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ORAL HISTORY TRANSCRIPT

STANLEY FABER
INTERVIEWED BY KEVIN M. RUSNAK
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RUSNAK: Today is May 8, 2002. This oral history with Stan Faber is being conducted in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Sandra Johnson and Jennifer Ross-Nazzal.

I'd like to thank you for taking the time out this afternoon. Maybe we can begin with a little bit of discussion about you growing up and what interests you might have had in engineering or aviation, or what led you on this career path.

FABER: All right. My home was Providence, Rhode Island, and probably from the age of nine or ten on, I wanted to be a pilot. But I wore glasses, so I downgraded to be an aeronautical engineer. I did complete my education at what is now the University of Rhode Island, with an aero engineering degree, and right out of college joined NACA [National Advisory Committee for Aeronautics]. Recruiting was easier then. The recruiter came to the school, he made an offer, and I accepted.

I was at the Langley Research Center in Hampton, Virginia, and through good fortune was assigned to the Flight Research Division. I think if I'd been assigned to a wind tunnel, I might not still be with NASA.

I was in what we'll call a fairly high-powered office. To show you the staff in that office, the Assistant Branch Chief was Chuck [Charles W.] Mathews. He was a big wheel in the space program. The Section Chiefs were Chris [Christopher C.] Kraft [Jr.], who was the [Johnson Space] Center Director, Sig [Sigurd A.] Sjoberg, who was the Assistant Center Director, and Harold [I.] Johnson, who also came down here.

I guess I'll say my sphere of study while I was a research scientist was more involved on the man-machine interface, and I did get to use simulators in those studies, and I feel that was the reason I joined the space program. It was obvious from the beginning that simulators were going to be a major portion of the training system for the astronauts, and I was one of the few who had much experience in that line at the Research Center. Of course, Johnson and Kraft and Chuck Mathews had already joined the space program. They were in it from the beginning.

Moving into the space program phase… Harold Johnson, [Helmut A. Kuehnel (another member of the Langley Branch),] and [I], we kind of dreamt up a training program for the astronauts. No one had ever done it before, so we were kind of on our own. A phrase in common use today, "system engineering," I think we used system engineering tools to come up with our program. It was an overkill. There wasn't any question about that, but that's the way NASA has done most of the things that they did back then. Not knowing when to cut back, we went full-bore on the safety side.

We developed everything from little Tinker Toy tools to what we generously called at that time the Mercury simulator. It was quite a bit less sophisticated than today's simulators.

Oh, I'll back up a step. I was recruited to join the program… I joined what was then the Space Task Group on the same day and basically in the same office with the first seven astronauts. We were all lumped together and shared a secretary, so that we were very close to the first seven astronauts. We didn't travel quite as fancy as we do today. You know, they rode the same back seat of an airplane that I rode. [Laughter] We shared rooms and so forth, so we were pretty close.

I will say that the training regime that we set up at that time, [one] thing [we continuously did] was to make it a little simpler. We actually removed some things that we deemed later on were unnecessary. The mandatory part of every flight—in fact, it still is, as far as I know—was to debrief the crews on their training and what needs more and what needs less. To show you something that was thrown out, we used to take the crews through a centrifuge experience. They don't do that anymore. We ceased doing that in the Gemini Program.

Let's see. The other thing I was quite involved with, and almost over my dead body. Chuck and Chris and some of the others had come up with the concept of the Flight Control Team, and training them and the astronaut in one package. I was assigned to make that work. I disliked it. I wanted to stay with the astronauts, but they were the boss, so that I headed up the initial development of what became known as mission simulation. We used it in the Mercury Program, and, of course, it's grown now, and I think it's bigger than astronaut training today, because there are many, many more flight controllers than there are astronauts at any given time.

One of the things in the Mercury Program, you weren't one thing; you were everything. So along with training flight controllers and training astronauts, I was also a flight controller. In fact, my first trip to Texas was to be a flight controller down in Corpus Christi during one of the monkey flights, and I had the wonderful experience of having a hurricane [Carla] come through. We did get the station back on the air in time to support the flight, but they had already decided to go without us. [Laughter]

Also, for John [H.] Glenn's [Jr.] flight I was a flight controller in Perth, Australia. The station was known as Muchea… a small town north of Perth, and spent a wonderful month and a half, two months there. I don't remember back that far, but we left just after the first of the year, and things went to pot in the States, and it was too much money to fly us back, so we stayed in Australia until the flight date, which was in late February.

Soon after we got back from John Glenn's flight, the entire operation had already been deemed to move to Houston, so we packed up and came to Houston. For a six- or seven-month period, I had an office both here in Houston and one back in Virginia. The one in Virginia was training the Mercury astronauts still to fly, and the one down here was getting ready for the Gemini and Apollo Program. The group I headed was call Flight Simulation Branch, and we were responsible for developing, acquiring, maintaining, and operating all of those simulators for Mercury and Gemini, Lunar Project, ASTP [Apollo-Soyuz Test Project] Program [and Skylab].

We did divorce off the training of the flight controllers. [That] went into another group under, at that time, Chris Kraft. He was head of Flight Operations. I was in Flight Crew Operations, and so the training did separate. But we did still conduct… integrated simulations. [We were] very involved. There were more computers than you could shake a stick at, and the amazing thing now is your average laptop computer has more power than we had on all those computers put together. But they shrunk. [Laughs]

Let's see. Where else can we go?

RUSNAK: Well, can we talk a little bit more about these early days before we move on heavily into the Gemini Program?

FABER: All right. Back in the Mercury Program, as I say, we were very close to the astronauts, and [I] conducted some [of the] training sessions. I'll throw in a little anecdote type of thing. We were conducting the training program on the human centrifuge up at Johnsville [Pennsylvania], that's operated by the Navy. It, again, was a monstrous situation of a great big computer over there and a centrifuge over here, and it was not a new computer. It was an old analog computer that was put together during the war.

We had [Al Shepard] strapped in the chair, in the gondola, ready to go, and I'm doing the countdown. Around about "two," minus two, that is, the gondola suddenly took off. Of course, the first concern we all had in the control room was, was he okay, because the safety circuit shut it down very quickly. I yelled, "[Al! Al!] Are you all right? Talk to me."

He says, "Why the hell should I after what you just did to me?" [Laughter]

I then called the computer lab, and I said, "What happened?"

And the calmest voice that you imagine said, "I don't know. We'll let you know as soon as the smoke clears." [Laughter] Obviously our day was shut down for the runs that day. We picked up the next day.

Another little anecdote on the Mercury Program. When we first got into this thing and simulators and so forth, I'm afraid some of our senior bosses weren't quite into computer systems as they were slide-rule, wind-tunnel people. One of them had made a point to tell us, "We will never hook up that thing that we bought from McDonnell [Aircraft Corp.] called the Mercury Procedures Trainer to a computer." [We kind of went around his edict by hooking it to a free computer we got surplus from the Air Force at Langley.] …He left the program, by the way, that particular gentleman. He was definitely a wind-tunnel man.

RUSNAK: What sort of analogs existed for these types of trainers at the time, and how much pushing the state of the art were you guys doing developing this?

FABER: Well, as far as the original Mercury trainer, which was fairly simple, we just had the trajectory built into the computer. Most of the switch operations were handled by dedicated circuitry. We had two of them. One was at Langley and the other was at Cape Canaveral. Our training flow, the astronauts started their training at their home base, and then for the last three or four months before their flight… they would go to Florida, and we would continue the training there…[The one in Florida was animated by a commercial analog computer. It was also tied to the mission digital computers at Goddard Space Flight Center to provide stable trajectory simulation.]

The other advancement to the state of the art that we did involved the out-the-window display. Traditionally, in airplane simulations and training of pilots, they trained them to land on the runway with a camera model-type system. I can just remember the first one I ever saw, happened to have been at FAA's [Federal Aviation Administration] headquarters in Oklahoma, and it was the worst television picture I ever saw, and the guy touring me would say, "Well, just imagine it's a foggy night. That's when you use these things." Yes, I accepted that, and that's what it looked like. But that was not what we wanted in the Mercury Program.

One of our contractors, the Farrand Optical Company, came up with the concept of infinity optics and a wonderful simulation of the celestial sphere, and we bought the first of them for Mercury, and it was a great advance. Now, we did not have anything else that was worth it, but the stars on the Mercury. That concept, though, was carried over into the Gemini and Apollo simulators. They all used the same type infinity optics. Now, the Shuttle also ended up using a similar type but a later development. It wasn't near as expensive or as sophisticated, but it did enough. That's why I said that, as we learned, we cut back and tried to save a dollar here and there. We didn't need pinpoint stars [in shuttle]. We could use the blobs that would show up on a television screen. They were good enough to teach them the celestial tasks they needed to do.

As I say, when we moved down here, we started working on the Gemini simulators. Again, the prime contractor for the spacecraft was responsible for developing the simulator, and we worked very closely with McDonnell up in St. Louis [Missouri] on that. They built it in-house but with the assistance of what was then the Link simulator, the Link Trainer Company, and that was really the first big jump in the digital simulation. The entire thing was in the computer. There were very few hard-wired circuits. It was almost all simulated in the computer, which I can say, thank goodness, because every one of the Gemini spacecrafts were different. The same was true with Apollo. As they went through their life span, they had changes, and [using] additional computer [software] even though it cost an arm and four legs, we were able to almost keep up with what the spacecraft was doing. We could not have with dedicated circuitry.

The other thing is in the Gemini trainer, our big jump there was in the visual area. Again, we used the same celestial sphere. On our simulator here in Houston, we used a camera model system for docking. Of course, we didn't have to worry about landing. You landed on a parachute. But we were dissatisfied with the camera model system. We wanted something easier to maintain, and we, along with the Air Force, funded some activity in the development of digitally generated images for the docking simulation. Actually, I'll back off. It wasn't digital; it was analog. [Laughs] Digitally controlled analog, that was developed by what was then Bell Aerospace, and they were our docking simulator. We ran comparisons between the camera model and the digital, and the crew's comments were, there wasn't significant difference. The only trouble they had in the camera model system, if you hit it too hard, everything stopped, and it did it in the auto-computer-generated, you could fly right through your target vehicle. [Laughs] It wasn't too realistic.

But that started our swing away from the direct… analog-type things.

RUSNAK: Did any of those techniques come from or were inspired by the special effects industry for movie or television effects?

FABER: No. No. That's one source that did not help us very much. We did keep close track of what the Air Force was doing. We were in close contact with the airline people. In fact, I, for a time was on the AIAA [American Institute of Aeronautics and Astronautics] committee on simulation, and that was just so I could go visit these other people and see what they were doing and how they were handling things and, you know, tell them what we were doing, so that it was a trade-off type of thing. But the entertainment industry, no, was not a part of it at that time.

Let's see. What else happened at Gemini?

RUSNAK: The Gemini spacecraft was a lot more complex than Mercury was.

