

# NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

## ORAL HISTORY TRANSCRIPT

EDWARD I. FENDELL  
INTERVIEWED BY KEVIN M. RUSNAK  
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RUSNAK: Today is October 19, 2000. This interview with Ed Fendell is being conducted in the offices of the Signal Corporation in Houston, Texas, for the Johnson Space Center Oral History Project. The interviewer is Kevin Rusnak, assisted by Carol Butler and Rob Coyle.

I'd like to thank you for taking the time out to meet with us today. I always like to start out with getting some personal background on you, like what sort of interests you had in aviation and the like growing up, and the things that brought you into the space program.

FENDELL: Well, I had no interest in aviation at all. I started out in junior college studying merchandising and ended up going into the Air Force and becoming an air traffic controller because I was fixing to get hauled up by my Army Reserve unit, and I was an artillery spotter, and the Korean War was on and they were trying to kill me. So I tried to join the Coast Guard. The Coast Guard had too long a waiting list, so I ended up in the Air Force and I became an air traffic controller, and I ended up in Korea, in a place called Indochina and so on.

Later on, after getting into that business, I actually became what's known as a GCA [ground controlled approach] controller, which was a radar system where you talked aircraft down to the ground in bad weather. Through a series of things after I got out of the Air Force, I ended up being contacted by Pan American Airways, and I ended up in a place called Gander, Newfoundland [Canada], as a GCA controller with ten other people on a contract. I worked up

there for three years, came back and went to work for the Federal Aviation Agency in Jacksonville [Florida], tower and approach control.

Visiting friends of mine in Cape Canaveral [Florida] who had been up in Newfoundland with me, I got offered a job by Pan Am to come down to the Cape and take over all the aircraft operations. Then after doing that for a couple of years, I started to look to try to make some money, because I was not being paid very much.

Without boring you to death, I ended up getting a job with NASA out here as a capsule communicator [capcom]. In those days, we had a series of remote sites around the world, and for every manned mission or even for a couple of unmanned missions, we would send a team to each site. We had a basic little control center at that site, which was run by the capsule communicator like a flight director, and he was accompanied by two systems engineers who monitored the vehicle or vehicles, whether it was Gemini or Gemini and Agena, or AT[D]A [augmented target docking adapter], and two doctors who monitored the astronauts, mostly American doctors who were given to us by the Air Force and the Navy and the Army, except in Australia we had Australian Air Force doctors that were given to us and one American.

From then on, my career went on from there with NASA, etc. That's how I got into the business.

RUSNAK: Why did you get into air traffic control to begin with? Was it something you sort of fell into?

FENDELL: What happened was, when I got in basic training for the Air Force, they did a series of testing, and even though I wasn't a good student, I had a very high IQ, so I got my choice of a

series of the top schools. Air traffic control sounded interesting, so I chose that as my first choice and that's what I got.

RUSNAK: Did you find then that that was a particularly relevant background experience to have coming into NASA as a CapCom?

FENDELL: Yes. When I was hired by NASA, NASA was hiring in those days mostly young engineers right out of college. There was a series of people, naturally they were always hiring experienced engineers, but over at Flight Operations almost everybody that was being hired was being hired right out of college. If you had an engineering or physics or math degree and you showed up on the doorstep and you were graduating from whatever college, you were hired. I mean, there was massive hiring going on.

What they didn't have was many people with any operations background. They had a small nucleus of people left over from Mercury, and they were looking for some ops [operations] people. They had heard about me through some people down at the Cape when I was working aircraft ops down there and supporting missile launches and those kind of recoveries and working on a tracking ship and so on. They'd heard about me and I ended up getting a job.

RUSNAK: I'd be interested to hear a little bit about these experiences in the Air Force that you just referred to briefly.

FENDELL: When I came out of basic training, I went to air traffic control school down in Mississippi, and I went over to GCA school, which was my choice. I was in the top 10 percent, I guess, or something like that, if I remember right. I really enjoyed the work. I liked it. I got assigned up to McGuire Air Force Base [New Jersey], which at that time was a dinky little base, which now is a massive base.

Then after being there for about eight months, I got orders to an outfit called the 1st ASCS Mobile Squadron in Japan, which was an outfit that provided emergency people throughout the Far East different places that needed people or needed team leaders or provided an entire team to go down and do a certain kind of operation. Like we went in and set up an entire air field in an emergency situation and we did that part of it.

If you want to hear where I was stationed, is that what you want to hear that? I don't know if you want to hear all that.

RUSNAK: You had mentioned specifically like supporting these nose-cone recoveries.

FENDELL: With Pan Am. Yes, I was working as an Assistant Superintendent of Range Operations with Pan Am. Pan Am at that time ran the contract at Cape Canaveral for the Air Force. They ran all the operations, the safety, the police, the fire, the medical, everything. I worked over in range operations, and I was trying to get ahead, so I got involved with all that. I got into ops school. One of the things we did was we coordinated all the range instrumentation that supported the launch, the radars, the optical cameras, the tracking sources, the support, the ships, everything. I got into doing that, and we recovered nose cones, we'd track them and then we'd direct the ships and the planes and so on and do all that. That's how I got into that.

RUSNAK: At this time were you following the space race or did you have any interest in what was going on there?

FENDELL: Well, let's talk about the space race. As far as I'm concerned, I never was involved in the space race. Okay? Even when I got here with NASA, we were working all the time, working crazy hours and everything else, but I was never in any race to beat the Russians. That was going on beyond me. I was down on the worker-bee level, trying to get my job done, trying to support the launches and everything else. The whole space race thing you hear about in books and that's written up, that wasn't on my mind, you know. We were doing our thing and you were too busy to do anything else. It was like a seven-day-a-week job. It was like that kind of thing.

RUSNAK: Before you joined NASA, did you pay much attention to the events that were going on?

FENDELL: Oh yes, because I was at the Cape when Mercury was going on. Naturally, you get into that business and you're interested in what's going on. The reason I ended up going down there, I had made a conscious decision to leave the airplane business, to get into the missile business, see. That was a conscious decision at that time. So naturally I'd gotten interested and wrapped up with it, like everybody else in the country. It's not like when a Shuttle's launched today, you know, it may show up on CNN [Cable News Network]. But every time there was a launch, it was like the world was coming apart. It was completely different.

RUSNAK: When you got into NASA, it was at the beginning of the Gemini Program. Mercury had ended.

FENDELL: It was prior to Gemini beginning, yes.

RUSNAK: You'd mentioned there was still a nucleus of people with some experience from Mercury. What sort of people were there and how did they provide some experience to you coming in?

FENDELL: Well, there were people around. I'll give you some names of people that you've probably already interviewed. [Christopher C.] Kraft [Jr.] was there, naturally, and I worked for [Eugene F.] Kranz. John [S.] Llewellyn [Jr.] was there. Let's see who else you might have interviewed as part of the whole thing. Glynn [S.] Lunney was there. Jerry [C.] Bostick came out at that period of time around I did. A lot of those people that were the early flight director people that were out there, they were around. Some of the people who had done capsule communicator work in Mercury, which was a complete different job because the spacecraft was so simple, they had moved into other areas. They were all gone. Chuck [Charles R.] Lewis was there, he was one of the people around still, and so on.

But we really didn't really know too much about what we were doing. Everybody knew a little area of something and everybody kind of helped the other person learn the opposite areas. For example, I didn't know much about flight dynamics, so someone else would teach us flight dynamics and I would teach people operations or something. Not as a class, but kind of

sharing information. That's the way the whole program evolved, actually, if you go back into it. I'm sure you find this true, same way over in engineering and everything else. There was no database to really get into. It was just a little bit of data there from Mercury and that was it.

RUSNAK: Did either you or NASA have any idea what they were hiring you specifically for?

FENDELL: I was hired specifically to come into flight operations as capsule communicator. I was hired as a capsule communicator.

RUSNAK: So they had some sort of definition of that job.

FENDELL: Yes. There was a definition of the job. The job had been done some in Mercury, but the other work that you had to do with it, I wasn't aware what that was going to be. In other words, I didn't know all the things you had to do to become a capsule communicator. I thought all you had to do was take some checklist and talk and so on. It was more than that.

RUSNAK: Things like learning flight dynamics and such?

FENDELL: Well, it was things like sitting down and taking a drawing of a schematic of a spacecraft, of a system, and learning it. I had never read a schematic in my life. I wasn't an engineer. Somebody handed me a book.

I'll tell you an interesting story. You want to hear an interesting story?

RUSNAK: Sure.

FENDELL: You know what schematics are?

RUSNAK: Yes.

FENDELL: I was sitting at my desk one day and the guy that I was working for walked in and dropped this book on my desk, which is now known as the Flight Controllers Handbook. You see them around on Shuttle and so on. I opened it up and here was this drawing, an electrical drawing with buses and circuit breakers and so on. I said, "What's this for?"

He said, "That's the Gemini spacecraft."

I said, "What am I supposed to do with this?"

He said, "Well, you've got to learn this to be able to be a capsule communicator, because when they have problems, you've got to know what they're talking about."

This was just several weeks after I came to work at NASA. I said, "No, you've hired the wrong guy. I can't read this. I don't know how to do this."

He said, "Sure you can learn how to do that."

I said, "How's that?"

He said, "Well, what you do is you go downtown and you buy yourself a book on basic electronics. Then you take the pages in the front of the book that show all the symbols, this is what a circuit breaker is, this is what a bus is, and so on. Then you get yourself a box of crayons. Then you take all these pages that have all these symbols and you make a Xerox copy



of it and you get a piece of cardboard and you stick it on the cardboard and you make this thing around your desk, right around your desk."

He said, "Then you sit down after work and you pull out this drawing and you start. You come to the first symbol and you say, 'Gee, what's that?' You look up and you say, 'That's a bus.' So you say, 'Well, I'll color my buses yellow.' So you go to the drawing and you color it yellow. Then you go over to your basic electronics book and you look up in the book and you say, 'A bus.' And you find a bus in there and it explains to you what a bus does. Now you know that. Now you take your crayon, you start working along and you come to another symbol and says, 'What's that?' So you go over to your thing, says, 'That's a circuit breaker.' So then you go back to your basic electronics book and it says what a circuit breaker does. You say, 'Okay,' and you color it on."

