that get started? Was it any one person's idea? Where was that idea conceived?

STAFFORD: Probably the people who talked about it before it came along was George [W. S.] Abbey and myself. Of course, I'm sure probably other people had, but the ones as far as the decision-makers that could—because, see, Abbey was on that airplane with me, that met with Goldin on that flight. I know we ran into [Valeri] Ryumin. So I told Goldin later on he should insist they kick him out of that job as far as the Progress, manager of it, because originally Ryumin didn't want a Russian cosmonaut to fly on this, to do a rendezvous. He didn't want—we said, first of all, have a Russian cosmonaut fly on the shuttle so we'd get used to working with the Russian language and get all the procedures and all that, and Ryumin didn't want that. [Unclear]. I says, "Remember," I said, "We're in the position now, it's the golden rule. We've got the gold so we make the rules." So I think O'Conner was a little taken in by Ryumin's ranting and raving, but I says, "Don't give him any slack. Just say this is what we're going to do."

Simonov [phonetic], he wanted to sign the document with Goldin along with Koptev [phonetic]. I says, "No. You just sign it with Koptev." So. [Chuckles]

Then it was decided, you know, what we'd do is do a series of rendezvous and really work out the work-up for the long-duration mission.

VANTINE: What changes did you see between the time that you had been over there previously with Apollo-Soyuz and then later with the Shuttle-Mir and the Goldin trip, not only within the culture, but within the space business itself?

STAFFORD: Okay. Now, once the top political leadership, the Russians, said, "Let's do it," I mean, everybody fell in line back in Apollo-Soyuz, but now, you know, it's a new democratic leadership, and like Ryumin and Simonov, they don't like Yeltsin. They weren't too happy, I think, to work with the Americans. The main thing they liked was the money.

The way the Shuttle-Mir was set up was exactly like Apollo-Soyuz with the various working groups, Working Group Zero, Working Group 1, 2, 3, 4, 5, just like we set up Apollo-Soyuz, worked on the same principle.

VANTINE: Were there changes? Did you witness changes in the Russian space program between then and today?

STAFFORD: Well, of course, they're still using the same booster and spacecraft. They've upgraded their spacecraft a little bit, electronics, but the *Mir* was a whole new thing they hadn't done before. They had their little *Salyut* starting to fly, something like this, the core of the *Mir*, but that's all they had. But they've done a good job putting together this whole thing, but you could see that their infrastructure was really hurting compared to the old days.

VANTINE: There's been a lot of talk that the Russians have taken from us and we haven't gotten much from them, but earlier you alluded to the rendezvous technique, for example, was

something that we learned from the Russians. Are there other examples of things that we've gained?

STAFFORD: The rendezvous, the way we did rendezvous, that came from the Russians. That was written by some Russian author on a piece of paper, even though they never used it a lot directly. Well, the data we got from them on long-duration missions. The main thing they could have gotten from us, if we go back to the Apollo-Soyuz, see, Russia was such a closed society. Like the amount of wheat they produced in a year was a state secret. The amount of oil they produced was a state secret. We're the first ones ever—I insisted, when I saw the Control Center, I wouldn't fly it. We saw the Control Center and the launch site, and I had to pry it open. But we learned more about where they were than they learned about where we were. What they could have learned from us was management, because they're so vertically separated.

They do a lot of good things. Like you look at the redundancy of oxygen generation now, all the electrons work, and they've got five levels of redundancy of oxygen on that Space Station, more than we've got. So we can learn something from them.

VANTINE: Going back before the Shuttle-Mir, going back to shuttle for a little bit there, on the shuttle, when you were flying the Apollo-Soyuz and the shuttle was slipping out and slipping out, what was the general notion on when the shuttle would fly? Was it perceived as a good vehicle that was about to fly? What was the feeling on the shuttle, when it would become the real dominant program that it became later in the manned space program?

STAFFORD: Well, you mean back in Apollo-Soyuz days?

VANTINE: Right around Apollo-Soyuz, about '75, the shuttle was—

STAFFORD: Yes. See, I was on the back-up crew of the first Gemini. I was the back-up crew of the first Apollo. So I'd had a little experience about the development of the vehicle and when they'd fly. Originally it was supposed to fly in '78. I said, "No way." I remember that morning I walked out to the gantry on Apollo-Soyuz, looked down at the [unclear], said, "I bet this is the last manned launch we're going to have for five years." Supposed to launch in three years. Well, it turned out it was nearly six years, because it was March '81 when it finally flew.

VANTINE: And that was just the size of the development program?