FABER: Well, the Gemini spacecraft was much larger, two people instead of one. It also had on board a computer system that controlled where Gemini went. Now, simulating that computer system was an even bigger headache than simulating anything else, mainly because it could change very easily. Gemini, the computer system was the responsibility of MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts], and I've forgotten what particular subgroup, whether it was Lincoln Labs or something like that, and they provided something they called "ropes" to IBM, and that's what went into the computer. Well, we couldn't use those ropes. We had to develop parallel things.

Computer simulation on the on-board computer was considered important enough so that at least one upgrade of the flight computers was delayed because we couldn't get it in the simulator, and Chuck Mathews said, "Well, we'll delay that one spacecraft until you've got your simulators running right."

As for other things, of course, it did could rendezvous and dock, and while it didn't affect the simulator too much, it was really a tricky thing for the crews to learn that sometimes when you wanted to approach another spacecraft, you had to slow down, not go through it. You had to fire your engines going the other way. Orbital mechanics were very important. But it didn't take too long for them to learn that lesson. Then they practiced it and practiced it and practiced it.

Since docking in Gemini was also considered a significant thing, we had a rather large full-scale docking simulator. The crew were in a mockup of the Gemini looking out the window, and there was a mockup of the Agena on a track and a full six degrees of freedom between the two vehicles. It was in the originally off in Building 260 in the boonies, and then we moved it up to Building 5 when Building 5 was built… [It was a useful device and] we did modify it and built a LM [lunar module] simulator in it. But the LM simulator didn't get near the work. For one thing, it was very uncomfortable. I'll get to that when I get to the LM.

Apollo was another monstrous task. Initially the Apollo [command module (CM)] simulator, simulation systems, and training was the responsibility of what was North American [Aviation, Inc. This company became North American Rockwell in 1967 and Rockwell International in 1973. Speaker uses these interchangeably.] But NASA [directed the contractor] to go directly to a simulator manufacturer for the main mission simulators. We were supposed to get a part task trainer from North American. Due to lots of factors, it was never delivered. The biggest factor was, they never finished designing the spacecraft.

Apollo [CM] probably went through more configuration changes than in any of the other programs. This is before we ever got to flight. The first simulator, as we were getting it developed, I nicknamed it "Alley Cat" because it was such a bastard. The software represented one configuration. The panels represented another configuration. The schematics that we were using represented [another] configuration. So it was pretty messy, and we wasted a lot of money. That was on this North American thing. So that the [Apollo 1] fire that killed the first three crewmen there gave us the opportunity, and Rockwell/North American the opportunity to catch up, so that we had one set of specs on a given spacecraft. We didn't have three sets. Of course, spacecrafts [changed]. The next one was different, but at least [the data for each] were consistent.

In Gemini, we, again, had one here at the home base and one in Florida for training the crew. When we got to Apollo [CM simulator], we upped that; we had one in Houston and two in Florida. The upgradings were taking so long between [flights] that we couldn't keep up to it, so that the ones in Florida skipped every other mission. We tried to make every mission here, and we also were responsible for updating the [simulators] in Florida. It became a tussle of how we can conduct training here and Houston and upgrading all three simulators. That was much more than a seven-day, twenty-four-hour-a-day task. So basically astronaut training was cut back to a bare minimum that we could squeeze in so we could do our other work.

The Apollo [CM] simulators also were much more sophisticated in their visual systems. We had five major windows to look out of. We had a sextant/telescope to look out of. So we had six visual systems hung on that thing. They were all using Ferrand Optical systems. Stars were very important…

In Apollo, they wanted an Earth view, and we made a very large effort to produce an Earth view. The contractor, again, was Ferrand Optical working for Link, and they came up with a film-based system. The only problem with it, to get it bright enough in the window, the intensity of the light bulb, or the spot of light going through the film, would burn the film instantly. So we had it in a little wind tunnel to cool it down, which sometimes worked. We burned a lot of film. Luckily, the out-the-window scene for the crew, gross details came through, and they didn't… need much other than that. Their star simulations were excellent. They needed that. The rendezvous/simulation was excellent. They needed that.

The pictures of the Apollo simulator, if you look at them, all you see is these massive visual display systems, which dwarf the crew station. In fact, initially when we got it, the crew station actually was down low. The crew got in, and it went up on an elevator to get into the visual system. We deleted that function and just let them crawl in, and took the window off of the hatch so they could go directly in the hatch. They just had their four windows. We kind of threw away one, one window, because, well, that elevator system was not very good.

Apollo, also, we had all kinds of digital computers animating it. We started with one and then two and then three and then four, a room full of the same family we had before, the DDP. Our initial computer in Gemini was called a DDP-19. Later, the company, which was Computer Control Corporation, upgraded it to a DDP-24. That was the length of the word. Digital computers were not as reliable as they are today. They didn't like to be turned on and off. They didn't like to have power fluctuations. They hiccupped continually.

Now another anecdote. In [Apollo] we were simulating a launch for one of the missions, and I've forgot which one, and I can't even remember the crew members. But, oh, maybe at two or three minutes into the launch, the simulator quit. Our team scrambled and got it back on, maybe a few seconds, twelve, fourteen seconds later. Everything was working fine. Well, they chewed me out completely about that.

Several weeks later when the actual launch occurred, they had a lightning strike the capsule on its launch. Looked exactly like it had happened in a simulator, came back on, twelve, thirteen seconds later. Call me a magician. [Laughs]

By now, the team were writing the scripts. I wasn't having too much to do with the hands-on training. One of the things I did while I was recruiting was to look for people with imagination who could, where… training [was] required… dream up problems which would trigger [learning].

Going way back to mission simulation in Mercury, the concept there that I worked up is that I wasn't teaching those people anything. They knew the spacecraft, supposedly. My job was to make this guy over here know how to talk to that guy and both of them how to understand what the astronaut was saying. So we developed our training… mainly to induce communication between everybody in the control center and the CapCom [capsule communicator] to the astronauts so that they would exchange information.

Again, in Mercury, I'm out of place again, we started training the Mercury Flight Control Team. We got down there [to the Cape Canaveral Mercury Control Center] for the first unmanned mission, and no one had thought about what they were going to do. You know, they were going to launch this spacecraft and get it back. So… I and my Cape Kennedy rep and a member of Kraft's staff wrote the first countdown and the first flight plan for this Mercury Redstone [MR-1] mission. Again, the main thing was to cause communication…. But we had to write the script and then train the crew to run the script. Of course, as we got into Gemini, we didn't have to worry about that anymore. There were plenty of staffers who were taking care of the flight plans.

Let's see. Back to Apollo. What else can I say about Apollo? Each of the Apollo [CM] spacecraft was unique. A lot of it was due to the actual flight crewman. He wanted this particular thing here, where some other flight crewman might have wanted it over there. NASA responded to those requests, which meant the simulator had to respond, and that did cause us considerable headaches and considerable cost. Simulators ended up much more costly than they had been originally budgeted. But 90 percent of it was for the change traffic that we had to do. The other 10 percent was for the fact that we did not have the reliability we needed.

Let's see. An interesting sidelight in the Gemini Program, and I don't know if you want to put this in or not. You can edit it out. It's got some politics in it. When we first came down to Houston, they built Building 4, and we put the Gemini simulator inside Building 4. It would fit. It was a tight fit, but we could get it in. Then they finally got around to building Building 5. Well, we wanted to move it across the street. At that particular time, there was tremendous construction going on, and with construction you had union problems. When we got ready to move the simulator across the street, there was a hassle of who was going to move it. Was my contractor going to move it, or were the trades unions going to move it? After going around a couple of circles, we decided NASA was going to move it.

My crew, which numbered something close to forty or fifty [civil servants] at the time, picked up all the cables, took them across the street on their shoulders, and spread them out on the floor in Building 5, rolled the cabinets across the street—they were all on wheels—over a Saturday and Sunday, and on Monday morning when the union reps came storming in, we were through. The ninth floor wasn't too happy with me, but we had our job done and we were back on the air. The unions were still complaining and did for quite a while. Every time we did anything in the building, there were complaints from the various trade unions, whether that was their job or not.

I also could have been hit by the child labor people because I had my two little boys crawling under the floor, checking where wires went. We couldn't do it; we were too big. But they could fit under the floor. We'd hear a voice, "The wire's over here," and we'd lift up that floor section and see where the wire was. [Laughter]

Okay. Apollo, Apollo, Apollo. As far as Apollo training, as I said, I had moved too far away from the crew, and I wasn't that close to the unique Apollo things that were going on, until the Apollo 13 experience… Now, my group [and I were] awarded the…[Presidential Medal of Freedom] along with everybody else for Apollo 13. But about the only thing I did was to make sure that the guys who were doing the work had the resources they needed when they needed it.

I had some of my people who didn't go home for a week, that they were sleeping in Building 5 on some cots we got them and bringing them food, and so forth.

One of the things I'd like to iterate on [the Apollo 13] thing is… the simulators had reached a point, they were so trusted, that every bit of software that went into the on-board computers went through the simulator first. [For Apollo 13] they would bring over stuff from Mission Planning [and Analysis Division, MPAD] and stick it in the simulator, and it wouldn't work. We wouldn't end up where we wanted to be. They'd go back and re-do the figures. "Everything looks good to us. Why won't it work?"

Well, we found out that [one of] the biggest error generator[s] in Apollo, Gemini, or anything else, [was] the crews had to punch in those programs by hand. They were exhausted in the spacecraft. My guys on the consoles were exhausted. They were making mistakes, so that—bingo!—double-check everything. Not one guy punch it in. One guy punch it in, and somebody else behind him making sure he did the right thing, and [they] did the same thing in flight, because those guys were just as tired. And solutions that MPAD brought over worked, and I think the simulator got back to Earth orbit about an hour before the spacecraft did, and everybody was very happy with the result.

That was another part of mission simulation, by the way, that I skipped over, is the fact that as the simulators developed and become more and more trusted, they became a significant tool in the flight control task. Everything that was going to be done in flight was done in the simulators first, mainly here in Houston because we were closer to the control center and the people doing the planning. The people at the Cape were too far away to be much help in those particular things, although they did try and back them up some, too. But it was mainly our task here in Houston to do that work. I think that's true even today, that when they go into a launch, the Shuttle simulator is on-line and configured to support the launch and any problems that may occur. Now, as soon as they get into flight, then they start picking up their normal task of training for the next crew, but always have that background task, and if it's needed, it's available.

Let's move on to the lunar module simulator. That was acquired through the Grumman Company, and, as it would happen, the contract was awarded to the same contractor that built all the other simulators—Link. I think it was still called Link at the time. The particular… contractor group went through several names as their home organization sold them off, because they weren't making enough money.

The LM simulator, we did smarten up a little bit, especially in our data flow, that rather than collecting schematics and so forth from the designers, Grumman developed a group (it was their Internal Simulation Group) and we didn't… necessarily [get] a schematic of a system. We got what was called a "math model" of the system. Cut out a third of our work, because if we got a schematic, we would have to develop a math model. So here these guys took a step ahead of us. So the data flow was much better.