Well, after a while, naturally, you don't need the thing anymore. Right? Well, that's how I learned how to read schematics. And if you're looking for the guy's name that told me that, his name is [Manfred H.] Dutch von Ehrenfried. He was an ex-physics teacher.

RUSNAK: Well, we're hoping to sit down and talk with him, so maybe we'll ask him about that.

FENDELL: He's a good guy. He's in Tampa [Florida]. That's how I learned.

RUSNAK: Well, it seems to be as practical a way as any.

FENDELL: Well, I wasn't an engineer. I wasn't an engineer.

RUSNAK: Did you find yourself then sort of atypical, since, as you mentioned, they were hiring a lot of these people?

FENDELL: No, I think in those days, I think there was only three or four of us at JSC doing technical work that weren't engineers. I was an electronics technician of some kind of a title. I was hired as a GS-10 or something like that. It was only a few of us who later became an engineer by an act of Congress.

RUSNAK: That's an interesting way to go about it, I guess.

FENDELL: Can you read a schematic?

RUSNAK: Can I?

FENDELL: Yes.

RUSNAK: I did that in some engineering as an undergrad.

FENDELL: You can understand that, then. I didn't know how to do that.

RUSNAK: I can appreciate it. So aside from learning how to read schematics and coloring on them with crayons and such, what other types of training did you have to do?

FENDELL: There at JSC?

RUSNAK: Right.

FENDELL: There was hardly any training available. There wasn't any training. You didn't go to classes and you didn't take this JSC indoctrination course that's given over there for flight operations. There was no such thing. The only training that really went on was the simulation training, which was very similar to what goes on right now, but you didn't sit in classes with workbooks and so on, because there basically was no such thing in flight ops in those days. You learned from everybody else, you know. Someone else, like I said, knew flight dynamics, orbital mechanics, and you learned it from them. I was going to do the retrofire and I had to have a good working knowledge on how it all worked and what I was doing.

Then we worked as teams, you know, like your remote site team, you knew who that was ahead of time, and a lot of times you stayed with the same people, not completely, but your team had certain people and we used to work together. We'd sit down at night and go over a system, spend two, three hours just going over the environmental system, your systems guys and yourself, and they would teach you all the work and all the data that went behind that system, and how that system worked. You talked and you'd ask questions. "What can we expect to see? What are we going to do?" We'd go to the flight rules and work the flight rules along with it and the checklist procedures all together, and that's how we trained each other within the team.

RUSNAK: So in terms of the systems guys, they each then specialized in a particular area of the spacecraft?

FENDELL: Well, they all came from a particular area of the spacecraft, but when they were assigned to a remote site, they worked the whole spacecraft. In other words, just like now there's an environmental area, and they came out of that, except there weren't so many areas because the vehicle was a lot smaller, you know. The Gemini spacecraft didn't have the complexity of Apollo or the Shuttle or whatever.

RUSNAK: Was their job to support you?

FENDELL: Their job was to support the system. The capsule communicator was the boss on the site. He even took over for the guy who ran the site. He was the ultimate god at the tracking station when he arrived. So they worked for you, and all the support people worked directly for you, the communications people, the telemetry people, the command people and all. They worked directly for you. You ran voice checks with them and tests that we'd write, that we'd run and practice so that everybody would learn to talk to each other. We'd sequence through the positions and so on. We'd write books like the Flight Controllers Ops Handbook for Remote Sites. I happen to have one if you ever want to see one. And so on. We'd call them confidence tests and things like that. That's the way we did it.

RUSNAK: What did you think about being assigned to these remote sites, some of which were pretty remote?

FENDELL: It was wonderful. It was the best job I ever had at NASA. It was a wonderful job. It was a great job. You would be gone like six weeks at a time. You would work really long hours, you know. When you get out there, you ran all these tests, some of them in conjunction with Houston, and because the communications were so bad in those days, sometimes you'd go to run like a command verification test and it would take you like sixteen hours to run it, you know, there would be so much noise in your head and static and so on. You'd work a lot of hours, and a lot of strange hours, because if you were in Australia when they were running a simulation in Houston, you ran it on Houston time, so you were out there the next day in the middle of the night, like when you watched the Olympics just now, the time differences and so on, except it was live. It wasn't played back on prime time.

So it was great. But the job was great. It was a lot of fun, and we used to party a lot. We always stopped somewhere—most of us used to stop somewhere for a week on the way home. Like if you want to Carnarvon [Australia], which was out in the bush, you'd stop in Sydney for five or six days on the way home and party. Then you'd come back and you'd go to work. If you were on a ship, wherever you happened to dock, you know, you'd come in and you'd take some time and do that. A lot of the married guys would run on home, but the single guys, we'd kind of go do our thing. It was wonderful. It was really a neat job. Got to go to a lot of great places and meet a lot of people, a lot of interesting people. Besides the sites were pretty shitty.

RUSNAK: I'd be interested to hear about the atmosphere at some of these sites, specifically the ones that you worked at.

FENDELL: Well, Carnarvon was a tracking station in Australia. During Mercury, there was a tracking station at a place called Muchea, which was just north of Perth. When Gemini came along, they changed trajectory, the longitude and latitude, so they needed a station further north. So they closed Muchea and moved to a place called Carnarvon. Carnarvon was—is; I shouldn't say was—is 600 miles due north of Perth. I don't know exactly what's there now, but between Carnarvon and Perth was one town, which was 300 miles away, halfway, called Geraldton. So you usually flew up there, flew back. Hardly anybody ever drove because the road was dirt. And you flew up in a DC-3, a C-47, which was an airline called MMA, Mickey Mouse Airline, we used to call it.

When you got to Carnarvon, Carnarvon was kind of like if you watch the “Late, Late Show” on TV in the old days, the “Late, Late Show,” and Hopalong Cassidy would right into town. Well, when Hoppy rode into town, if you threw four or five cars on the street, you had Carnarvon. And the main thing to do in Carnarvon was drink beer. And there was a lot of guys who were running ranches out in the middle of nowhere, huge sheep stations that hadn't much grass, and they'd be out there for like three or four months at a time, they'd be out there along with the dogs, they'd been hired to run these places. They'd come in and they'd drink beer. And people from the tracking station.

A hotel was not like anything that you could imagine in your mind. It was completely different. When it was time to eat, you ate where you lived, and you ate during that period of time or you didn't eat at all, because there was nowhere else to eat. There was no Wendy's or McDonald's or anything; you ate there.

The big thing there was drinking Swan Lager beer. That was the big thing. There were a few women worked there, lived there. You could go out at night and shoot kangaroos, which I don't do. And that was it. You worked and drank beer.

RUSNAK: Certainly sounds like a colorful place to spend a tour.

FENDELL: Yep. That was Carnarvon. Guaymas [Mexico] was another station, which is now closed, which is located down on, oh, about 600 miles south of Phoenix. There wasn't much there then. Now it's a big fishing resort place. It was kind of grim. Food was very bad. Had the typical Mexican problems when you ate the food, and having it for six weeks was a long time. [Laughter]

I was in a massive head-to-head car accident with a giant tanker truck pulling another tanker. The car was totaled. We were on our way to a site in the middle of a mission. I was driving. We went head to head on a bridge. We all came out okay. That was another place we went to.

Where else did I go? I sailed on the *Rose Knot Victor* a couple of times, which was one of the tracking ships. That was interesting. You'd get out at sea and just sit there and wallow. It was nothing like going on a cruise ship of today, if you've been on a cruise ship. But it was a lot of fun. The seamen were very interesting. They were kind of the bottom of the earth.

One of the things that happened, I'll give you an interesting story on the *Rose Knot*. We were sitting out off of San Juan [Puerto Rico], about 600 miles north of San Juan, and we were just wallowing there. We were on position. If the mission would slip, you'd just sit there. And we had gone down to watch a movie in the hold, which was a little bit bigger than this room.

We got a call. There was an accident. My doctor and I went running up. The seamen used to fish for sharks off the side, and they'd use old hunks of chicken with these huge hooks. When they'd get one on the line, what they'd do, they'd take a big rope hawser, make a sling around it, drop it down over the line, lasso the guy and pull him up, because you couldn't pull him up on the line.

What had happened was, somebody had gotten one on a line, they were hauling him up, and another guy got one on another line and he decided not to wait, so he tried to haul it up with this line. While he was doing that, the hook straightened out and came flying out, and this guy was walking by and it went right through his nose and out the other side. This guy was standing there when we got up there, with this big hook, maybe about, I guess, a sixteenth of an inch wide, right through here and out the other side.

So the doc said, "We need to cut the barb off." So this guy got a pair of bolt cutters, and here he was trying to bite this thing off. He wasn't very strong, and the guy's whole head is going— [demonstrates]. So finally this huge boatswain came over and he grabbed the bolt cutters and cut the thing off. The doctor pulled it out, took him and stitched it up, and half an hour later he was down in the mess drinking coffee.

RUSNAK: That's something the guys in the Mission Control Center would not have experienced.

FENDELL: They had no idea what was going on. It was interesting.

RUSNAK: Obviously you got around to several of the sites. How did the rotation process work?



FENDELL: You had no choice on that. That was kind of decided by Kranz. He would decide who was going where, for which mission functions. Every mission had different function things. He just would decide where you're going for that mission. If you got hauled back in the control center, that was because of whether they wanted to rotate you in there or whether you were being—we used to call it being punished, but I didn't have that happen to me till very late.

Where else was I? I was at Hawaii a couple of times, which was really nice. We used to stay at a place called the Kauai Surf, which was a very nice hotel. We'd stay there. The tracking station was up on top of the hill, and we used to race down the mountain.

I was at Canary Islands also. We used to race back and forth from there. That was down at the other end of the island.

Where else was I? I don't think I left anything out.

RUSNAK: The Gemini Program began with the network simulations before they actually went into missions.

FENDELL: Right.

RUSNAK: Could you take us through these very beginnings of the program?