STAFFORD: Yes.

VANTINE: I mean, just the sheer complexity of it?

STAFFORD: Even though it was scheduled in '78, I said, "There's no way." That was just based on experience, from being on the first mission of Gemini and Apollo.

VANTINE: And then when we did shuttle and then we had the *Challenger* accident, were there any differences between *Challenger* versus the Apollo 1 fire at that time when *Challenger*—

STAFFORD: Well, Apollo was first off the pad, and there were a lot of mistakes made, but where *Challenger* had been a series of flights all before that and then you had a failure and there was a series of these things that caused that failure had been identified, it had been wavered and swept aside, where it was not so much on Apollo.

VANTINE: What was the cause of the *Challenger*? Was there a cause of the *Challenger*? Besides the O-rings, I mean. We can talk about that. But if somebody would ask you in your expert opinion what the cause of the *Challenger* accident was.

STAFFORD: Not the proper engineering disciplines and quality control and follow-up of discrepancy reports. In Apollo, it was pretty much, if there was a problem, I mean, it was widely disseminated, and there wasn't any wavering or trying to follow up or anything. These people down in Huntsville just kept just shoving it under the table.

VANTINE: What was the ultimate consequence of Apollo? NASA then sat on the ground for two years and got ready and—

STAFFORD: We changed the management and changed the management structure a little bit. Now, what happened on Apollo, and I was involved a little bit on the Rogers Commission, the presidential commission. Gene Culver [phonetic] is a dear friend of mine, Dr. Gene Culver. There was Don Cotina [phonetic] and there was Bud Whalen [phonetic], chairman of Hughes. I knew all three of them very well. What I determined is the astronaut inputs had been smothered, and there had been a—you see, in the old days, the astronauts had an awesome

amount of power. I mean super power. There were just a few of us and great publicity. And a lot of other managers around the center were very jealous of us.

After [Dr. Robert R.] Gilruth left, there was a concentrated effort to put the astronauts down to a lower and lower level with more levels over them. So I told both those people, and later I gave congressional testimony that the head of flight crew operations should report directly to the Center director. And that's what they wrote in their report, and that's what's in the congressional language, and that's what happened. I went on my own vendetta to get that squared away, and they changed a lot of ways they did business.

VANTINE: Later, when you were working the synthesis group—you went on to work the synthesis group, Dick [Richard H.] Truly gave you a call on that, to do that, how did that come about and what was Truly looking for?

STAFFORD: Well, on the twentieth anniversary of the first lunar landing in July of 1989, the White House hosted a reception for the Apollo astronauts and Apollo management still around, and that's when Bush said, that after the turn of the century we ought to look at returning to the Moon this time and staying, eventually having an expedition to Mars. I was sitting out in the audience there with my wife, and I says, "Gee," I said, "where's the money coming from, Mr. President?" That was in July, and by November the Berlin Wall came down, and so I said the amount that the DoD [Department of Defense] would go down would be far more than we'd ever need to go to Mars.

Now, of course, right away the liberals in Congress started taking shots at it because it was a Republican President, and right away he reactivated the Space Council, put the Vice

President in charge, just like [President] Jack Kennedy had LBJ in charge. Then Lyndon Johnson had Hubert Humphrey in charge of the Space Council. Hubert didn't do a lot with it. You know, he was a big space buff. But LBJ really worked it. And then the Space Council was there under [Spiro] Agnew, under [Richard M.] Nixon, then it got done away with in the reorganization.

But anyway, Bush reactivated the Space Council, and they had Aaron Cohen head a study for ninety days to determine how they could go about it. Well, they had some data, but they put every gold watch on the table and kept it on the table. Every time you'd go to the Moon, you'd have four or five shuttle launches up to the station and transfer fuel from the station to another thing that would take you out.

So it turns out that I was on the Aeronautics and Space Engineering Board of the National Research Council, the operational arm of the Academy of Science and Engineering. This was November. So after the results of this, [Dan] Quayle and some of the people, Mark Albrecht over at the Space Council wasn't too happy with it, and they pulled together a team of thirteen people headed by a former scientist from MIT [Massachusetts Institute of Technology] named Guy Stevier [phonetic], and we had breakfast, lunch, and dinner served every day at the Academy of Science over on Constitution Avenue, and we just really churned through it.

At the end, we said the NASA study was not imaginative, and his idea was to go faster. After that, he said, "We need to go out there faster, better, safer, cheaper." And we said that they had completely ignored nuclear thermal rockets. We asked them why. They said, "Well, we just politically can't do it."