The big thing with the lunar module simulator was we were going to land on the Moon, and now we had a landing scene we had to generate. We came up with a massive structure with a probe and camera system. The little probe was probably a quarter-inch square, and that represented the window on the LM, and it could be placed anywhere by this big drive system and look in any direction. It was a maintenance headache, because anytime you've got to drive big pieces of steel [there] around are maintenance headaches. But it worked.

Unfortunately, it had one—well, we had three scenes. We had a very rocky scene. The [second] third was not too many rocks, and the other third was no rocks. [This] didn't represent the Moon at all. Here I'm not exactly sure who came up with the particular concept, but they came up with a concept of building an actual model of the Moon surface we were going to go to. We had data from prior spacecraft projects that would describe the [Moon] and the area we were going to. That's how they picked the landing site. They wanted the minimum of holes and rocks.

Now, the key is, on the Moon, you don't see items; you actually see shadows. So therefore, we had to develop a sunlight source, collimated light. So we had this large bank of lights shining on our lunar surface. We could change the angle of the lights, which would change the appearance of the scene, and we had one of those for each of the lunar landings that was built, at tremendous cost. It wasn't cheap at all.

But when the crews came in to land, they knew exactly where they were landing. Each one of the crews, they could recognize the various landmarks and so forth, as they were coming in, and they came in pretty fast. It wasn't a slow approach at all, so that they had to do it very rapidly and decide where they were going to set down. It was a successful technique. As I say, I don't know who to congratulate for that, but we were too busy to worry about giving credit to anybody. [Laughs] Everybody got credit.

Of course, the lunar module simulator and the command module simulator had to work together so they could dock together. Both of them had to work individually and together with the control centers. We did our final training from Florida, which it takes about a second to send data to Florida so that we had to come up with some way to keep the two computers, the computer here and in the Mission Control Center, in sync with the simulator computer so that they wouldn't diverge, which would happen. The mathematicians developed a technique. I wrote the check. [Laughs] But it was a continuous headache to do that.

That kind of led to the idea that when we moved into Shuttle, that we were not going to have simulators in Florida. We could fly the astronauts back and forth easier than we could keep the simulators together, so that that was one of the minor factors that went into that. The other was the significant cost of a simulator. They're not cheap.

RUSNAK: Why had they decided to put a duplicate set in Florida in the first place?

FABER: Because we thought the crew would move to the launch site for the last few months before they flew, and that was their home for that term, and we needed to train them. Conceptually, even today, they talk about actually having training in the Shuttle to train the crew to land the Shuttle, because, you know, they could be upwards of two or three weeks from the time they've practice a landing, so that they did develop some simulations that actually fly in the Shuttle. The crew would get into their position and turn the switches, and everything works just like they were landing, to get some practice.

At one time we [thought of] the concept of… plugging the actual crew station that they were going to fly into a computer and use that as a simulator. Well, that turned out to be a very bad idea. They don't have enough time to fix the crew station, never mind to donate it to training. The other factor is that in training, the systems get used thousands of times more than they get used in flight, so that they would wear out. So that was another reason for not doing that.

Let's see. Something else had popped into my head, but I forgot what it was. As with Apollo, we tried to develop a visual simulation of the lunar surface, not the landing, but the going around the Moon. At the time we had seen the front side, but we hadn't seen much data on the back side. The contractor, again, tried a film approach, and it was even worse in the Command Module Simulator] approach. They had learned their lesson about trying to crank so much light through a film pack, but they just couldn't get the linearities and opposing the non-linearities of putting a scene on the film and having it show up on crew station looking anything like real… We tried for years, but it never got it to work.

The lunar module was considered a very difficult thing [to fly] when [NASA] first started working on it, and someone, in their extreme wisdom, decided they were going to build a free-flight simulator of the Lunar Module. It would fly on a jet engine, which was supporting five-sixths of the weight, and the crewman flying it could control it as it landed and so forth. Then the intelligence took over and they said, "We'd better have a simulator for that simulator." So we, in-house, built a simulator of the Lunar Lander Training Vehicle. It was put together from scrap parts from various Air Force simulations that we had access to. We used to have a warehouse out at Ellington [Field] with all these spare parts in it, and the guys would go out there and find something they needed. It had a visual system, very crude, camera model system. But it was enough to tell them where the horizon was and how high they were from the ground and when they were in trouble. Was it [Joseph S.] Algranti that bailed out? Algranti, you know, he knew when to pull the handle and get out of that thing, and the only way he could have known that was from this static simulator that we had.

…Going on [to shuttle] we [felt it] necessary, [to simulate the] shakes, rattles, and rolls [of] its launch [and landing] phase…[we therefore built two crew stations]. We had what was called a moving-base simulator, which was mainly for the launch phase and for the landing phase. Then we had a fixed-base simulator, which was mainly for the on-orbit phase, when systems were more important. Now, the same software ran both simulators… [We had these great big spools of tape to hold the programs, maybe ten of them, and we would load them into whichever simulator was to be used at the time].

The other thing that we did in [shuttle], closing in on [that] program. We had another simulator [in Building 35] that had been [built] for procedures development. We made it look just like the mission simulators, and rather than procedures development, it became our development tool. We developed our software on that one and then could take it over to the mission simulator… Gave us one that training did not interfere with development, because of that.

Let's see. Did I skip anything?

RUSNAK: Well, there are probably a couple of question I could ask you if—

FABER: Say it now before I go into Shuttle, if you've got some more Apollo questions.

RUSNAK: Sure. You had mentioned a few minutes ago the simulator for the LLTV [lunar landing training vehicle]. Was the LLTV something that was under your department?

FABER: No, no. The LLTV was developed by the—who was it that headed up that one? I don't know who headed that up. It was handled mainly out of the group that took care of the airplanes down at Ellington.

RUSNAK: Aircraft Operations

FABER: Yes. We just had to build a simulator for the simulator.

RUSNAK: You had spoken earlier about the Gemini computer, but the Apollo guidance computer is much more complicated.

FABER: Yes. I don't know how many computers there were in that package, but there was many more than one. We kicked around many techniques on how to simulate the Apollo guidance computer, emulation, or so forth and so on, and our final decision was to actually get flight computers and use them. We didn't have to worry about programming them, because they programmed them for the spacecraft, and we could just stick those programs in. Cost-wise, it was expensive, but it eased our problem quite a bit. Or did I—am I out of whack here? Wait a minute. I know in Shuttle we used flight computers. I'm not sure what we used in Apollo now.

RUSNAK: There's something called an interpreter.

FABER: Yes, an interpreter, which took the instruction set that were written in one language and converted them into an instruction set that would work in the DDP-24s that we were using to animate the simulator.

But you've asked a question. I'm going to back off on my answer. I'm not sure. I know in Shuttle—as I say, in fact, in Shuttle they have five computers in the simulator, just like they have five computers in the spacecraft, and care and feeding of those is not simple. But I'll back off. I've forgotten exactly what we did. I know we weren't happy with what we did in Gemini because the lead time was bad. So we did something different, but I can't remember exactly what it was. Have to get one of my other experts. [Laughs]

RUSNAK: That's all right. We can find that out, I'm sure.

FABER: One other—I like to throw in these anecdotes. In the lunar module there was a piece of equipment that was supposed to show the astronaut how high he was and what his orbital rate was going to be. In other words, when you go around, you're in a continual procession to stay with your—pointed towards the ground, and we had a piece of equipment which was named ORDEAL [Orbital Rate Drive Electronics, Apollo, LM], which stood for Orbital Rate da-da-da. We had one tremendous problem simulating that, and we called it "the ordeal." It just would never work the way it was supposed to work. It was such a miserable device, that when we took one that we had played with it so much in the simulator that it broke, I had them put it in a box to give it to the contractor as an award [laughter] for the effort they had put into trying to simulate that particular device. They used to complain that I didn't know how to spell because I didn't spell "Ordeal" necessarily right. But there were several of those. Now, some pieces of equipment just would not lend itself to ease of simulation.

Another piece of equipment in the lunar module, we had a lot of trouble, was the radar that was measuring the surface of the Moon. The problem there was the things were changing faster than the computer could keep up with, and we finally had, after many, many false attempts, developed a way that we could think ahead of the ground we were going to go [over] so that we could make sure that radar altimeter would give a proper [reading]—but you had to know you were [going] in that direction, look at the ground ahead of it, and stick that database into the computer, as opposed to the database for going that way. Those were some of the things we had to learn.

Now, with the lunar program, we only had one in Florida. We had one in Houston and one in Florida. The lunar module was a more stable, predictable device, so it didn't change quite as rapidly and we could keep up with the configuration. Besides, budgets were getting tighter.

RUSNAK: What sort of effect did all these changes among the command module particularly have on things like cost and scheduling and your ability to have trainers set up to a high enough fidelity to train specific crews?

FABER: That was our task. We did have budgets to worry about. We did fight for every dollar we had. The director at the time was Deke [Donald K.] Slayton, and Deke was more interested in keeping his airplanes flying at Ellington than he was keeping the simulator flying at Building 5. So we were in a continual fight for money.

The other attitude in there was, really, we had reached a point where more computer was cheaper than reprogramming what we had because we had to condense it, but we never did convince Deke of that. He would make us go back and spend manpower, as opposed to buy another bank of memory or something like that. As I say, it didn't help my standing with the astronauts or with Building 1, but I kept things going. [Laughs] We were able to—obviously, we got all our crews trained. I don't think that any debriefing I went to, there were very many negative comments that, "You didn't teach me how to do that." All of the comments were on the line, "Yeah, I saw everything that I was in flight in the simulator first."

At the end of the lunar program, when we were in a phase-down stage, NASA went into the Apollo-Soyuz Program. We did not need significant new hardware for that because the Apollo was the same Apollo simulator. Also, the maturity of the spacecraft was much better, and we didn't have near the change traffic from the command module side. We did have a small tunnel built, which was the docking tunnel, which, by the way, happens to sit over in Space Center Houston right now, on display over there. And we did cooperate with the Russians on the program, and we tied our simulator here in Houston to the control center in Houston, and also to the simulators and training systems in Russia and their control systems. So we did some worldwide integrated simulations to test the procedures and the communications paths.

We also had got back to a five-day week. [Laughs] The interesting thing we did, though, is, you know, Shuttle was coming along at this stage, and we took the lunar module simulator and its computers and the visual simulation system, and we developed a Shuttle simulator for the landing phase. The optical probe that we had used representing the lunar module became the Shuttle. We needed a different TV system, so we went out and bought an RCA TV. In fact, it was the identical model that I had at home. That wasn't planned that way. And we did develop a crude infinity optics to go on the front of it, and it was used for a couple of years while procedures were being ironed out on how are we going to land this beast. We had a model board built, which represented the Cape Kennedy area, or at that time it was Cape Canaveral—Cape Kennedy, by the way… [I] flip-flop on the name. We did do a lot of procedures development on that particular device during those years.