FENDELL: Well, what happened first is, Gemini I was a straight launch with a dummy vehicle on top. Gemini II was a suborbital launch that went down range. There were two ships that supported it, the *Rose Knot* and the *Coastal Sentry* [*Quebec*, CSQ]. We had full teams on each ship, and I was on the *Rose Knot* and Chuck Lewis, I remember, was out on the CSQ. I was

sitting—oh, I can't exactly remember where, I think about 400 miles from San Juan [Puerto Rico], and the ship only did about 8 or 9 knots, you know. Chuck was sitting further southeast of me another probably 500 miles. What we were to do was to just monitor the vehicle as it went by and so on.

When the vehicle counted down to be launched, I don't know whether you've ever heard this or not, but as they came down to the terminal count, they used to say things like "recorders to flight speed," was all part of the count to get the systems working at the Cape control center. It wasn't at JSC in those days. We lived out here and worked here, but they were building the new control center. They had never simulated all that, and what happened was, as they came right down to the terminal and they decided to do that, that additional power load kicked everybody off the bus and they went black. The vehicle counted down and they launched.

I was the first one to see the vehicle, so I was sitting there reading out what I was seeing, what events were going off, the different parameters that we needed to know, and so on. In the meantime, they came back on line, but I didn't know that, so I just kept going. Then Chuck Lewis took over and he finished up what I was doing.

Gemini III was a regular launch into orbit and we went around several times. I had the retrofire on the *Rose Knot* between—I was stationed out between Los Angeles and Hawaii.

Every mission did something else. You want to go through the whole program?

RUSNAK: Sure.

FENDELL: Gemini IV, I was at Carnarvon. It was the first EVA [extravehicular activity], which was done in secret, the training for that. There were three capcoms who were involved in the

planning process: myself, a fellow by the name of Bill [William D.] Garvin, and another fellow by the name of Stu [Ambers S.] Davis. Bill was at Hawaii and Stu was at Guaymas.

Our teams did not know the planning of this was going on; it was all done in secret. I carried with me in one of my suitcases a sealed envelope which was about that thick, which was what we called Plan X flight plans that we had written in preparation for all this, and working with the guys who developed the two systems, the gun and the backpack. I think it was Norm [R. Norman] Prince and—I forgot the other guy's name. I can't remember his name. They worked over in engineering.

The only other person on my team who knew about it was Dave [David R.] Scott, the astronaut, who came along as an observer. We had a similar thing in Hawaii. I think Walt [R. Walter] Cunningham was there with Bill, and Bill [William A.] Anders, I believe, was at Guaymas with Stu Davis. The doctors didn't even know what was going on, and they got very furious about it when the whole thing came out that we were going to do it. Then I opened up and showed them I had the flight plans, and we sat down and we went through things and so on, got ready what we were going to do. Our job was to give them a go to open up the door and get out the hatch. Garvin had the major role, which was up over Hawaii, monitoring the systems and so on, and then we went on down and up over Guaymas to finish it up and tell them to get back in, which is what Davis did, basically.

On V, I was in Guaymas and we had problems at launch with the fuel cell.

Let's see. On VI, we tried to launch. I was at Carnarvon or I was in Hawaii. We tried to launch and the first vehicle went up and the Agena died, if I remember right.

Then we rescheduled a thing called 76, where we launched two vehicles, basically, and the first rendezvous was done over the top of me in Hawaii. I was the first one to see the rendezvous done.

Then we went on, 76. Then I went to Carnarvon and we had the ATA. The alligator—the jaws didn't open.

Where was I on IX? I can't even remember. This old age is killing me.

Anyways, somewhere around there I got sent to Apollo school on the way back and brought back into the control center with my feet kicking and screaming and hollering.

Then I went back out again on Apollo 501, went to Canberra [Australia] and to Carnarvon.

RUSNAK: I wanted to ask you a couple of specifics about some of the Gemini missions. For the 76 flight, Gene Kranz tells the story about you faking a heart attack during that. So I was curious to hear your version of those events.

FENDELL: All right, I'll tell you about that. Let me see. Well, let's start this way. We had brought on board a few Air Force people to start training in manned space flight. There was a program plan called MOL, Manned Orbital Lab, that the Air Force was going to fly, which was basically a version of the Gemini vehicle. They were building a control center at Sunnyvale [California]. They had picked some what they called astronaut candidates. They were forming teams. They were building a control center. They were doing documentation. So they brought in a series of people to train with us.

One of the gentlemen's name was a fellow by the name of Bill [William F.] Bucholz. It worked out that Bucholz had gone to college with Kranz. That was just a coincidence. They had gone to Parks College in St. Louis together. Bill was kind of a big, tall guy. He had feet about size 18, and he had a big mass of kids that he used to drive around. What he did is, he went out and bought an old hearse that he had changed over so he could carry all of his kids and family and everything, and used to drive this thing. And he was a pretty smart guy and he was an interesting guy, but he had this Air Force mentality that you did everything with a checklist.

He was a pilot, okay, and he ended up, when it was all over, over in Vietnam flying. So everything was done with a checklist, you know a checklist type of operation. So we were having trouble with him, getting him to learn to sit down and get deep into the systems and really get with the job, and it wasn't because he was lazy, it was just that that's the way he was brought up and trained in the service.

So when we went out to Hawaii for the mission, each team carried with them a simulator guy out of the simulation part of JSC. The guy with me was a guy by the name of John [W.] Collins, who worked for—in those days he was a Philco tech rep. John came up with this idea that maybe in the middle of a simulation that I would kind of pass out and make him take over. At the same time we had a doctor who was past retirement age, he was a Navy captain, and he was very old. I mean, he was really past age. He was a nice guy and everything. And my doctor, I had traveled with him before, was an Air Force guy who was very aggressive and, you know, ready to go, young guy.

So John came up with this idea that maybe in the middle of a pass I would fake this heart attack and the only one that would know about it would be the young doctor, Dr. [James R.] Wamsley, and we'd see how they react, you know, just to kind of test the thing. Well, they

had worked it out with Carl [B.] Shelley back in Houston, who John worked for. Well, Carl had failed to tell Kraft that this was going on.

So they decided, and John got us aside, said, "We're going to do this tomorrow and at the following time what I want you to do is to, in the middle of this third pass (or whatever it was), to grab your heart, make this big noise, and fall out of the chair." We had these big chairs. And Wamsley was ready to go. He was going to tell the doc to take care of me, and he would watch the vehicle.

So we came along, and all of a sudden in the middle of the pass I rose up out of the chair and grabbed my chest, and I passed out on the floor and started holding my breath. This was right in the middle of the pass. You have to understand, nobody else had contact, you know. You had like a ten-minute pass or eight-minute pass, whatever it was. So JSC was sitting back there just listening to the voice and getting a low speed teletype message out of you. You were following through with what you were supposed to do.

I went down, and Wamsley said to this other doc, I can't remember his name right now, sent him over to take care of me, and he was going to watch the vehicle. Bucholz jumped up to take over the job as capcom. With that, he stepped right on top of me with those 18-size feet, grabbed a hold of the mike, and instead of saying, "Gemini VI, this is Hawaii," he said, "Gemini VII, this is Gemini VI," because he got all flustered.

At that time the system guy jumped on the land line to Houston, which is something they didn't usually do, and says, "I think Fendell's had a heart attack."

The doctor leaned over to me. I'm holding my breath. He said, "I think he's dead," you know. So this whole series of events started going on and so on.

Well, after the pass was over, naturally it all stopped, but they let this thing continue on through Houston as though they had sent the message, "He's been taken to a hospital down there," because they wanted Bucholz to run the rest of the day.

Shelley never told Kraft. Kraft thinks I'm down in the hospital, I'm either dead or they're trying to revive me for the rest of the day. Then finally they get this message through that I'm alive and okay. Then Kraft found out what had happened and he really went berserk. But it worked real well and got him to do his job, and that's how it all came about. And it's been repeated around Manned Space Flight and different places. I work out in Sunnyvale—I used to, anyways—and they've even done it out there and so on. But the doctor said I was dead. That was good. I just nearly burst open then when he said I was dead. I'm laying there holding my breath, you know.

RUSNAK: That's an impromptu thing that becomes part of the training regiment, huh?

FENDELL: Yes. But it did its job; it got him working.

RUSNAK: I think that's a good example of how you guys were kind of learning these things as you go. What other types of experiences were you having through these missions that were really developing?

FENDELL: Well, let me explain something to you. The first thing to understand is, young people today are twice as smart as we were, so anybody that thinks because we went to the Moon we were smart and all, that's not true. These kids today, they're way beyond where we are, were,

and they have tools to work with. You know, sitting over here is a computer. I mean, you know, that thing was like the control center, got the capacity of the control center. And the young people today know how to do things with computers and so on that's way beyond what we did. So people shouldn't think that we were smart and they're dumb, because that's not what it is at all. It was just that we were there when there was an opportunity and there was a lot of money and there was a goal established by the President and so on that we were going to do something.

The big difference as I've been working right up to the last year, both here and with the Air Force for the last fifteen years on an unmanned vehicle program, is there was a complete different attitude. The way I like to explain it was, or is, that there was nothing you couldn't do. Everything that was attempted or was talked about or any job you took, you had this "can do" attitude. You didn't ever say, "I can't do that," because if you did, you disappeared. In other words, you just made it happen somehow or you found out or you worked it or you worked around it or something. Like you go to a meeting today, someone will say, "Well, we can't do that," and you spend half your time trying to convince that person that maybe you can do that. That never happened. If you did that a couple of times, you disappeared.

So you saved a lot of time. There wasn't a lot of arguing about what you couldn't do. It was finding a way to do it. Whether you knew it or not, someone would find a way or you could find someone who could find a way. And that's really what made everything work. It was a different attitude.

The work ethic was very different. In other words, if you had a job, you may work till nine o'clock at night doing the job. We worked every Saturday. You know, you just got up on Saturday. Every Saturday we did flight rules. I went to work every Saturday and did flight



rules. You just went to work. You didn't know whether you were being paid overtime or not. I don't even know to today whether I was or not, because I never sat and looked at my check or my check stub. I've talked about this with other people. We don't even know. You just went to work. It was more than—and I'm sure this was not only true not only in flight ops, it was everywhere, you know. It was more than a job; it was a life. It was the way you lived.

When I look back at it, I don't even know how the married guys' families existed. I really don't. I was single and I was going here and I was running there and I'd be gone for six weeks. I don't know how the married guys, now when I think about it, how they even existed. And, you know, in engineering, I'm sure these guys were sitting over there working on Saturdays and Sundays, same way. I don't know how the families existed.