I said, "Hey, you're not supposed to be a politician. You're supposed to understand the technical terms." So there were just all types of things.

So he told Truly to canvass the United States and NASA for all ideas. He told him that in February. By May, nothing had been done, really. [Chuckles] And Quayle got really perturbed. So did some of the other people. So then they activated the American Institute of Aeronautics and Astronautics to ask all their people, have panels and all this for ideas. They asked Rand Corporation to set up a 900 number to call in for ideas, to screen ideas from universities and all that.

Then I got a call from Truly, said that him and J. R. Thompson had talked to the Vice President and they wanted somebody to volunteer to put this whole thing together and would I do it. That was in June of 1990. In fact, I remember Gorbachev was in town, coming to town. So I thought for a minute, said, "Yes, I'll do it, but with the proviso that I sit on a lot of boards. I'm not going to give those boards up for this. I advise a lot of people, and I just will not advise them on the Moon and Mars in this period of time, and I want a no-conflict-of-interest letter."

So they got that, and then they said the Vice President wanted to meet with me. Also, Gorbachev had his meeting over there in the White House. We had an early summit meeting over in the White House, and he hosted a special luncheon at the Soviet Embassy which I was invited to. So I went to the Soviet Embassy for lunch, then had to leave a little early, and got a cab over to the White House and met with Quayle. It was Quayle and Mark Albrecht and Truly and myself. I told him I'd do it, gave him my criteria—I wanted no conflicts of interest. I'd volunteer half my time and I'd put together the group and would work that. [Phone rings. Tape recorder turned off.]

So anyway, my criteria from him was to put together the technology priorities that would be required to go back to the Moon and on to Mars in two or more different architectures of how you would approach it. I was riding back in a taxicab to Old Town Alexandria and

thought, well, from what I'd done before, looking at the previous data that Aaron had done and what we'd done at the National Research Council, I says, putting together technology priorities, it'll take work, but that will fall in place. The architecture is going to take a lot of work and [unclear].

Truly thought I ought to go out to somewhere like Sandia, out in the mountains. I says, "Nuh-uh. Every decision this country's made inside this beltway. I'm going to do it right here inside the beltway so I can call on people and have all that available."

So then he called me, and I said, "I'm going to need a lot of help from NASA."

He said, "You'll have it." So then that's when he called me and wanted to know if I wanted George Abbey. So I got George on board, and we needed to recruit a lot of people. So we ended up with about forty people full time and a bunch part time, about 150 people part time, had a senior advisory council. I had General Don Cromer [phonetic], who I'd known for years. He headed Space Division for the Air Force, a three-star general. He was the DoD coordinator. Before that, it goes back years ago, he was the assistant launch tech conductor on Gemini VI as a captain, and then he was my launch test conductor on Gemini IX. So we'd known each other, rubbed shoulders, for years. He did a great job putting it together.

We had people from the Department of Energy working with us, NASA. John O'Neil came up here about half time. We had just a lot of people, very talented people. Had Arnold Nicagosian [phonetic], had Minnie Mott [Mike Mott], Dee Lee [phonetic], Sam Armstrong. So, a lot of key people. Doug Cook. It was a real fun time.

So we started that and then finally wrapped it up. On June 11, 1991, the Vice President and I had a joint press conference in the White House and outlined "America at the Threshold." And that was it. Which is still, I think, pretty much the architectures. I think some of the

technology was very good, too. You know, electronics has moved forward and some of the materials.

VANTINE: So the architecture is still good today for what we would do, still outlines the game plan?

STAFFORD: Yes.

VANTINE: You've witnessed Dan Goldin since he's been in place and kicked off the Shuttle-Mir with the "better, faster, cheaper," and been actively involved in some of that.

STAFFORD: Right.

VANTINE: What are some of your observations on perhaps where we're going?

STAFFORD: Well, I think the success you've seen on Mars has just been exactly what he's tried to talk about, and a lot of the other things he's done, instead of building these Taj Mahals in the sky. But when you have a Mars mission, just by nature you've got to have a big mass, you know, for human exploration of Mars. You need to get that heavy lift launch vehicle to get things going.

VANTINE: How long do you think before they'll go to Mars and go back to the Moon?

STAFFORD: Political decision. With this budget crunch, the Balanced Budget Initiative, Minnie's got a way to look at it and so has George. They wanted me to get briefed. I don't know when I'll get a chance to, but I'd like to.

VANTINE: Okay. Thank you. That's it.

[End of Interview]