At the end of the Apollo programs, there was a major reorganization of Johnson Space Center. I and my group, responsible for crew training, had been in the Flight Crew Operations Directorate. The Mission Control Center and their simulation were part of the Flight Operations Directorate. [After] Apollo, what was the Flight Crew Operations Directorate was abolished. They also reorganized how we did things, and my simulation group became responsible for just the simulator and not for conducting the training on the simulator. That went to the group that was doing the mission simulation… It didn't do my group very much boost of their morale, by the way, and we had a pretty good outflow at the time.

We did write up specifications for the Shuttle simulator that was bought directly by NASA, and the [shuttle] contractor wasn't involved at all other than as a data source. I was involved very actively. I gave them the budgets of what I thought was required. They hacked them. We went out for bid, and the bids came out not too far from what I had [predicted], which meant we were maybe $10 million short, and that's when I said, "Have fun, fellows. You don't want to do business my way." I said, "I will help, but I'm not going to be a responsible party for this." Actually, one of the astronauts took over, chairman of the configuration of how we hacked the simulator down to meet the budget. The big mistake was not increasing the budget, because they have spent much more putting those things back [in], that they took out….

Shuttle [missions], especially…[the early ones], were all very different. The standardization wasn't there yet, even though it was the same spacecraft. In other words, what it was doing and the system in it were changing. One of the things that they had deleted [from the simulator] was an easy method to modify the software so it could take care of these changes… That drove them crazy, keeping up with [the changes], and ran the cost up.

…[In the visual area, the shuttle was to land on a landing field.] The powers-that-be were not quite as convinced as I was on how good a computer [image] generation system was going to be, and we had the most complex [camera model] system. We had a model board that was some fifty-odd feet wide and thirty feet tall, and a camera… system on a track, you know, and it came in to land. Daylight, so we had a lot of light, had to go on this thing to pick it up. Again, the probe—actually, the probe was the same quarter-inch cube that I'm talking about. But that picture was split into three images: one for the pilot looking that way, one for the window over here, and another for the window over here. Now, the co-pilot only got one. If the co-pilot was going to land, we could switch the scene so he had these three windows. It was so hot in that room that the model board had problems, and we had tremendous air-conditioning to keep the temperature so it wouldn't crack apart.

Two of those systems were built. We built one for here, and the Link Company built one for an Air Force helicopter trainer. Neither one were very successful. The maintenance on them was horrendous. Now, the optics in that probe were phenomenal, but even then they couldn't keep them perfectly synced. You could look in these three windows, you know, green over here, it'd be blue over here, it'd be orange over here, because of the balance of the television systems and so forth, because these were all color systems. So that pretty soon, within a couple of years of developing the simulator, that system was x'd out, and we went to 100 percent digital image generation.

Now, as I say, we had started out with a simulation of the docking in Gemini. It was a little bit better in Apollo. The industry had caught on. There was more than just Singer [Singer Corporation, parent company of Link Flight Simulation Division] building these things. There were several companies putting together these scene generators, and they made tremendous strides. I'm not sure, since I left NASA, I think they may be on their third or fourth version of electronic [digital] image generation for the landing scene, each one getting significantly better. But we did eliminate this great big camera model system. They did, because I had left it by then.

I did retire from NASA in 1982. I left the Simulation Branch a couple of years before that and moved to division staff to handle things there. One of the big efforts I had on the division staff, we had a mode of operation known as Control Mode. That's when we flew Air Force missions in a secret mode. We didn't call it secret; it was called Control Mode. Well, we had to do a tremendous amount of changes around the site to take care of that particular aspect, and the simulators were a big part of it.

We also had some problems that the Air Force wanted to lock everything up, and our management said, "We're a public group. Our charter says we will tell everybody everything. In fact, we have to let visitors in," so that, in fact, Building 5 used to have a rail balcony. We had to seal that balcony with triple-pane glass so they couldn't hear anything. They couldn't hear anything anyway. We had to turn things around so they couldn't really see anything from the window, but they could walk down and look at the simulators, and they still do. That's still part of one of the tours that Space Center Houston runs sometimes. They go to Building 5.

We had to take care of our data lines and protect them. I mentioned [earlier] we were developing the software in Building 35 across the street and shipping it over to Building 5. Electronically it didn't work. We just could not at that vintage develop the data flow that would be fast enough and stable enough, so that they still, even today, I think they carry these great big computer disks across the street from the Development Center over to the actual training simulators. But we made many efforts on that. Of course, we had to seal up the building and to go through all of that particular thing there, but I was the division man on that particular task for a year or two.

As I say, I did retire in '82 when we were on a phase-down stage, and they offered some early-outs at fifty-five, and I accepted that particular early-out.

Do you want anything on my post-NASA activities?

RUSNAK: Sure.

FABER: Okay. Knowing I was getting out, I went looking for a job, and I went to work for the Aerospace Corporation, who are an Air Force contractor. At the time when I first went to work for them, the Air Force was planning to build a replica of Mission Control [Center] in Colorado Springs [Colorado], and astronaut training. So we were going to have a simulator in Colorado Springs and a complete Mission Control [Center].

Somebody back in the early Shuttle days talked about sixty launches a year. Mission Control Center could not handle sixty launches a year. In fact, most of the people in mission control felt they might be able to handle fifteen or maybe twenty. Simulator-wise, my number was even lower than that. So the Air Force, to support their programs, they were going to have their own system in Colorado.

After we spent several years writing a specification, going out for bid, selecting a contractor, everybody realized that eight to ten or maybe twelve missions a year were going to be maximum. Mission Control Center Houston, could handle it. Simulators in Houston could handle it, so that the program at Colorado Springs, at least the Shuttle Program at Colorado Springs, was terminated. Now, Colorado Springs had other functions associated with Air Force functions, and they were continued and completed.

At the end of that particular phase of things, rather than fire us, which they could readily have done, the Air Force was beginning to put some payloads into NASA flights. Instead of having their own dedicated flight, or dedicated Orbiter (they wanted a blue Orbiter) but instead of having that, they would have a dedicated flight, or put payloads, regular payloads, on the flight, so that those of us who had worked on the Colorado Springs program moved into payload integration.

We were the interface between the payload investigator, who quite often was a scientist or university professor, somebody else who, you know, wasn't used to working with the bureaucracy of NASA. The Air Force certainly wasn't used to that particular thing, and we, several who were ex-NASA, so we knew that. We had the people. We knew everybody, so we transferred into doing payload integration, and for about the next six years, I worked on that particular phase, helping to put the payloads into the Orbiter, doing the safety analyses that have to be done. The things that NASA did for their own payloads, they did not do for their scientists who came from elsewhere and had all kinds of problems with it. They do now. But we were basically the interface to NASA for the payload community and [I] took care of several payloads over my next few years of experience until I retired from them.

The Air Force decided they weren't to fly any more payloads, and our office dropped from some sixteen or eighteen people down to one. The youngest guy is the guy that stayed. [Laughs] Everybody else retired, so that I left Aerospace in '92. Been retired since '92. I can't tell you the payloads I worked on, because I'm sure someone thinks they're still classified.

RUSNAK: Was that kind of work quite a change of pace for you?

FABER: Definitely. Well, the big change of pace is when I was working for NASA, I took everything home with me. I was up half the night, "What am I going to do with that?" Well, working for Aerospace, I didn't have to take anything home. When I left the office at four or five o'clock, I was on my own. I didn't have to worry about anything. So it was a great retirement job. I know a lot of the NASA people who retired and took jobs with their contractors, and they were working just as hard or maybe even harder than they were with NASA. Well, I'd decided that was not for me. I wasn't after making a million dollars, and between my retirement pay and what Aerospace paid me, I was very satisfied to take this fairly low-key job and do it.

As you can see from my shirt, I have an even lower-key job. I'm a volunteer at Space Center Houston, and I spent the morning over there helping get some eight hundred children off their buses and into the Center, and then greeting the guests at the front door and trying to help with their experience and telling them what's going on in the building and where things are. I've been a volunteer there ever since '93.

Anything else? Any questions?

RUSNAK: Well, I've got questions that are from here and there, but—

FABER: Go ahead. Fire the questions. Well, that's all right. I've been all over the country.

RUSNAK: Well, perhaps we can start back at the beginning and then work our way forward, if that works for you.

FABER: Now, let me add one more thing in there. I worked for the NACA for about eleven, twelve years as an aeronautical research scientist, and all that time I went on one trip, one official trip. I moved across Langley Field to the Space Task Group, and I was on travel about a hundred days the next year, which, just as an extreme difference that we had, from the Research Center life to the life in the Space Group and so forth, and those travels stayed with me until I retired from Aerospace. I always had a bag packed and I was ready to go somewhere.

RUSNAK: Coming out of school, which kind of life did you envision for yourself as an aeronautical engineer?

FABER: Well, I wanted to work with airplanes, and I did. As I say, being assigned to the Flight Research Division, I could go out and touch airplanes all I wanted. We had them. I think I was very fortunate to be assigned to the Flight Research Division, and in the office I was in with Chris and Chuck and Harold. The organization in that branch, by the way, the branch chief was [W.] Hewitt Phillips, was kind of unusual in that we had a branch chief, an assistant branch chief, and three section chiefs. Depending on what you were doing, you could report directly to any one of those five people.

It was an informal-attitude thing there, and you were the one that budgeted your time. If you wanted to work on this project full time, you could. If you wanted to put that aside and work on one of the others part time, you could. Gave you a tremendous amount of flexibility in what you were doing, and on your own project, because you were generally on your own project. Even as a junior engineer, you had a project to work. You were given in that group tremendous freedom.

I used to say the management style was "Keep going, and if you're going in the wrong direction, we'll give you a little nudge to point you back the way you want to go. We're not going to have a rope on your neck and pull you back. We're going to nudge in the right direction." And that was the management style that we had there. I liked it, and I think I've tried to repeat it myself in my own organization. I don't think I rarely ever corrected anybody and said, "Don't do it that way. Do it this way." I was a pretty good manager in that "Let's try this approach" type of thing.

Now, those years in the Research Center were, I know, I was in my own little pond, I was a big fish, and it was very enjoyable. I worked on, as I say, like the man-machine interface was a key [project]. I had a flight program [with] an airplane which would be today considered a variable stability airplane. We didn't call it that. From ground one, I built the package, I ran the flight tests, so forth. I had some [other projects] that weren't so successful. We won't talk about those. [Laughs] But I did get involved with the computers and with simulation and that particular thing, because at those times we used to think a flight hour, which might cost eight, nine hundred dollars to fly an airplane an hour, that was a lot of money, and I could run the simulator for a heck of a lot less money than that. [Laughter] So we would do a lot of our work on the simulator and then fill in a few points that'd bias the whole curve up or down with the flight experiences.

So it was a great career. I enjoyed it. And, as I say, I didn't choose to come to the Space Center; I was recruited. You know, I'm going to leave this world where I'm my own self in this little world, and I'm going to become a cog in a great big world. So there was a lot of hesitation there. But I'm not unhappy with the decision I made to come join the Space Task Group. I think it was a great move for me, and I think my career was a good one.

RUSNAK: We've heard that a lot of the old NACA hands were a little leery of the space work going on there, the Space Task Group and such, and perhaps didn't see it as really a great career move because there might not be any future there.