But it was a different way of life. It's not that there's anything wrong with what JSC does now. It was just different. And you were just very lucky to be involved in it, that's all. So when you try to explain what it was like, you can't compare it with the two and you can't sit and put down what they do now, because that's not fair, because you've got a tremendous amount of great people over there, smart people. It's just a different atmosphere, very different. And you didn't make the atmosphere; the atmosphere was there. I don't know whether that gives you any kind of an explanation of what you're interested in or not, but that's the way I look at it. It was very different.

RUSNAK: Do you think there's any way to try and reproduce something like that, or would it even be worthwhile to?

FENDELL: I don't know. I'm probably not smart enough. NASA has become an agency, you know, and it's very hard to go into that mode. Maybe if they were going to Mars and there was a real big crash, but I don't think so. I don't think you can recreate it. I don't think so. I don't think it's possible.

RUSNAK: I suppose then you had the added advantage of having a specific goal and a specific deadline to work for.

FENDELL: You had a deadline to work for. Very few of us were trying to beat the Russians. I don't know how many tell you they were, but they weren't. [Laughter] The bosses were, but we weren't. We were trying to beat the deadlines, the flight schedule, and getting things to work, build the consoles, get the requirements, build the documentation, do the simulations and the training, work with the crew. That's what you were doing. You weren't trying to beat the Russians; you were trying to make the schedule work. You were trying to equal the schedule, is what you were doing.

The schedule was tough. It was very tough. Because when you came back from a remote site, you went into simulations for the next mission or you were almost already starting at the back, you know. You were going again. There wasn't much of a turnaround, and some of these places took four or five days to get there. It was a little different.

RUSNAK: That actually answers one of my other questions about what happens in between the missions, but if you had—

FENDELL: Between the mission you had to redo your documentation, the checklist, your flight plan those people were working. You had to work with that. You had to learn that. Chances are you were going to have different team members with you.

The thing you have to remember, the real difference in the operations was the communications. Let me give you an example of the way I like to explain it. Let's say you were on one of the ships. Well, you were on this HF [high frequency] communications system. You might be looking at the other ship and you couldn't talk to it. Okay? I mean, there would be so much noise and static, or you just couldn't even talk. You couldn't establish a voice link or a teletype link. Now I sit home and I've got this little dish sitting up there and I've got 700, 800 channels of video coming into my house, you know. I mean, I sit there with the clicker, you know, and I'm going. I've got Channel 742, 960, you know, and I've got all these channels. Well, we couldn't even talk to each other. So it was really difficult.

The way you were able to talk, the real secret that I found out in being able to talk was knowing the subject. I'll give you a little exercise you can try. Pick up the phone with your friend over here and get him to put a lot of noise on the line. In other words, get him on the line, too, and just let him put in a lot of noise on there, static, you know, [demonstrates]. Let her start talking to you on a subject and let her talk to you during that noise on a subject that you know nothing about, and let her talk to you about a subject you know what she's talking about, and I will guarantee you on the subject you know what she's talking about, you will figure out what she's saying through the noise. But on the subject you don't know what she's talking about, you won't hear anything. So the secret was really knowing what was going on, what the system was, what the problem was, what you were doing, so that you could figure it out through the noise.

That noise was incredible. You could take your headset off and it was still there. It would run loose in your head. So it was very different. It's hard to picture now. You sit there and they're talking through TDRS [Tracking and Data Relay Satellite] continually to the Shuttle and it's clear as a bell and everything else except down at the end. It was very different.

RUSNAK: After a while, you mentioned that you were pulled off of Gemini to go to Apollo school, you called it. What was that?

FENDELL: Well, my illustrious leader, Mr. Kranz, decided that we were going to get ready to fly Apollo, so I guess it was the end of IX or VIII, I can't remember what it was, I got this message to leave Hawaii, and the next morning to be at [North American] Rockwell Downey [California] to go to Apollo System School for a week, and the class started at six o'clock in the morning.

So all these capcoms came gathering in straight into L.A., guys flying in from Australia, Canary Islands, and everything, and we ended up at this motel, and at six o'clock in the morning we started classes and we started learning the Apollo spacecraft, these classes by these Rockwell instructors. The classes went on twelve hours a day.

Well, nobody could stay awake. So we'd have people falling asleep in the chairs. I used to walk back and forth across the back of the room to stay awake. I'd walk several miles a day, just trying to stay awake, going across the room, because if I sat down, I'd fall asleep. And we'd party at night, you know, because that's the way we lived. We partied.

That's how we supposedly learned the Apollo spacecraft, initially learned the spacecraft. It was the first class. I was in the first class, and I think there was, I guess, about fifteen of us. Then later on they had subsequent classes, but they cut down on the hours and changed things.

But that's how we started, really started into Apollo, with the vehicle, and I got moved into the control center.

RUSNAK: It's a little bit more formalized training than dropping a book of schematics on your desk.

FENDELL: Yes. We now were into the real world of training.

RUSNAK: So going into the control center then, did you see that as punishment, as you mentioned before?

FENDELL: Well, I wanted to fly the rest of Gemini out at the sites because I loved the job, and I didn't want to go into the control center, and then I didn't want to go into the job I was going into, and I didn't want to do that job, which I ended up doing for several years and I didn't like it. I was an assistant flight director. What you really were was an assistant to the flight director. You were like a technical assistant to the flight director. Some of the flight directors wanted you and some of the flight directors didn't want you, and you didn't have a direct in-line position. In other words, you were chasing this and doing this. So some people, you'd get in someone else's way. You weren't a direct line item, and I didn't like the job. I did that for several years. Although I did get to go out on Apollo 501, went down to Canberra to try to get them checked out on their first mission, and then went with a team on to Carnarvon for controlling the burn on the vehicle back in. Then I stayed there.

RUSNAK: What about the changes to the tracking on the remote sites for Apollo, where now you've got something like the Deep Space Network?

FENDELL: What happened was, Goddard [Space Flight Center, Greenbelt, Maryland] came up with a new design for new consoles to be able to handle the Apollo vehicle, and it was the first attempt by anybody to build a control center on a computer-based system. It wasn't like the Gemini consoles were direct wire lines, patched to either an event light or to a meter. We used to look at things that came in on meters.

We had a series of meters on the console, and it would read in the voltage. What would happen is, we'd get the direct reading from the Cape and the data would come out in percent full scale, and the system guys would take a Gerber scale and change that over into engineering units, make a meter scale on that, and they would slide that down to the meter so it would be in engineering units for that parameter. For example, if the parameter was set per square inch, it was reading in psi. You weren't reading 80 percent or 20 percent and then had to convert it over to say, okay, 20 percent is equal to 1200 psi.

So here we were now, and they were trying to build a system that showed up on a CRT [cathode ray tube] and it was a new command system and everything, and it didn't work very well. They were trying to invent the wheel in those days, and nowadays you can go out and just buy a system. But the system was late, was going on. We'd worked with it and worked with it and so on. We never really did use it. It was never really used. We used it in a simulation before the program began, and some of the sites worked, some of the sites didn't work. The one I was on didn't work hardly at all till the very end. It was difficult.

So there was only a few people left—see, we were going to have remote sites to start with, and then after the fire pushed everything back, by then they had gotten the computers up in Houston, the data links were now working better, and they decided to go over and run directly out of Houston. But the delay is what did that.

I was scheduled to sail on Apollo 1 at that time, it was called, on the *Vanguard*, and I was scheduled to sail like, I think, four days after the fire because it was a thirty-day trip. I was going down off of Christmas Island. We had to go through the [Panama] canal and so on. But naturally we never sailed and the ship never went down there.

RUSNAK: Besides adding this extra time that they were able to bring these computers up, were there other changes in mission operations?

FENDELL: Well, a lot of things changed because now the control center had data coming in from the sites, real telemetry data. It wasn't this low-speed teletype message that said this is what it read when I hit the button. They had direct communication to the spacecraft when it was over that site. TDRS wasn't there yet, but when it was over that site. And they could send commands over that site, get telemetry and talk to the crew and so on, so the whole operation changed. The astronaut in Houston, he was the capcom, so he pretty well did the job, except on a couple of the unmanned flights and so on. We had a series of unmanned flights with Apollo.

RUSNAK: What effect did the fire have on the way you guys operated in terms of mission operations, procedures, or anything like that?

FENDELL: Well, the fire stopped everything. It stopped the rush, because we couldn't proceed the way we were going. While the investigation was going on and the redesign and the rebuild, a whole new attitude was taken on the reviewing of what you were doing, the documentation, the philosophy behind the flight rules, things like that. The very same thing happened after *Challenger*. So it changed a lot of things on your mental being and how your documentation was written, the philosophies behind it, and how you were going to do things and what you were going to do in certain cases. But it took a lot of time to go back and do that; it just didn't happen in one day. It took a long time.

RUSNAK: You've mentioned a couple of times moving in the assistant flight director position. I guess Apollo 7, being the first manned mission, was the first you served in that capacity.

FENDELL: Right.

RUSNAK: With this first operational experience as an assistant flight director, what did the job then involve for you?

FENDELL: Well, in the planning thing I was doing the flight rules and a lot of the checklist stuff and so on, and the flight ops panels and so on, and then during the mission I basically chased problems, followed the checklist, made sure the flight director was kept up to date on what was going on on my shift. I worked the shift. And you were kind of like a technical assistant to the flight director, you know, when he need something done or you could find something you wanted to do or needed to be done, you went off and did it on your own. Just chasing different



problems, making sure things happened that should happen on time, those kinds of things. That's what I did. I did that for several missions.

RUSNAK: Did they move you into that position, I guess, as a steppingstone to something else?

FENDELL: Well, Kranz thought it was a steppingstone up. Okay? I didn't quite feel the same way, but that's what he thought. And Kranz was the ultimate personnel guy. He never makes a mistake. That's sarcasm.

RUSNAK: We'll be sure to note that.

FENDELL: His wife agrees with me. [Laughter] So do his kids. If you'd ever worked for him, you'd know what I was talking about.

RUSNAK: We have, I guess, only you guys to tell us about these kinds of things.

FENDELL: Right.

RUSNAK: Do you remember anything else from that mission specifically?

FENDELL: Seven?

RUSNAK: I know there were some issues between the crew and flight control.

FENDELL: Yes, if you want to get into that. I was working with Glynn Lunney, and Glynn was the lead flight director. As you've probably been told by other people about the problem that went on with the ground and Wally [Walter M.] Schirra [Jr.], later on it kind of got over into the other two astronauts on board also. It kind of—I guess what the biggest part of it was, was it violated our culture.

In other words, one of the things at JSC that even today is, there's a culture over there in flight operations, you know. A guy is a flight director and how he got there or why he's there or why he was the one picked, it doesn't make any difference; he's the flight director. And if you've ever worked over there or you've been over there a lot—I'm sure you have—you'll find out that the flight director is like God. The way the hierarchy works over there, he's treated like God in the pre-mission planning and everything else, you know. He's got all kinds of people working for him, but nobody works for him. In other words, he doesn't write any job descriptions or personnel evaluations or worry about some guy having a problem at home. He's not a manager of people, but everybody reacts to him when he says something. In other words, "I want this," and it happens. So it's a culture that's been established since back in the beginning by the people that started all this, and it still carries on today. If you go over there today, it's that culture, with the flight director being boss and the commander being boss of the space vehicle.

Well, by the time we flew, after everything that had happened during the fire and everything, things had gotten kind of—I don't know what the exact word is—cantankerous with Schirra, and there was a lot of arguments that went on, on how the flight rules and the philosophy and different things, etc., went on. Well, when we lifted off, it got worse. On top of

that, I think Wally had a cold and we didn't know it. And Wally's a good guy, don't misunderstand me. He's a friend of mine.

The exchanges started to pick up, and then when things went wrong, it got worse. Every time something went wrong, it got to the point of, "No, I'm not going to do this and I am going to do that." And the flight directors were having a really bad time because they were trying to run this operation and they kept running into this brick wall. So it got kind of bad. Glynn had a very tough time. He got into a thing with Wally and the rest of the crew. I calmed him down one time, I got him aside and said, "Look. Don't do something you're going to be sorry about later on," you know, because we all have a different level on when we break. Some of us break quick and some of us, you know, are very cool and they just move on. You can make a mistake in life and ruin your whole career in two seconds, you know. So I tried to calm him down and all that, and I got him calmed down a couple of times, but it was kind of nasty.

But the mission went on and we got the job accomplished and so on, but it did hurt several people's careers, you know. That crew never flew again. Not one of those crewmen ever flew again. Wally was retiring, but Cunningham never flew again and [Donn F.] Eisele never flew again. They would never probably have flown again either. My guess. That's just my guess.

RUSNAK: I think Chris Kraft said something to that effect after the mission.

FENDELL: Yes.

RUSNAK: Coming off that mission you have Apollo 8, which was—

FENDELL: I didn't work Apollo 8.

RUSNAK: What did you think about sending the second Apollo mission all the way around the Moon?

FENDELL: I thought it was very exciting. I thought it was really quite a challenge. We had looked at something else that you're probably not aware of. We had looked at possibly sending a Gemini spacecraft around the Moon at one time, with a highly classified mapping module, camera system, an Air Force tracking system on it. That had been looked at by several of us who were brought in to take a look at that, and that was tossed out. So the idea wasn't a new one, but it was whoever brought it up brought up a novel idea and it worked great. The guys that worked it did a great job. The crew did a great job. [Frank] Borman and his guys were great, you know. The crew that worked it on the ground did a tremendous job, Harold [M.] Draughan, the flight director, and a lot of those guys, and [Clifford E.] Charlesworth. Those guys did a great job, they really did, and it worked fine. It was quite a gamble. It was quite a gamble, and it really caught the attention of the world, boy, it really grabbed them.

RUSNAK: A lot of people we talk to recall that as really one of the highlights of their career.

FENDELL: Sure was. Like I said, I didn't work that mission. I was working 9, so I didn't work that mission.

RUSNAK: Nine obviously had a lot of technical challenges. We're here using the lunar module for the first time and in lunar orbit and all this.

FENDELL: Eight?

RUSNAK: Nine.

FENDELL: Yes. Nine was interesting, yes. Nine was interesting, 10 was interesting. Yes, 10 was the change in my career, as a result of 10. Ten was the first time we separated the lunar module from the command module. I was working with Kranz as assistant flight director, and to give a go to separate the two vehicles, you had to have voice communication between the two crews, and they couldn't talk to each other. They couldn't establish communications at all.

At that time, the communications systems themselves, the way they were allocated on the ground, there was an environmental console and so on, they were spread vehicle-wise. In other words, the guy that was called TELMU [Telemetry, Electrical, and EVA Systems Engineer], who had the electrical and the mechanical and the LM side, he had the LM communications. The EECOM [Electrical, Environmental, and Communications Engineer] on the command module side had the command module communications. And later on there was another area called the experiment systems guys, and they had the communications that were going to go on the Moon, the high-gain antenna and so on.

Well, what happened was, when we went to separate, we couldn't talk to each other, and they worked on it and worked on it for I don't remember how long it was. I'd have to get somebody's log up. I think it was a couple of hours. Finally, they figured out that they were out

of configuration switch-wise. They were not in proper configuration, and because there were so many people involved, it ended up to be a snafu.

When the mission ended, Kranz said to me, "We're going to take the communications out of all the different areas and we're going to form a communications area, a communications section."

I said, "Yes, that sounds like a good idea," because you have to talk to each other and so on.

And the next thing I know, he called me in one day and he said, "And you are going to run the section."

And I said to him, "Well, that's not my area of expertise."

He says, "Well, it is now."

And with that, he gave me three people who had worked communications, two LM guys, one fellow by the name of J.O. Sayler, another fellow by the name of Hal [L.] Moore, one being a Grumman guy and one being a Philco guy or whatever company they were now. They'd changed names several times. So it was J.O. Sayler and Hal Moore. They had been working LM communications. And they gave me the Rockwell communications guy who had been working CSM communications, command module, by the name of Tom [Thomas L.] Hanchett. And everybody else he gave me came from different places, not from communications.

The section was formed, which is now called the INCO [Integrated Communications] section that you've heard about. I was the section head, and off we went. And it's still there. We took over the communications. We made a lot of changes. We built our own computer

systems that went with it, you know, antenna pattern systems on displays that they never had before.

I was lucky to get some really sharp guys, and later on I got some more sharp guys. We went on to Skylab and so on. I was really lucky to hire a lot of good guys who have done really well at NASA, did real nice jobs at NASA, flight directors and so on down the line, program office and so on. Bob [Robert E.] Castle [Jr.], Lee [Alan L.] Briscoe, John Burator [phonetic], later on Al [Granvil A.] Pennington, a fellow by the name of Harley [L.] Weyer at the time, Alan [C.] Glines. A lot of really sharp young guys that had come on later on, who really did a magnificent job. They really carried me. They did a great job.

We ended up with a great area. That's where it came from, and we grabbed everything, all the communications stuff. Television, everything came under us.

RUSNAK: How long did it take you to form this group and really get up to speed on all the communications and be ready for a mission?

FENDELL: Well, we worked 11, but we weren't really that ready for 11. We kind of halfway worked 11, but we did. From then on, it was ours, it was all ours. It just happened. With Kranz—have you interviewed Kranz?

RUSNAK: We have.

FENDELL: Well, with Kranz, you didn't fool around, you know. "We're going to do it and now we're going to do it, and you're going to go do it," and it's done. And you didn't go back and

say, "Well, you've given me the wrong guy," because it didn't do you any good. So you just went.

We changed a lot of things, how they were done, documentation and things, so that people knew what they were doing. There was data behind the drawings. There was schematics. There was system briefs with each system, which is now a common thing over there at JSC. We started that. I started that. Console handbooks, formal console handbooks where the procedures were all documented and so on, I started that. That's where it all began, in the INCO section, which is now universal over there and has been for many years. That's where it all began, so we could kind of learn from each other. Then when we brought somebody new on board, he had somewhere to go to know what was behind there. Like if somebody was working a recorder, you could see the recorder schematically. You didn't have the data behind it. How many inches per second does it run? What's the playback rates? And so on. And instead of having to go out and learn from the wheel, we documented all that. So everybody had a job. Everybody had systems assigned to them to go off and work. Everybody had their own area of responsibility, and it worked out real well. Like I said, I was lucky, it turned out I ended up hiring later on and so on, a lot of really good guys.

RUSNAK: How much interaction did you have with the people in engineering and development who worked on communications?

FENDELL: Real strong. We got real strong. There had been a lot of conflict going on between flight ops and the comm [communications] guys, different comm guys over there, you know, between the LM comm guys and the flight ops comm guys and so on. I got over there and I



stopped all that. The guys over in Telecommunications Division were great for us. They were really super in helping us learn things and working with us on the systems. Guys down there under Ralph [S.] Sawyer, who was the division chief. We ended up with some really good interfaces.

As the new systems came on, we were deeply involved in the design to make sure they were operationally usable and so on. We got very, very involved with the people, which was called TCED, which was the Communication Division in those days over in Building 12 and 44. We had a great working relationship with them. They were great in taking our inputs and explaining things and showing us how they worked and letting us participate in the testing and everything. It was super. Worked out real well. Like lunar television thing, we were even involved. I was in on the source board on the camera and everything. It was great. Worked out great. Real good.

RUSNAK: As far as your console itself in mission control, what kind of things were you looking at there, and how did you develop the types of instruments and displays you'd be seeing?

FENDELL: When I was in INCO?

RUSNAK: Yes.

FENDELL: Well, what happened was, Harley Weyer, who worked for me at that time, who is now retired, he went off and designed—got a hold of the documentation that showed antenna patterns on the antennas on the vehicle, and he sat down with the people down in Flight Support

Division and their contractor, which at that time was IBM and so on, and they actually designed the antenna plot displays. So what happened was, for example, on that display you had the antennas and their plots and which antennas they were, and then the vehicle coordinates would come in and down in the system it would know where it should be pointing, which antenna you should be on or where you should be looking, and it would track it. If you go over there now, they have similar displays over there so you could manage your antennas, the onboard could manage it, or you could manage it with commands from the ground.