FABER: That was there, and, as I say, I think even bigger, though, is that back in the Research Center, you ran yourself. When you joined the Space Group, you didn't run yourself, and I think that probably was a bigger factor than worrying about whether they had a career or not, because we weren't that big. We didn't recruit that many people to join the Space Task Group initially. I'm guessing that Project Mercury at its peak probably had less than 300 civil servants, supported by maybe another 300 contractor types. [However] the move… down to here, that did cause some qualms.

In fact, a couple of my people came down, spent less than three months, and moved back. They didn't want to leave the environment they had in Virginia, or their wives weren't happy with it, or something like that, because I had a couple of my staffers who came down for a short period of time, and I know one of them left definitely because his wife wasn't happy here. She was from West Virginia, and she couldn't tolerate the flat plains around here. [Laughs] The other ones, you know, they just missed their family because their families were in that area. But we did actually recruit more people after we came down, and people came from Langley and from the Lewis laboratory. They were the main centers that we drew from. We didn't draw too many from California.

I don't think too many have had that insecurity feeling that the job wouldn't last. At least I didn't. I can't speak for the others. I'd been happy after the last Mercury flight to go back to work in the Research Center again. [Laughs]

RUSNAK: I find it interesting that you were in Corpus Christi during Hurricane Carla. Shortly after that was when a group from the Space Task Group came down to do a site survey here, and the whole area had been devastated by this hurricane.

FABER: [Laughs] Yes, it was an interesting period of time, the speculation of where we were going to go. In fact, during that particular time phase, there was a lot of talk that we would join

Goddard Space [Flight] Center [Greenbelt, Maryland]. I, actually and my wife, we went up and toured around, and I actually put down a deposit on a piece of property somewhere in rural Maryland. But when they didn't choose that area, the guy gave me my money back.

I was definitely not part of the team that chose this area, so I won't make any comment on their ability, other than that it was a heavy political hand. The story that went around is at that time Texas had more congressmen who voted against space than anywhere else. They still do, even though the Space Center is here in Houston.

RUSNAK: Well, but you're still here, and it's been forty years now, so you must have gotten used to it.

FABER: Yes, but I, not too long ago, saw a blurb that discussed closing the Johnson Space Center as part of an economy move. The last few administrations have not been space oriented. You know, if you've got a surplus asset, you shut it down and get rid of it, and that's what they were thinking of doing… [Headquarters tried to do that] to [some] assets [on] site… and only through some back-door finagling were [these assets saved] so they could be reactivated later when needed.

RUSNAK: Well, we're also out of tape, so if we can stop to change those out and come back in a few minutes.

A couple of more questions related to the Langley period. I had come across some information that you had worked on the X-15.

FABER: Yes, that was one of the simulators that I helped put together. The X-15 was an interesting program in that it was directionally unstable at the highest speeds. If you slowed down a little bit, it was stable, but that didn't meet the contract requirements. The contract requirements had to be so high, so that we put together a monstrous mess of hardware and software. There were three or four of us working on it, and I was kind of responsible for the crew station—quote, crew station—the controls and the displays. Somebody else took care of the computer programming. Somebody else provided all of the math model and so forth, that went into the computer programming. We were able to simulate this phase and developed some techniques that would allow us to carry the program, in other words, marginally stable if you don't do something wrong.

In fact, at that time frame, one of the other X Series airplanes, the X-2, had crashed because it had the same kind of problems… Traditionally a pilot, when he flies, he said, "The air field I'm going down there is over there," when you do a turn, you pull back on the stick a little bit because you want to increase your angle of attack a little bit as you're turning. Well, that's where they lost their directional stability. As long as you kept going straight ahead and slowed down a little bit, then you could make your turn.

So we proved that to the pilots in the X-15 mode. Scott Crossfield was one of them, I know. He was with Rockwell at the time. Was it Rockwell or North American? I may screw up my names of companies. But we put it together, and it was all analog… We had every piece of analog equipment that Langley Research Center could get together in one room, hooked together to do the simulation. We scrounged up hardware to make an electronic simulation of the attitude indicator that the X-15 was going to use, because we couldn't get a piece of [flight] hardware, and demonstrated to the crew, you know, you can't pull any angle of attack. You have to make sure you stay at one or two degrees' angle of attack max. This was on the angle of attack indicator. You want keep your side slip to zero and basically keep going straight ahead until you slow down a little bit, because they're not going to drop you off the mother airplane until there's room. If there's not room for you to turn around, they're not going to drop you. But, as I say, it's just a characteristic of pilots. When the airfield goes over there, they want to turn towards it.

So we were able to demonstrate that if they keep going straight ahead [they were ok]. So it was a big project.

The only anecdotal thing I can get there is there was a big conference right at the end of our experience, and Scott Crossfield was one of the speakers, and his comment was, "Company policy says that I say, 'That's the best-flying airplane I've ever been in.'" [Laughs] Even though he had crashed about forty times the day before, you know, trying to learn where the boundary was.

Manufacturers had done simulation before then, but they really hadn't done simulation for such procedural work. They did simulation to prove out a subsystem. So we had to pull together this thing to show them that procedures can be developed the same way, flight procedures, and that kind of started it off. I guess on that program I was working directly for Chuck Mathews. As I mentioned, I worked for each one [(branch supervisors)] of them on various programs.

Oh, I've got one other thing I'll throw in. Do you remember White? What was his first name? Flew outside the Gemini with a hand-held maneuvering unit?

RUSNAK: Ed [Edward H.] White [II].

FABER: Ed White. Back at Langley in the pre-Space Task Group days, Harold Johnson, again one of the section chiefs, and myself, Helmut [A.] Kuehnel, and a fourth member, one of our technicians, we put together [an air] gun to control ourselves. We had a simulation. You'd point the gun, pull the trigger, and you would go that way. Point the gun, you would spin. It wasn't complete freedom, but it demonstrated very readily that a pilot, a human, with just a simple air gun could control his attitude, his direction, his speed. Now, he had to be pretty good at it, because I developed the gun and it had all of twenty seconds' worth of power. [Laughs] We were on a rail system, and the rail was about sixty feet long, and, as I say, other people developed other portions of it. My portion was the thing there [- the air gun].

Art [Arthur G.] Trader was the fourth member of our team. When we came down here, Harold Johnson and Art Trader did build that first gun that Ed White used to fly. [They] corrected a lot of things that we had on ours. For instance, the one I built, you pushed it that way and you went that way. The one that they used in flight, the thrusters were that way, so at least you went in the direction you pointed at. [Laughs] But it did demonstrate the human could very easily control all those attitudes. And that was, as I say, long before we had ever thought of the Project Mercury.

RUSNAK: Why did you guys mess around with that sort of thing?

FABER: I guess we always were trying to stay ahead of the game. And I can remember this well, Harold came up with the idea—Harold Johnson was a tinkerer and an idea man. He came up with this idea, and we went up to the directorate to get money, and the director said, “No, but come back in three months and tell me how you’re doing.” [Laughs]

And we did, and he covered the funding that we had spent for that first three months, which allowed us to borrow money for the next three months, and I guess we were about six, eight months into the project before we demonstrated what we wanted to demonstrate.

We were great scroungers back in those days, and one of the items that we had scrounged that they were using for part of the control system came from a navy destroyer, and Hal Johnson and Art Trader went over to the navy yard in Norfolk [Virginia] and got it, put it on a truck, and brought it back, because money was not very [available]—we couldn’t go out and buy things very often. We had to scrounge them, and we did a lot of that, and we did a lot of that in the early space program when we came down here.

The first Mercury trainer, the analog simulator was actually from an Air Force—I think it was a F-84 trainer. It was very difficult to run, so we hired the company that had been operating it for the Air Force at Langley, and they reprogrammed it and operated it for us, and brought it down here and brought those same two guys down with us. [Laughs] They could keep it running. No one else could. There wasn't a great deal of documentation on it.

Speaking of documentation, I would say through the simulator programs, I'm not sure if it's even true today, but knowing exactly what software was in your computer, whether it be the digital computer or the analog computers we used early, documentation *never* kept up with what was actually there. In some cases, [the] particular engineer [would say], "Oh, I got a patch for that… in my pocket. I didn't need it yesterday, but you need it today," that type of thing, and whether that was poor software design, the operating system not being stable, I can't answer that question, but it was a fact of life. We tried to document our stuff as best we could. But, again, there wasn't any profit in documentation. That was somebody's later, so that if a guy had to fix this problem or document what you did yesterday, he fixed today's problem. That was with this analog computer, because they knew what they were doing, but they just didn't have it documented at all. If either of them had had an accident, we'd have been in trouble. [Laughter]

RUSNAK: Well, fortunately you did not.

FABER: No.

RUSNAK: But I'm sure they've come up with a more rigid system on documentation these days.

FABER: Hopefully. But, again, if it's fix today's problem or documenting yesterday's solution, fix today's problem takes priority. I'm sure of that.

RUSNAK: Well, it makes good sense.

FABER: It's just they don't have as many today problems. [Laughs]

RUSNAK: At any point, either as early on as the NACA or later, did you have any interaction with the wider human factors community, or industrial psychologists, anything like that, in how to simulate things?

FABER: As I say, I was working the man-machine interface, so I had some contact with people back then. In the Mercury Program we did have a Dr. [Robert B.] Voas, who was supposedly a psychologist and so forth. We managed to keep him out of the way and take care of our training program—now, not the whole training program; I'm just talking about the spacecraft itself.

At those same time those Mercury astronauts were learning about the Mercury spacecraft, they were getting courses in astronomy and orbital mechanics and all these other things. They were handled… totally separate from our [work]. Our work was flying the spacecraft, controlling the spacecraft. The biggest task the Mercury pilot had to do was to turn it around and control the retro rockets. Now, we had an automatic system that did it great because we did it on two capsules that didn't have a man in them. [Laughs] But the astronauts insisted on doing that. That was our big task.

The control technique, normally, of flying an airplane, you do what's called a rate control. When you make a turn, you set up a turning rate. When you're controlling in the spacecraft [in] direct control, you are an acceleration controller. You give it an acceleration. If you want to stop accelerating, you've got to fire in the opposite direction type of thing. That was something that had to be learned. Our first astronauts, some of them learned it instantly. Some of them, it took a little time to convince them. [Laughs] But they all learned it. You know, it's just a different technique than they were used to in flying.

Now, did we discuss all of this with head shrinks and so forth? No. We did in our own community, and, unfortunately, very, very little documentation. We did… Johnson and I co-authored a chapter. There was a book written after Mercury on Manned Space Flight Engineering, and Harold and I wrote a chapter on training. We did have, after the Apollo Program, a NASA technical note on the simulation systems that were used, that a whole of bunch of us are listed as authors on. We all contributed this, that, and the other to it. I can't speak of today, but I'm [not] there. But we didn't really do a great deal of documentation of what we were doing when we were doing it.

Something, and I'm still sorry about it, back in the Apollo days, I tried to get a paper written and distributed on the visual systems, because they were unique. We never finished it. Four or five different people made input to it, you know, but there was always something more important to do than go back and sit down and work on it, so that it never got published.

The simulation of the lunar radar was another thing that was kind of unique at its time. We never published a paper on that. Again, somebody wrote one, a first draft, but I don't think I ever read it, to show you how bad [it was]. The guy's section chief might have read it, but it never got to me. [Other] things just were too important in a very changing world.

RUSNAK: At the beginning you mentioned that you came in at the same time as the Mercury 7 astronauts, and you spent some time working with them, and I guess [L.] Gordon Cooper was down at Muchea with you.

FABER: He was, yes, yes, yes.

RUSNAK: So I was wondering if you could maybe just characterize them a little for us or just share some of your experiences you had working with that first group.

FABER: Well, I mentioned the centrifuge program there. The other thing I might say, and it's almost anecdotal, the doctors hovered over those guys. We were up at Johnsville, and [in] the centrifuge experience, you work very hard when you're in the centrifuge. The guys would come out, and they would want to take a shower, and they had showers for them available. They were typical Navy, just a sheet-metal structure type of thing. At that particular time, Slayton was just beginning to show the heart murmur that grounded him, and he came out of the thing there and went to take his shower, and he banged the wall with his fist. I thought the doctor was going to come unglued, running in there to see what he had done, and Slayton was just laughing, because he knew the attitude.

The seven guys were quite different. I'm not going to comment on the selection order or anything like that. Someone else took care of that. I didn't have to, thank goodness. I will say that of the first seven, Gordo kind of did the right thing instinctively. John Glenn did the right thing after he thought about it. But they both took about the same length of time. John was very thorough in his analysis of everything, and he would come out with things [like why or why not]. But Gordo [would say], "I don't know why I did that. It just seemed the thing to do." [Laughs]

Now, as I say, we were together in Australia there for a couple of months, and as different from now, we didn't each have our own car. We were sharing a car, and he wasn't used to driving on the wrong side of the road, and several instances, it was real close that we got back and didn't get hit.

But all of them were enthusiastic, motivated. That was one thing you never had to worry about, was motivation. "Let's go train on something."

"Okay."

Where you'd get some baseball player and say, "Let's go take some more batting practice."

"I'm tired."

But these guys were very well motivated to be as good as they could. They also thought out everything they were doing and could tell you—we knew when they needed more exercise or something, but they also knew it. We had very little problem with that. In fact, we had the opposite problem. They wanted more simulator time than we could give them.

RUSNAK: Did you have the chance to work as closely with the later classes?

FABER: No, especially after the transfer down to here. I've got two offices. I'm trying to get a house settled. I'm building two new complexes. The personal contact with each succeeding wave was less and less and less. I was the guy they came to with a bitch, so that I was ogre that didn't give them the simulator time they wanted, type of thing, so that that's when I met most of them after that. I tried to explain to them that we're doing as best we can, and most of the time I was successful. At least, they went away without taking my skin. [Laughs]

RUSNAK: How did the first crews feel about the effectiveness of the Mercury simulator, for instance?

FABER: Again, their post-flight debriefings indicated that they got what they needed. Where they thought it was unnecessary, for instance, the centrifuge training, we tapered that off. Some of the other hand-eye things that we had developed, we had some things to train you on acceleration control that were very simplistic, and they said, "We don't need that. We know acceleration control. Now, put that junk away." We had a simulator that was called ALFA, Air-Lubricated Free Attitude. This couch sat on a spherical ball that was frictionless by air jets and was controlled by air jets shooting out the top of it. The astronaut would climb into that. We'd carefully balance it so it would be stable, very slightly stable, and then disturb it. He had to bring it back and point it to a particular attitude and so forth. That was part of the training. We didn't even bring that down to Houston. We left that in Virginia. No, we brought it down. I'm sorry. We never set it up. There were things like that that we were able to dispense with because the other simulations took care of that need.

I think Mercury, the biggest shortcoming we had there was not having a decent out-the-window simulation, even for retro-fire. In fact, what we had were three dials. We didn't have a horizon. We had three indicators that said, "Here's your pitch, here's your yaw, and here's your roll. You've got to set them to these and these numbers, and you've got to hold those numbers a while," because the rockets did cause disturbances. Rocket fire is not very stable. But that was the probably the biggest shortcoming, that and the fact, well, the Mercury craft wasn't sophisticated, so we didn't have to be sophisticated. It was very simplified.

Now, in flight control training, and I've got another little story there, doing some simulations there, the Mercury capsule had some chain of events that occurred that were actually caused by relays operating. There was a set of relays over here and a set of relays over here. Well, as long as this got to its last point before this one did, everything was pretty good. If this one won the race, things were bad. We simulated that because we thought that was not a very good system at all.

After the simulation there was Faber, Don [Donald D.] Arabian, who was number one systems guy back in those days, and John Glenn, heads all together, our mouths open, talking, and the *Life* photographer took our picture. I still would like to kill that guy because I never got a copy of that picture.

But we argued about that, and each one thought we knew the system, and they went back up to McDonnell, and they changed the system because these relays, depending on how they operated, could get out of sync. So they put better interlocks in the two, so it got the right point at the right time. John Glenn wanted to run them all manually, and Arabian wanted to run them all automatically. By the way, Arabian was a classmate of mine in college. He also went to the

University of Rhode Island. Our aero class had, like, seven people of it, and I think five of them went to work for NASA, and two of them came down with the space program here to Houston.

RUSNAK: Yes, Don Arabian was telling us that he was originally going into art school, I think, rather than doing engineering.

FABER: I didn't know Don before I met him in class. He was just one of my classmates. In fact, I didn't even know he took the job here at Langley until I showed up at Langley and he was there, because Don did not live on campus, and so it wasn't very much social contact. You saw him during a couple of hours a day in the classroom, and that was it.

RUSNAK: Well, he's certainly quite a character.

FABER: Yes, he was, but a good engineer.

RUSNAK: Oh, yes, he's certainly one with, I think, very strong instincts about engineering.

FABER: Yes.

RUSNAK: Well, then we'll move on to a couple of questions about the Gemini Program. The first flight was Gus Grissom and John Young. How prepared were the simulators for that first mission at that point?

FABER: We were in good shape for that flight, because they didn't have a great deal [to do]. They were testing things, the spacecraft itself. They weren't using the spacecraft to do other things as we did on later missions. Our replication of the spacecraft, its systems, at that time, was fairly decent. The onboard computer wasn't pressured to do anything because we were not going to maneuver a lot, so that get it in the right attitude, you're going to land where you're supposed to.

That was the big thing in Gemini, because Gemini could maneuver during its entry. Mercury, once you fired the retro-rockets, you were going to land wherever it told you to. You had no control after that, as [M.] Scott Carpenter found out. In Gemini you could maneuver. We had that much of the simulation working fairly decently. The control laws that we replicated and so forth, they were fairly stable, so that the simulator worked pretty well, and, again, post-flight, I think their comments and critiques were, "Yeah, we got what we needed."

It's when we started adding maneuvering in, rendezvous in, adding experiments that the crew had to do inside the spacecraft, that became our responsibility also. If there was an experiment going to be in the thing there, we had to develop the simulation for that experiment, especially if it was mounted to the wall or something like that, and those added tasks, and we probably weren't as good as we could have been on some of those things. But, again, they found out what they had to do, and that and luck, they got the experiment conducted.

I guess [Walter M.] Schirra [Jr.] tried the first rendezvous and did all the wrong things, because, again, they had not practiced that in the simulator. That was almost an afterthought, and before we did it again, they practiced at the simulator. It quadrupled the power needed in the computer system, but that's okay.

That was another change as they went from Mercury to Gemini to Apollo, was the sophistication we had to have in our trajectory simulation. In Mercury we didn't have much at all as far as trajectory was concerned. Gemini, we had a little because we were going to do some docking. By the time we got to Apollo, our trajectory simulation, we had to include all of the fact that the Earth isn't round, that the sun is shining at some times and not at some times, so there's a gravity effect of the sun, of the Moon. There's a big anomaly in the South Atlantic that changes the thing there. All those things had to be stuck into our equations. Then we were going to rendezvous. So we had a whole second set of equations that did the same thing and were [not] simple things. "I'm going to bring this over and do to this. That's a six degree-of-freedom problem." When you bring all these trajectory things, and each item is going at 17,000 miles an hour, it gets much more tricky. The accuracy requirements and so forth are tremendously higher. So that was a big jump as we went up. Of course, in Apollo we also had to go to the Moon, which, that was another set of equations. Actually, the orbital equations were worse than the translunar and trans-Earth equations. We just had to transition to them properly, but they were less significant effects, mainly because they were coasting.

RUSNAK: In the Gemini Program, did you have to work on EVA [extravehicular activity] simulation, particularly for, like, Ed White?

FABER: No, we did not. Now, I'll go back to back to Harold Johnson and Helmut Kuehnel. When we came down here, we prepared a paper on what we thought was required to train astronauts. One of the items we had in our list of things was a water tank. We got thrown out of [the Headquarters Building]. [Laughs] They couldn't see any function of that at all… We had been trying to figure out how to simulate zero gravity. We had study contractors and so forth, look at it, and the general consensus that we had come to was that underwater was the best simulation of zero gravity in a pressure suit. We hadn't figure out how to do it without the pressure suit, the pressure suit restricting the motions and so forth. That's why the water tank. But we did not get to build that thing when we first came down. Somehow or other, the people at Marshall came up with the idea, and I don't know where they got it from, and they built a water tank.

The phone rang. "Build a water tank now." [Laughs] So we had a little water tank. It was not under my jurisdiction, though. It was in Building 5, but it wasn't under my jurisdiction.

I don't know who ran it, to be honest with you. I know Harold Johnson was one of the leads on building it.

Actually it was an oil tank, came from one of the tank builders that build water tanks around here, and they had all kinds of help with the safety things they needed to it, but all I did was give them the space in Building 5, that we had put in there for a zero gravity simulator that we were never able to build. We had dedicated that space for that task, but we never came up with anything that would do the job. So the water tank was put in that space in Building 5.

That was our water tank for many years until they put the one in Building 29. Building 29 was originally built to be a centrifuge building. As I say, we had already decided, as far as training was required, it wasn't necessary. But the people who were developing human factors and so forth, they thought it was, so they built it. It was not well used, and they tore it out and put the water tank in. Then we were able to tear down our Mickey Mouse water tank in Building 5. Now, that water tank in 29 was used for many years until they built a new one out at Sonny Carter [Manley L. "Sonny" Carter Training Facility]. But never under my jurisdiction was the water tank.

Now, they tried to give me the centrifuge, but my boss wouldn't take it. [Laughs] Warren [J.] North was the division chief, and he wanted no part of that. He didn't want any doctors in his loop, and that's who wanted the centrifuge, all the doctors.

RUSNAK: A question related to that sort of EVA training, I'd heard from one of the flight controllers that for Ed White's flight at least and I think for later ones, one of the things they had to do was calculate reentries for a one-man return for Gemini in case there was a problem with the EVA, and so I was wondering if that was anything you guys had simulated.