We built displays. Different guys built displays for us that showed status of the vehicle that were strictly communications displays. They weren't intermixed with electrical and mechanical. We built all of our own stuff. We separated all our drawings out into separate areas. We built displays and things like that. Our guys got in there, because they were good at that. We kept a real strict configuration control on our systems so that we knew where we were and what we were doing.

Then as the new systems came on, we were involved both with engineering and with factories in actually designing the systems, which have really helped us, what the crews saw, what the crew could do, what we could do, you know, because we're sharing. The communications we were operating from the ground, but the crew could also control it by switches. So you had to avoid conflict on what they were doing and what you were doing and so on.

RUSNAK: You said for Apollo 11 then you guys weren't quite up to speed yet.

FENDELL: But we were working, yes.

RUSNAK: Did that mission have any issues with the communications systems that you guys had to deal with particularly?

FENDELL: No, no, not particularly, no. No. You know, the comm cut in and out, as you've listened to the tapes, landing on the Moon, but there wasn't much we could do about it. We just had to kind of go where we were and we pressed on.

RUSNAK: Did you have any time to think about what was going on there? Here you're doing the first landing on the Moon.

FENDELL: You want to know what I was thinking about?

RUSNAK: Right.

FENDELL: Well, I think I was levitating. I actually don't believe I was touching anything. The first thing you have to remember, I don't know what you've heard from other people, but most of us didn't believe we would land on Apollo 11. Have people told you that, in their opinion, that they thought we would make it the first time? I didn't believe we would ever land the first time, but we did. Okay. And when it started getting down close, I don't think I was touching my chair. I actually believe I was levitating somewhere over that chair. That's the way I felt. I know I wasn't levitating, because I can't do that, but that's the way I felt. It was so intense that I don't think most people really fully realized what we did. I know I didn't.

And I'll tell you a little story, what happened to me. I was living in an apartment up on the Gulf Freeway, a place called Cottswold [phonetic], which was up just about at Monroe and the Gulf Freeway, if you know where that's at. And we landed and we gave a go for T-1 and so on. We went on and we did a shift change. I went home to sleep for a few hours and get cleaned up and then come back to work.

Well, I went home and I slept for a couple of hours, I got cleaned up, and I was going back to work and I stopped to eat some breakfast. And between Monroe and Edgebrook in those days there was a Dutch Kettle, you know, one of these little coffee shops with the round stools. I walked in there, and I knew we had landed on the Moon, and I was proud and all that and everything, but because I wasn't out there with the public when it all happened, I really wasn't that jived as to what the real effect was going on in the world. You know what I'm saying? You know, there were people going crazy all over the world. You'll see these pictures on the movies and the newsreels, you'll see thousands of people standing in Times Square watching this stuff and so on, you know. So you weren't into all that, you were so intense in what was going on and what you were looking at and so on.

Well, I picked up a paper, which I have today, I still have that paper, and I walked into the Dutch Kettle and I sat down up at the counter, plunked my paper down and I ordered my scrambled eggs. And I'm sitting there reading the paper and so on, and two guys walk in and sit down on the two stools next to me. They are from the Exxon on Enco or whatever the gas station was down at the corner down there, and they're in their gas station clothes and they've got the grease under the fingernails and so on. They were a little bit older. They sit down and they get their coffee and they're waiting for their breakfast. They start talking. Well, you know, they're right next to me.

One of them says to the other one, he said, "You know, I went all through World War II. I landed at Normandy on D-Day." And he said, "It was an incredible day, an incredible life, and I went all the way through Paris and on into Berlin," wherever the heck it was he was talking about. He said, "But yesterday was the day that I felt the proudest to be an American."

Well, when he said that, I lost it. It all of a sudden hit me as to what we had done, you know. And I just threw my money down, grabbed my paper, and walked out and got in the car and started to cry. As you can tell, I'm getting a little choked up right now talking about it. You know, then I realized what we had done and what had happened, but I hadn't until that moment. It hadn't hit me. It wasn't like sitting in the control center and, "You know, we're here, you know, giving a go." That was great and it was a tremendous experience and relief, actually, you know, they were alive and we had made it and so on, but it was just a complete different feeling. I had now joined up with the rest of the world as to what had happened.

I finally got myself together and I drove off and I went to work. But until that moment, I didn't really have the feeling effect of what had happened, because you were in this closed-off room, working at what you were doing, intense and so on. Interesting story, I guess.

RUSNAK: It's a great story.

FENDELL: That originally was in Kranz's book, but it got cut out by the editor. [Laughter]

RUSNAK: Well, maybe it'll make it into the paperback.

FENDELL: Oh, God, no. Don't tell me that. He's not going to put it in a paperback.

RUSNAK: You brought up some interesting points in there in terms of being in sort of this closed-off environment. You were speaking of this room specifically. But overall, how aware were you, while things were going on, while you were involved in the Apollo Program, of what was going on in the outside world?

FENDELL: You weren't. I wasn't. Later on I was, on Apollo 15 I was, and I can tell you about why. But you just weren't. You were intense on what you were doing. You were locked up on your job, you know. It wasn't like where you fly a Shuttle flight, which I did later on, where, you know, you went to work and the thing kind of became a normal routine type of thing. But everything was an adventure. Everything was a challenge, because it was a steppingstone. Going to the Moon was a whole different thing. It wasn't like engineer, where you went up and went around, you know. You really were gone. And 13 brought the real reality of it all to you, you know. That's really what that amounted to.

I always like to look at it as how much junk I ate to make some astronaut famous. [Laughter] Did you ever think about that? Those guys were sitting over there days and nights in this room, eating God knows what during their shifts, you know, whether it was a burrito out of some machine or it was something they had brought in a bag, forgot about, and ate it ten hours later and it was dry and crappy or what. Did you ever think about what some of the people in that room ate to make some astronaut famous? [Laughter] I've told that to certain astronaut friends of mine. I said, "Do you have any idea what I have consumed to make you a hero?"

RUSNAK: I'm sure they appreciate it.

FENDELL: Oh, yeah, right. Oh, yeah. Try eating cold beef in Australia for six straight days.

[Laughter]

RUSNAK: You certainly made a lot of astronauts famous.

FENDELL: Oh, yeah, yeah, right.

RUSNAK: Some of the, I guess, more colorful astronauts were on the next flight, Apollo 12, where you had Pete [Charles C.] Conrad [Jr.].

FENDELL: Oh, yes, that was a colorful group. That was really a colorful group. [Laughter]

RUSNAK: Are there any stories or particular memories of them or that mission that you'd like to share?

FENDELL: Well, Pete and I were old friends, and Dick [Richard F.] Gordon and I were also very close friends. In those days, I wasn't very close with Al [Alan L.] Bean, but I had worked in Gemini. They had flown together and I was doing the coordination on their spacecraft, so I used to go to St. Louis [Missouri] with them on trips. So we had gotten to be pretty good friends, and I realized what I was involved in. They were just really two great guys and two really wild guys. Al Bean is a little different kind of a guy. He's a very quiet guy and so on. So whenever

the whole thing leading up to the mission was just wild, you know, because these guys, these two guys especially, were real fighter pilots. They were test jockeys, and they could do anything. They constantly were carrying on with each other and giggling and laughing and joking and everything, so it was a little different atmosphere than with Neil [A. Armstrong] and Buzz [Edwin E. Aldrin, Jr.] and so on. It was a complete different kind of crew, you know. It was very different, so it was more in a joke manner.

Naturally, Bean broke my TV camera, pointed it at the sun and burnt it out, so that killed our big thing there. And the experience with the lightning was also very interesting, on launch and so on. But it was a good mission, a good group, a lot of fun. A little different. That's about the most I can tell you about that.

RUSNAK: If we can take this opportunity to change out our tape, take a short break.

RUSNAK: I thought maybe we could pick up with Apollo 13, which I just mentioned briefly before. If you could tell us about what your involvement with the mission was initially and then once the accident happened.

FENDELL: I was the INCO on Gerry [Gerald D.] Griffin's shift. Gerry, I think, was working his first or second flight, I can't remember. The flight had gone and we had run a shift in. We used to play fast pitch softball in town, several of us ex-ball players, and Gerry was on my team. I was managing and playing on a team. We had our team. And we had played that evening over at Reveille Park, which is up off of Telephone Road and near Belford, up in that area. I could show you where it's at. The park is still there. I just can't explain how you get there.



We had left the park. We had played and we'd gone to my apartment, and Gerry and I were sitting in the apartment drinking beer, having a couple of beers. He was married and he lived out in Nassau Bay. And the phone rang. One of my guys said to me, "We've had a real problem. You need to get out here."

I said, "What happened?"

He said, "I can't talk to you now. Just get out here."

So Gerry grabbed the phone and called his console, said, "We've had a problem. You'd better get down here."

So we both took off. I had bought this Corvette and I went zooming out there, and I parked in the first place available, not caring whether it was reserved or not. It turned out that it was Sig [Sigurd A.] Sjoberg's parking place, who was the Deputy Director of Flight Ops. I also, unknown to me, had come in and had locked my keys in the car.

So we got in there, and Gary [B.] Scott, who worked for me, was the young man that was on the console at the time, and if you've ever listened to the transcript, you'll hear the first thing that happens, he says, "Omni [omnidirectional antenna] Charlie, Flight." That was the thing he said to get comm back. And Gary had been working and he was kind of worn down. I sat down with Gary and I eventually took over for Gary. Then as we brought people in, we started forming with the rest of the people as to who was going to do what, and we worked on out through the mission.

And every day Sjoberg would come up to me and ask me when I was going to get my car out of his spot, and I kept telling him, "I don't have any keys." So my car sat there for the entire mission. Finally found some keys. I bought the car from Dave Scott, the astronaut, and

finally they found some keys at the Chevy Motor Department in Jacksonville, and they air-shipped them out to me and we got the car out of there.

The mission, it was really tiring, but you weren't tired. I think I worked three straight days without any sleep. Guys like John [W.] Aaron and people like that were really the keys to it. Our job was trying to keep some kind of calm going while we were in the lunar module, and the lunar module com was not built for Earth orbit ops. The antenna system, we ended up going to a mode of communications that the engineering guys said wouldn't work, that the guy who worked for me, J.O. Saylor, who I mentioned earlier, said for us to try, and that's the mode we flew in all the time, and it worked. He was the one that had come up with the idea to do it. It was a combination of switch antennas.