FABER: Well, all that would do, that would change the parameters, targeting parameters, because the CG [center of gravity] was different. You know, there were the two people in the CG within a certain place. We probably flew some, but that was just a change in the targeting parameters so that it didn't make any significant difference to us.

RUSNAK: I don't know if there were any procedural differences since you only had one man aboard.

FABER: Well, because of one man having to do it, and all those procedures would have been exercised. I don't think it was considered significant enough that we spent very much time on it. That wasn't the NASA attitude. The NASA attitude as amplified later on by [Eugene F.] Kranz was "Failure is not a condition that we will accept," and so we always thought we would know it. Now, one thing that Ed White's flight did do was, we tethered everything after that. [Laughs] Nothing goes outside the spacecraft that's not on a tether or with a control system of its own. That glove coming out bothered a lot of people.

RUSNAK: Yes, I think his point in telling us that story was that he was requesting these computer runs or whatever to do this, that people were wondering why he was doing this for Gemini IV while EVA was still a secret for that mission, it hadn't been publicly announced.

FABER: Yes, that's true. NASA sometimes kept secrets. For one thing, you know, it was proposed, and it wasn't approved until the very last minute type of thing.

Let me cover one more little simulation system that was in Building 5. We called it POGO. It attempted to simulate the one man walking around in lunar gravity. It had a long suspension tube, and that as he jumped, it would support five-sixths of his weight so he could take these great big steps. We had it in Building 5. Now, I paid for it out of my budget, but I had nothing to do with the design or operation. It was just a budget line, and the people who were working on it worked for me. We then went further with that and took it outside and mounted that thing on a truck and drove it around the backside of NASA so the guy could really take big steps. [Laughs] Did it train them or anything? To my opinion, no. [Laugh] I think it was a waste of effort, but, as I say, I was told, "Support this with your people," and I supported it with my people and with my money. They had one at the Space Center, but they've had to take it down. They had space problems with it. So they're trying to figure out where to put it again, because it was a favorite item, being able to jump six feet in the air.

RUSNAK: Speaking of the Apollo Program, you had said for that that you procured the trainers from Link, but through either North American or Grumman, and then in the Gemini they had come from McDonnell. So I was wondering how the different ways were established of getting those and proved effective.

FABER: Back in that particular time frame, that kind of was the tradition that the military had had, that they bought their trainer systems from the aircraft manufacturer. So we followed that same pattern for Mercury and for Gemini and for command module and for the lunar module.

McDonnell decided to build them in-house, the first time with not a formal division. The second time, they had a division that was doing electronic work, and they had that division do it. They were actually in St. Charles. McDonnell is the one that went to Link for the subcontract. We had nothing to do with that particular thing. They also went to the Ferrand Optical Company for the visual. We probably influenced that a little bit because we had done some work on Mercury and we thought it was an excellent approach. "Let's not go back and invent the wheel. These guys have something we like. Use what they did."

With the command module, as I say, Rockwell and their thing was building…[a part-task trainer], in-house. But they also recognized their limitations, and they went out on contract [for the mission simulator]. We had a big evaluation. Now, the NASA people participated in the evaluation, but we were not voting members of the board. We had to give them an opinion.

They could accept it or reject it. It wasn't our job to direct them in that line, and, if I remember the Apollo activity, I think we had more than one company that we felt could build the mission simulator, and on a total basis, Link won that particular contract.

We now got very much in their pocket because when it came to managing Link, we were probably much closer involved than normal, would have been considered normal, and I guarantee in the Grumman contracts with the lunar module, we basically took over management of the thing. Money, schedule, and so forth, were a problem and that the Apollo director thought he'd put more manpower on it, more senior manpower. I had more help than I ever wanted. It did do some good, having that senior help.

I remember we went up to Binghamton, New York, for a meeting, and the program manager got up and said, "Happy to report I'm on schedule and within budget." And then we spent two days hearing about everything that was behind schedule and over budget. The program manager was gone that night, due to senior NASA input. [Laughs] We didn't go directly to Link. They went to North American. North American went to Link, so that he just wasn't with the program. He disappeared.

The lunar module program was pretty similar, although in the Apollo Program we did not have a real strong man at Rockwell. In the [Lunar] Program we had a real strong man at Grumman. In fact, at the end of the lunar project, when things tapered down there, Link hired him to be one of them, to be president. They liked him that much, because he was a good manager and a strong individual and could get what he needed done, and people didn't lie to him like were lying to the other managers. He could see through them much more readily.

RUSNAK: There's the infamous story about the command module simulator, Gus Grissom hanging the lemon on it because he was unhappy with it.

FABER: Well, because it didn't represent—he had seen his spacecraft in Florida, and the simulator didn't look like it. That was our data problem. As I say, it's a sad note that it took his fatality to give us the time to catch up. Our data was just totally, as I say, inconsistent. There were systems that had no switches. There were switches that didn't do anything, [things] stuck …in there, and they didn't fit because this panel left a gap or overlapped type of thing. The design was just pretty poor, and they were doing a lot of fit and not getting it back on paper. Oh, they were changing things instantaneously. You know, "I don't like that switch. Turn it over." Well, they turned it over for the astronaut, but by the time they told us, he had already bitched up the line. [Laughs]

The data flow, Rockwell said, "Hey, we want to control this data flow. We don't want to give you bad data." But it meant late data because it had to go through their people. So we had this continual battle of getting things early but not approved, or getting things approved that were too late for us to get in the simulator. That was definitely true in the first couple of Apollos that were on the pad. Now, the unmanned ones, it didn't make that much difference, but the manned ones that Gus was going to fly in, we just weren't there. As I say, at least we could choose whatever set of data we wanted, but was it the right set? We didn't know.

Part of my organization was in Florida, and part of their responsibility was to keep their nose in the vehicle preparation area. Sometimes our data was a photograph that those guys took, and they'd ship it to us and see if we could go to Rockwell, "How do these two compare?"

The guy in California would say, "I've never seen anything like that."

Then we would go, "Well, that's what's in the vehicle in Florida right now."

It just took a lot of work, and NASA management at the time and Rockwell management or North America management of the time just had to learn how to do their job and keep that stuff from happening. The simulator was not number one priority; the vehicle was. And keeping us poor people informed was—you know, that guy would say, "That's not my job. That's California's job, to tell you what's going on." [Gus] was definitely unhappy. [Laughs]

RUSNAK: Did it turn out to be more a function of time or were there procedural, organizational changes that needed to be—

FABER: I think the biggest trouble was that the design was—we were ahead of the design. They were designing it, and we were trying to build it in parallel, and that doesn't work. You waste an awful lot of money trying to finalize something. If you go into it with an attitude it's going to change, and you develop your simulation system to tolerate change, which we tried to do in Shuttle, that makes it much easier. But we didn't have that experience in Apollo. When we did something, we though it was cast in concrete, and we'd get to work the next day and find they had changed something.

As I say, I don't know how they're doing Shuttle today. I know it's still a headache because of the simulators here. Shuttle is going from the mechanical cockpit to the glass cockpit. Not all of them have made that change yet, so we've got to maintain both systems. Thank goodness they're able to do that satisfactorily. Now, I don't know how, but they're able to do it.

But he had a legitimate complaint, and I had a legitimate excuse. Believe me, I was in Building 1 more often than not, complaining about something.

Now I'll jump to the lunar module. Our path there was such that we were getting good data before the Program Office was. We had a path from their simulation people to our people here, and if something wasn't working, we'd hear about it, and then I would pass that word over to the Program Office, because I'm trying to get on the good side of the guy that was bossing me in that line. See, I was both head of the Simulation Branch, plus, on the Program Officer tier, I was the responsible project engineer for the simulators, so that I had to report to someone over there, too, and I had to keep him happy. He'd find out things from me that he didn't find out from his own organizational path, because they weren't quite [as up to date]. Grumman was very heavily involved in simulation and had been for years, so that they used the simulator people to design things. So that's why we would find out about them so fast.

In fact, I mentioned an airplane program that I had. Turned out it was a Grumman airplane, the F11F, that we were making a variable-stability airplane out of. They had simulated a lot of stuff that I was developing. So I was able to use a lot of the stuff that they had. I didn't have it on the simulator. I was modifying the airplane to fly various things there, and they told me what I had to change and where I had to change it to make it so that it was a linear system, which I could replicate easy, instead of a nonlinear system which I could not replicate easy.

So the contact with Grumman, Grumman is a totally different organization than Rockwell was, or North American, and as I say, they actually allowed freer communication paths with us, and we didn't go telling people out of turn that they're doing something wrong or something that—so we developed a trust. No one was going to get blamed for anything, because that's the first thing that happened when you do that, when you start violating company policies, they start blaming you. "You weren't supposed to tell them that was broken." Well. [Laughs] We figured a way to tell them it was broken without anyone finding out where we found out about it. I can see the company's viewpoint, but I was more worried about mine, because I didn't like being chastised for having bad simulators.

RUSNAK: How did something like Apollo 8, where they changed the mission within a few months of when it was going to fly, affect your ability to keep up with the—

FABER: The mission change didn't change the configuration of the vehicle very much, so that that was a procedural-type thing. They fired the thrusters at various times to change the orbit and so forth, so that it didn't give us that much—our big headache was keeping the configuration on tap. We could handle the trajectory much easier than we could handle the change of a subsystem, because physical laws don't change them. The Moon is there, the sun is there, and we had already accounted for them in our activity. I can remember listening to more than one presentation about what had to be in the trajectory computation, and it was all up here, and I had to go along when my guy said, "We need this particular terms in there to replicate it sufficiently."

So, "Put them in."

"It's going to cost you money."

"Put them in." [Laughs]

As I say, we had a very involved simulation of the trajectory, but it was there from early in the program because we knew we were going to Earth orbit and docking and the Moon, so that we had that basis there. So, changing that mission, we needed new guidance information, but that came as a package to our simulation. We didn't have to do too much creative work on that. We didn't have to do the modeling; it was done for us.

RUSNAK: One of the things we haven't talked about, or that you hadn't mentioned, was the Skylab Program.

FABER: Okay. Well, Skylab. We did have a Skylab simulator. In fact, we had several because we did it piecemeal. If you've been to Space Center Houston, you've seen the trainer they've got over there, which was a high-fidelity mockup of the Skylab. It didn't have active systems in it. We built a little simulation of the control of the solar telescope, and it would sit in a room a little bit smaller than this. And I've got an anecdote on that in a minute.

We had a simulation of the other experiment controls, how the heat, light—not experimental, I'm sorry. Living, habitability things, that was in another area. They didn't necessarily have to go together. They individually part-tasked it. We did run, quote, integrated simulations or time-line experiences, where the crews would do something in the mockup and run over and get in the simulation of the solar telescope and then run over here and get in the simulation of the—there was an experiment that looked at the ground with a high-powered telescope and track things on the ground, those type of things. But they didn't have to be closely knit together so the computers didn't have to talk to each other. So we had all these little piecemeal things. We also had a lot of time in Skylab. They had one vehicle, [only three] crew[s]. There weren't a lot of changes going on.

Now, in [Apollo-Soyuz] there were several maneuvers that they were going to do. You know, they were going to fly around the [Soyuz]. One of our astronauts got a tremendous amount of training in that task. The engineers ran the simulators, could do that task using *x* pounds of fuel. The astronaut would use about 5*x* times the fuel. He just never mastered that technique of turning slowly type of thing. He would be jerky. So we gave him more time and more time and more time. Back in those particular days, our training planning, we had squares that had to be filled, but they weren't formally filled. The instructor on a particular task would say, "He needs more," or, "He has enough," or, "He needs a refresher" type of thing. There was no performance other than the individual instructor type of thing, and the instructor on this particular mover kept say, "He needs more. He needs more."

Now, as to coming up beside the thing [Skylab] and tearing that solar sail off that was broken, no, we didn't simulate that. That was not in our book. We did simulate rendezvous and close-in stationkeeping type of thing. But we didn't simulate opening the hatch and going outside and cutting the broken structure off.

We spent a lot of time developing and conducting simulations on the solar telescope, which gave us some problems. That was an experiment. What is it going to show? So we went to the various experts, and, "What is he going to see?" Some of them weren't right. So we had some complaints back from the crews saying, "It doesn't look like the simulator." But we had made it look like the scientists in California had said it was going to look like. So that we had some problems there. We did teach them the procedures. It was just the results that came up, weren't as exact as the astronaut was expecting. We had gotten too good in our job, and he thought we could do anything. So we did have some of that problem in there.

The ground-tracking experiment, we showed them all the procedures there. They were able to do it. The little anecdote there is, we had told the contractor—we built that all in-house, and we told the contractor, our local support contractor, "Now, we're going to build this, this, this, that, and the other, and we want it in an enclosure so it can keep out the noise."

They came back, and my section chief in charge of that was a fellow named [Wayne K.] Williams, and they came into a configuration control meeting and made the presentation. They were going to build us a $40,000 hut. It was smaller than this room. It was about half as big as this room.

I said, "Will Fab is going to take that job and do it for a thousand." [Laughs] They took the hint, and they just built it out of two-by-four and sheetrock instead of this fancy metal structure they were get built somewhere and so forth, and ship down here. But that became a thing, that whenever we wanted something, Will Fab was going to take the job and build it cheaper. [Laughs]

It was not a complex program, Skylab. There were some complex experiments in it, but we didn't simulate those. The habitability aspects were very simple. We knew we had temperature problems, so they were a factor, but it wasn't that severe. The solar telescope, you know, had to be pointed just right for it to work right, and we were able to develop that particular phase of the simulation, even though our data coming back wasn't right, but the procedures were. So we had one [a Skylab simulator]. By the way, we housed that simulation, an IBM computer, IBM 360/65. At the same time, Mission Control Center was using IBM 360s-something further up the line, much bigger, but same basic structure.

We ran our simulations in real time. When an astronaut flips a switch, he wants an immediate response. He doesn't want to wait two, three seconds. We developed a team, I had two or three members of the team, control center had a couple of members of the team, IBM had six or seven, to write a whole new real-time software package that we could use in the simulator and they could use in Mission Control Center, that would be much closer to real time that they were using at the time. It worked, and everybody was happy with it.

The other thing on that particular thing, that particular computer was a gift from the Air Force. In the middle of the Gemini Program, we were chugging alone, the Air Force came up a program called Dyna-Soar [Dynamic Soaring], and they were going with this big manned flight thing. Well, it got cancelled, and I got a phone call from a senior guy in the Pentagon saying, "We've got some surplus equipment. You guys interested?" We took the 360/65. We took a few other items, and they became the basis of the Skylab simulator. We junked a lot of it, too, but there were certain portions which met our needs perfectly, of course we didn't use any of their software programs. We did all that ourselves, but the physical hardware and some of the interconnecting equipment was usable.

We put that together relatively inexpensively, which made Slayton happy. Of course, then he became an astronaut assigned to the program. [Laughs] So he was real happy then. No, I guess he went to Soyuz. He wasn't in the Skylab. Slayton was in the Apollo-Soyuz Program, yes. As I say, our simulation there was even easier to take care of, because there was very little active in it, other than what we already had.

RUSNAK: You have talked a lot about your preparation for simulations, getting the simulators together and all that. What was your actual role while the astronauts were in the simulators or they were running integrated simulators?

FABER: Well, by the time we came down here, I was more a watcher than I was active hands-on participation. Mercury, I wrote the scripts, I ran the simulations. Somewhere in my collection of photographs, I have one of me in the Mission Control Center in Florida with two different headsets on, hooked to two different circuitries, and a telephone in front of me that I could also talk on, because they weren't all integrated, and I'd be sitting at the mission director's console running the simulation. When we built the simulation system in Building 30, we had a separate room for that type of thing so that we weren't as obvious, and we definitely had much better communications.

But as I say, during those stages, I was not too much hands-on. I was, "Have you got the resources you need?" I didn't even approve the scripts because I wasn't that close to the activity. I did participate, you know, when they would come through and say, "Here is the training status for this crew," I would review what they had, and I would go with them when we presented it up to the next level above. But I wasn't very hands-on at that stage. I had enough headaches. I didn't need any more of that.

They used a modus of reporting known as—we called it the time of discrepancy report. That's when someone says, "Something isn't like I think it should be," and that was my main input, …looking at those and trying to, "Are those significant, real or… just some guy's misimpression?" …Now, it was sometimes it was the guy was wrong. Sometimes it was a significant error in our simulation, and sometimes it was something we just didn't think was necessary to simulate. Now, that was a level below what we thought was necessary when we were setting up the simulation. But that was my main activity in those days, was trying to reduce those from astronomical numbers of hundreds down to teens. I don't think we ever got down to teens. [Laughter]

It was also a source of a major argument between Gene Kranz and myself, because his people would be writing these discrepancy reports, a lot of them, and I would be trying to say, "Those go beyond what we've done. Get your guys to better analyze what they've done before they write them up," and he wouldn't do it. He'd say he's going to give his people all the freedom they had and let me worry about whether they were true or not. But, as I say, that was my prime job there. As I say, I was the guy the astronauts came to complain to or the flight control bosses came to complain to. I tried to insulate my guys from that particular thing if I could.

RUSNAK: You brought up an interesting point with regard to the Mercury simulations when you were still working with the flight controllers. I've heard some mixed stories from them on the effectiveness of these canned or taped simulations that they had to do, particularly from the remote-site people, and as someone who, I guess, was on both sides of this, I wonder how you thought about it.

FABER: Well, we did not have worldwide [voice] communications in Mercury. What we did is, we attempted to write a script so that each of the manned remote sites had something to do. Something would happen there. They were very artificial. In fact, we didn't have a malfunction system. We brought our patch cords with switches in them, so that at a particular time the guy in the back room threw that switch to simulate a loss of something or other.

Again, the main purpose was communications. "I've [(Mr. Flight Controller)] noted something. I teletyped it to the Cape." …Most of the telecommunications was teletype, [as] not every site had voice. They'd come back to me with a teletype telling me what to tell the crew. That was our main function [in those simulations]. Yes, they were pretty poor.

I think one other thing I'll say about pretty poor, I would say throughout Mercury and probably most of Gemini, I don't think we ever ran a simulation that didn't have a fault, even though we planned to. Something always happened, and our attitude was, "It's a spacecraft problem." Even though it was a simulator problem, we would say, "Treat it as a spacecraft problem. Think of what could cause that thing so in the debriefing you can tell the guy, 'This is what failed, and you missed it.'" [Laughs] That was the attitude we had. But the taped things around the world, they were very, very artificial, because, as I say, the attitude was, give each site something to talk about.

I got Kraft irritated with me one day. I'm in Australia, and we're doing a round-the-world type of thing, and of course from Australia, we were on voice link. Each station was reporting in, and they got three feet of snow everywhere in the States, and I said, "Temperature in the nineties. Sun shining. Everything's wonderful." Kraft normally was not answering that line, and he came on the line, "Knock it off, Faber." …We were the only site that was having good weather like that. [Laughs] Everybody else was having [all sorts of problems]. As I say, [the simulation plan was] just to trigger something [to cause the flight controller] to use the [available data] paths.

The aeromedical simulation was totally ridiculous. We had a heart-rate type of thing, and we could run it fast or run it slow. That was all we could do for the doctor. No, come to think of it, we had some traces that we could stick in there that showed all kinds of weird conditions, that in no way could have been a human. You know, someone's having a heart attack, they might have that kind of a trace, but the doctors instantly could recognize that that was not one of the astronaut's traces.

RUSNAK: I heard a story from one of the flight controllers that they did throw a heart attack in for one of the doctors, but he missed it because he wasn't paying attention or something.

FABER: Well, I missed that one.

RUSNAK: I think that was later on, though.

FABER: Yes, we did try that with splicing tapes in and so forth. But Mercury was very, very, very simplistic.

Now, Gemini, we didn't have to go worldwide anymore, because all the data came directly back to the control center and we didn't have to put flight controllers out around the world to quickly analyze the data and to communicate with the crew. It was a much simpler process if we get the data back here.

Back in the fifties when we were in Australia, or sixties rather, there were times of the days when we could not use the voice link to the United States. At sunset and sunrise over the Pacific, it caused effects that we were using HF [high frequency] radio, and it would get too static-y. Later in the program, by the time Cooper flew, we had a path going the other way. Originally we went from Australia to Hawaii, to Canada, to Goddard. Later in the program they had a loop that went the other way through South Africa and up to England and across, so that if the Pacific was noisy, they'd go the other way. But we threw that in a couple of time, and, of course, it was not good because we weren't flying during that time, when the early flights were not all day long. They were only several orbits long. It wasn't until Cooper flew that it was a twenty-four-hour flight. By then they had the communications both way, and by the time we flew Gemini, they were all automated, didn't have to do any of that.

RUSNAK: Well, those are about all the questions that I had for this afternoon. But I did want to ask Jennifer and Sandra if they had any for you, if you don't mind. Jennifer?

ROSS-NAZZAL: I actually don't have any.

RUSNAK: Okay. Sandra?

FABER: All right, I hope I've done what you wanted.

RUSNAK: Absolutely.

FABER: Having read several of these things way back several years ago, [Maxime A.] Faget and [Paul E.] Purser and [Joseph G. "Guy"] Thibodaux did some of these things, and they were much more politic-oriented at it. This was before there was such a thing as a Manned Spacecraft Center. These guys were working on the Mercury, what became the Mercury Program, for about a year before it actually formalized. They were more question-and-answer-type things, triggering thoughts from those guys.

RUSNAK: Yes, I've had occasion to read those interviews, too.

FABER: I learned things reading those, and I was there. [Laughs] But I didn't know they had been working on it for over a year before they started, before it became public knowledge, and I didn't know that Eisenhower made the big decision to make it a nonmilitary program.

Okay.

RUSNAK: Unless there are any final comments

FABER: Well, I'll be waiting to see what I said.

[End of interview]