The problem was that you just worked and everybody worked. In watching all the plaudits and reading the books and watching the movie, seeing as we're doing a historical thing, I'd like to say that I think they leave out one important thing, one very, very important thing. The flight ops and the crew get all the plaudits in this thing. I don't think people realize how many people worked at different places around the country, working on things to make this happen, getting that crew back. You know, there were people in places like MIT [Massachusetts Institute of Technology] in Boston, in Rockwell, and all of Rockwell's subcontractors on each of the individual systems and so on, doing things, running simulations, trying things, providing data, providing suggestions, contractors all over the country. And I don't think that's really very well brought out in either the book or the movie as to the contractors around the world, involvement and how many people worked day and night, that never ever get any credit for anything. I really feel very strongly about it. I've talked to Kranz about this.

It's really amazing how much went on. I'm talking literally thousands of people now, you know, that were working day and night doing things, like with the computers, with power systems, trying to do different things, simulations being run in different places, both in Houston and Downey. And those people just hardly get any recognition about it at all. And that's one of the things that's missing, I feel is very missing in all the documentation and so on. And that goes in true with engineering stuff with NASA people, too. It's really missing in the whole context of what happened there.

RUSNAK: All the people we've talked to either formally or informally have all mentioned how as soon as they hear about it, they raced to their site or their contractor facility or wherever they were.

FENDELL: Exactly. Yes.

RUSNAK: And when you think about how many people were involved at the time.

FENDELL: I'm talking thousands, because you forget that Rockwell built the spacecraft, but they didn't build all these parts of it, you know. Just like the Shuttle. Rockwell built the Shuttle in those days. But everything is subcontracted out. I mean, God knows how many companies are involved, you know. Rockwell doesn't build any communications equipment. There must be five or six different companies involved there, you know. Similarly, that went on in Apollo, and that's the way these vehicles are built. They're the integrating contractor; they only build part of it. There literally were thousands of people working and involved, and when you read or you

watch the movies or so on, people don't realize that went on. It really went on, really did. I'm sure the simulator in Downey, for example, the couple of simulators that were out there, were going twenty-four hours a day. And same thing up at Grumman [Aircraft Engineering Corp., Bethpage, New York], for example, and their contractors.

The mission was very scary. Looking at the numbers, we'd go to meetings and so on in the day, it didn't look like we were going to make it. When we finally came down and went on the chutes and everybody started hollering, I couldn't holler. I didn't feel as though the crew was safe till I saw them. It was quite emotional to a lot of people. It was very, very, very emotionally draining to an awful lot of people. I can't imagine what it was like to be a wife, you know. It's like having your husband out there dying of cancer and he may make it and he may not. I imagine something like that. It had to be very, very difficult. Very, very difficult. And going on for days in front of the whole world, you know. It's interesting. Now that I've got you all choked up.

RUSNAK: Well, it's because of this team of thousands of people that they were able to save the three men that were up there.

FENDELL: Yes, but I think there's a big missing void there.

RUSNAK: What do you think you as a flight controller and the mission operations people as a whole learned from this episode?

FENDELL: Well, I think we learned that we could do almost anything, and I think we really took a real step forward in improving how we could adjust to different situations. I think that was really the big thing.

I think the biggest result of it was what I call using sustained engineering. What that means, in my mind, it may not mean what other people call it and so on, but what they found out was, as you probably are aware, is that they were able to go back and later on see this spike that had happened in the oxygen tank, that it was there on the data in the testing. Okay? You do remember they later were able to recreate that this thing had actually really almost occurred back up the road in the testing?

RUSNAK: Yes.

FENDELL: And the first part of it had occurred. One of the things we got out of it that I thought was major was that we started to pay an awful lot more attention to what was going on with testing, and we started to keep track of problems and what was done about them on the ground to be used in flight. I think that's continued on and it still goes on today. I call that sustained engineering. I don't know whether that's the proper term for it or not, but keeping that data and so on.

It's very hard to do when you have a turnover of personnel, but I think that's the biggest thing I saw that came out of Apollo 13, was really learning how to follow test data, being involved in the testing, knowing what these things that happen, you know. With a pad test, something always goes wrong, not necessarily a catastrophic thing or the beginning of a catastrophic thing, just things go wrong that you're able to take and say, "Gee, that happened

here. I can use that data. I know what happened. I understand it. I can do that." And I think that was one of the big things that was learned from Apollo 13.

RUSNAK: Were there any immediate changes for the next flight, Apollo 14?

FENDELL: I don't think there really were that many changes, no. No. Everything was pretty much the same, I think. Naturally, on the ground they started digging in and finding out what went wrong, and changes were made as far as certain vehicle procedures and what you did with tanks and so on, but in my area there were not many changes at all. I know my antenna got blown off, you know. That was what went. The high-gain antenna went when that thing went out. It blew it right off of there. But there were no changes as a result of what happened on my side of it.

RUSNAK: Here on Apollo 14 you've got Al [Alan B.] Shepard [Jr.] heading up the next successful mission. Any particular memories of him?

FENDELL: Well, Al and I were pretty good friends. Okay? And I won't go into why or how, but we were pretty good friends. Part of it had to do with cars, but that was only part of it. It was nice to see him get to fly again, and he had waited a long time. There was some dissention went on with other people about him flying ahead of them and screwing up the crew mix and so on. But Al was really an interesting, good guy, and he was a pretty smart guy, too, you know. He was really a smart guy. But he was funny and he was a good guy.

The mission went well. It was a typical mission to the Moon. Nothing much went wrong. There weren't many changes on 14. Fourteen was kind of like 12 and so on. It wasn't until the next flight that things really changed for me. Not much else to say about it. That's about it.

RUSNAK: For 15, a big change is the first of the J missions, there's a longer stay time, they have the rover, additional camera equipment, and these kinds of things. What sort of training and preparation did you go through here?

FENDELL: Well, let me tell you everything to do with 15. First thing is, we were involved for the J mission in the changes that went on in the service module, the experiments that were carried in the service module, the changes made to the communication system, we handled all that. We were involved from the beginning in that. This is the first thing we got involved with, with design. We worked with engineering on that and also with Rockwell.

At the same time, we started into this television camera thing of controlling the camera. Now, that was kind of interesting, the way all that started. A young man over in engineering by the name of Bill [William E.] Perry came up with this idea of taking a camera and attaching it to motors and being able to control the pan, the tilt, the zoom, the different things. He had come up with the design and the concept, and he worked over in engineering in Building 44. Bill is now dead. It was basically his idea that started this thing.

E&D [Engineering and Development Directorate] engineering came forward with the idea of doing this, so now the way it worked, you had to go sell this to the program office and to

management, that you wanted to go do this, build this system, spend the money, hire a contractor, etc.

Well, it was coming up to the control board to bring this up, and because I was running the communications, I was told to go up and give Flight Operations' opinion on the camera, on doing this, how Flight Operations felt about it. Well, just prior to that, Kraft had moved from Flight Operations up to be [JSC] Center Director. Well, when I went through our management and everything, everybody said, "We have no requirement for this." So my pitch was one slide, and the slide said, "FOD [Flight Operations Directorate] has no requirement for a controllable television." And I went up to the meeting up there, and I had given my slide in, and it went back behind the bowels of the thing up there on the control board, and it was sitting there and I was just sitting there waiting for my turn to stand up.

Well, Kraft was sitting there and everybody was sitting there, and a fellow by the name of Tony [Anthony J.] Calio, who was the head of Science and Applications [Directorate] at the time, stood up and he got up there, threw his chart up, and his chart says, "S&AD has no requirement for controllable television."

Well, Kraft landed on him with all sixteen feet. I mean, he started eating him alive like there was no tomorrow. I mean, "What do you mean? You could do this." I mean, he was just chewing Calio up to pieces, and I'm sitting there waiting for my turn with this slide, you know. I'm saying, "Oh, God, I'm going to get it. This is really going to be incredible," you know.

So there was a guy by the name of Mel [Melvin F.] Brooks, who used to be one of Kranz's deputies. Mel comes running back to me. He says, "Pull your slide! Pull your slide!"

I said, "I can't pull the slide. The slide's in there."

"Oh, shit," he said. "You're going to get killed."



I said, "Oh, this is really going to be something," because here Kraft was the head of FOD and he had just moved up to Center Director, and he is eating old Calio alive, and I am just sitting there saying, "Oh, God, this is not going to happen to me."

Well, he finally gets done with Calio, and I meekly kind of stood up, you know, and I said, "Can I have the first slide, please?" There was only one slide. And this thing comes up on the wall. "FOD has no requirement." Well, the place just burst out laughing. The whole place just came apart. And Kraft looked at me and just shook his head. He said, "Sit down." [Laughter]

Anyways, to make a long story short, we were given direction to go off and make this happen. At the same time, we had to build this unit system on the rover called the LCRU [lunar communications relay unit] to go with this. So they gave a contract on the LCRU direct to RCA in Camden. That was in Camden, yes. And they had a competition between Westinghouse, who had built the cameras on board, and the camera we were using on the Moon, the still camera, the one camera, was built by RCA, so they formed a source board, we let an RFP [request for proposals], did a quick turnaround, and I was on the source board for the camera. I was actually involved in the whole thing from the beginning.

So the INCO section had been involved right from the beginning. Then we worked directly with E&D, with RCA in Camden and RCA in Heightstown, who built the camera, and everything that went on with it. So we were involved actually in the basic design and the procedures, and we were like this little tiger team that was working this, E&D and the program office and ourselves.

E&D did some really neat things on helping us get ready to operate this thing. They built a thing called a lunar table, and what it was, was a table I guess six feet in circumference or

bigger, even bigger, maybe ten, and they brought some people in and they built a lunar landscape. They put things on there like lunar module and astronauts and so on. Then they got some lights that they could move and adjust to provide light on to different things. The reason for that was that one of the biggest problems in controlling the camera was controlling the light. You had a tremendous amount of light, and the camera used to bloom if you got it in the wrong thing. You could control the light settings, the iris, you could control that, and you could control these couple of automatic light settings, but where you went with the light was really important. One of the ways you controlled the light was with the zoom. You'd zoom the brightness out and so on. By using that table with a camera, they really helped train us a lot with the light setting with that table. They really, really worked with us on that.

One of the other things we did, the crew would run an exercise with the 1-G rover down at the Cape, and we would control the camera and follow them. Things like that. We did training like that. I went on a lunar training trip up to Tonapa, Nevada, outside of Tonapa. That's kind of how we learned to operate the camera, and we worked very closely with the U.S. Geodetic Service people.

In the back room, there was one room that was the lunar surface team. I don't know whether you guys have talked to anybody from that group. But a couple of the people on that thing were Lee [Leon T.] Silver, Dr. Silver, and Bill [William R.] Muehlberger and different people from NASA, Calio's people and so on, who did all the planning, selected the landing site, decided where we were going at each stop. They had that all plotted out and so on.

Well, the U.S. Geodetic Service was very, very involved in that, the people out of Flagstaff [Arizona]. The first thing they wanted us to do at each site was to do a thing called a pan. If you look at any of that TV, you'll notice that we'd arrive at a site, the crew would point

the antenna at the Earth, they'd give us control, and we would move the camera 360 degrees around the site they were at. What we would do is we would move it 3 degrees, and then this guy by the name of Tim [M. H.] Hait, who worked for USGS [U.S. Geological Survey], would take a Polaroid picture. And then we'd move it another 3 degrees and he'd take a picture.

So by the time we did this pan, he had gotten a complete Polaroid view back in that back room of that entire site that we were at, and they would lay that out and stick it all together, and we would start into following the crew and doing our things with the crew, because we knew where they were going, and they would start also looking at what else they wanted to see. They would also use it to figure out where they were by looking at this panoramic view. So when you've seen some of that TV, I don't know whether you've ever seen the whole thing, you'll notice the camera, at each site when we stopped, as soon as we got control, the camera would go all the way around. That's what was going on. And they would build it out of Polaroid snapshots. That's what they would do. So they'd see something, they'd say, "Can you go back over?" And I'd take the camera back over and I would give them a view of what they wanted to look at.

At first it was a little tricky, but in trying to figure out how to keep up with the crew and to lead what they were doing, you had to kind of anticipate what was going on. If you watched some of the television, you will notice that when the crewmen started to move, the camera didn't start to move, it started to open up. If you look at the pictures, you'll notice that the first thing it would hit would be a zoom function, and you'll notice it on the TV. If you look at it, you'll notice that as soon as he started to move, I would hit zoom out. What that would do would give me a chance to stay with him, because the picture was opening up, and then I could see if he was moving left or right, and then start moving the camera. Then if he would stop, I could

zoom back in. If you take a look at the pictures, knowing that that's what was going on, the secret was in using the zoom. The zoom allowed you to breathe. In other words, by opening up, you could see it. Because what you saw was three seconds old, see. So that's the way you were able to kind of stay with it.

The other thing you had to watch out for was the light, like I told you. The light was crucial. Because you'd get this big bloom. In some of those pictures you'll see this big strobe of light coming in there, and that's what that is, because the sun is incredibly bright with no atmosphere and everything.

After a while, it became real easy, but you really had to pay attention. You couldn't stop and think, and you couldn't stop and go to the bathroom, and you couldn't do too much talking with anybody else, but you had to monitor the other comm systems, too, but you had a back room. But you really had to pay attention. If you went through six hours of that, you were really tired. It really wore you down, because it was constant. The only time you got to take a breath is when they started to move, and they took over the rover, and that was like your break time, like, "I'm going to the bathroom, quick. I'll be back." And that's what you got. But it was real intense.

The other thing that I'll explain to you how it worked, and it's a little interesting, is you've seen this picture where the lunar module lifts off and the camera follows it. Well, on 15, the motor burned out and we couldn't do that. On 16, the rover was not parked in the right place, so consequently we missed it.

Now, the way that worked was this. Harley Weyer, who worked for me, sat down and figured what the trajectory would be and where the lunar rover would be each second as it moved out and what your settings would go to. That picture you see was taken without looking

at it at all. There was no watching it and doing anything with that picture. As the crew counted down, that's a [Apollo] 17 picture you see, as [Eugene A.] Cernan counted down and he knew he had to park in the right place because I was going to kill him, he didn't—and Gene and I are good friends, he'll tell you that—I actually sent the first command at liftoff minus three seconds. And each command was scripted, and all I was doing was looking at a clock, sending commands. I was not looking at the television. I really didn't see it until it was over with and played back. Those were pre-set commands that were just punched out via time. That's the way it was followed. That's the way it followed it.

On that same mission we tried to track it back in. I don't know whether you know that or not. You know, the lunar module crashed back in. There was a scientist who wanted to see it coming back in, and then they were going to look on the seismometer, whatever you call it, and get that data and so on. But everything that was figured out or whatever, we never saw it. But that's the way that was done, but it wasn't done by looking at the camera, at the picture at all. It was all done via time.

RUSNAK: And the result was probably some of the most remarkable footage.

FENDELL: That came out great. I'm pretty proud of that, yes. And that's how that worked. But the camera work was really, really a thrill. A lot of publicity. Got a lot of crap. Got into stuff that I, as a guy, like I told you, my background in the beginning and so on, never thought he would get into in his life. Won an award in Germany called the Golden Camera Award, which is their Emmy Award. Have been over there three times with that thing and had a lot of publicity, you know. Big ego thing, you know, and so on, but you can't buy any coffee with it

anymore. It was interesting, a lot of fun, a lot of interviews, a lot of TV interviews, Walter Cronkite, people like that and so on. It was quite a boost to the old ego if you have any kind of ego, if you're just a peon who got exposed to something.

RUSNAK: So who gave you the nickname "Captain Video"?

FENDELL: I think it was either *Newsweek* or *TV Guide* or somebody. An article came out and that's where it was from.

RUSNAK: So did your fellow controllers give you a hard time about the ensuing publicity and such?

FENDELL: Oh yes, yes, yes. Llewellyn gave me real bad grief over all that, the camera and all that crap and everything. But it was a lot of fun. I still get called that occasionally. I don't really care for it, but I have been called that.

I'll tell you one of the things that was amazing about all that. On 15, the United States networks carried it all. Okay? All the TV that was done was done in real time. We knocked the soaps off the air. It was prime time and so on. In Europe, it was the same. On 16, we didn't show, the United States. I mean, we could not move anybody out of the way. We got a little bit here, a little bit there on the news and so on, 16 and 17. Later found out that in Europe, every single network carried it live. They had better coverage in Europe than they did in the United States. Germany, they have these national networks that are owned by the country, they carried 100 percent of everything that we did.

But we couldn't do anything later on. That's why when you see a Shuttle launch, they don't even show you the whole launch anymore. They give you just a part of it. That's what's happened. It's like Station. People said they were going to do all this. They aren't going to get coverage. They'll lose it all. You're not going to move the users. Station is not going to knock *West Wing* off the air, trust me. [Laughter]

RUSNAK: Towards the end of the Apollo Program, is this when you started to become more aware of things that were going on, perhaps the interest in the space program wasn't as strong?

FENDELL: Everything started to change, yes. Yes, things started to change and you started to realize things were changing and so on. The other thing that started to happen is, after we flew 17, everything changed. JSC changed. Everything changed. We became a completely different place. It was a transformation at the end of Apollo to a whole new thing. JSC became an agency. NASA became an agency. The way things were done started to change. It may have been changing already, but you didn't feel it; you were too involved. But things changed. Everything started to change. Doing things and getting things done were harder. There was a bureaucracy growing, which is bound to happen. There's nothing wrong with that. It happened.

You started to see for the first time a mass exodus of people. People that you had worked for for a long time started taking jobs in different places. Like some guy saying, "Gee, I've always wanted to live in Colorado," and he left and want to work for Martin. And other guys took jobs somewhere else. I had been offered a job at one time and came very close to leaving. I was going to work on the [Air Force] Manned Orbital Lab [MOL] Program and it got canceled the day I was getting ready to give my resignation.

But you started to see your fellow workers leave. At first it was a guy here and a guy there, and you didn't notice it, and then one day you woke up and found out that there weren't many left. They were gone. Most of the old-timers were gone and if you were one of the few, you stayed. But in Flight Operations there was a whole change of people. You started seeing people in jobs that you said, "How did this happen?" But you didn't think about it because you were going to work every day, if you were like I was, who stayed on, but it changed. Everything started to change. The people started to change and so on. The attitudes started to change.

We got into Skylab, it was completely different. It was a different kind of program, you know. It wasn't the same thing. It was like a station. You were putting people up there and they were going round and round, and we were collecting lots of science data, you know. We weren't exploring; we were collecting data on different things. So everything changed. There was a big change in JSC and NASA at that time, really massive. I don't know how many of your people have told you that or talked about it, but it really did change. That was the beginning of a different era. It was more than just an end to Apollo.

RUSNAK: With Skylab, you're moving into more science-oriented missions, but also long-duration, where they were up there for thirty, fifty, and eighty-some days. How did that affect the way Flight Operations worked, and how well were you guys prepared for that kind of change?

FENDELL: Well, I don't think we really realized what we were getting into personnel-wise. In my area, I had other people now involved with my communication systems, because they



weren't systems that had come out of E&D. They were systems that had come out of Marshall [Space Flight Center, Huntsville, Alabama]. And we started working with people at Marshall who had a different attitude than we did, and we started having massive battles in my area. My counterparts at Marshall and I had some massive battles. I don't want to mention names, okay?

So it was very, very different. We were dealing with different people, with a different approach and a different attitude, and they had gone off and done things and building systems that interfaced by locking them together without talking to us, and we'd have done them different. So there was a lot of conflict that went on.

In the entire planning process and everything that went on there, one of my guys took that all over and he worked with his counterpart at Marshall on that, and they got along great and they made things work. That was a guy who you know, by the name of Lee Briscoe. He took that all over and did a bang-up job, working with a fellow by the name of Bill Kilpatrick [phonetic] over at Marshall. They ended up doing all of our planning. So we were in really good shape in our area, as far as what we had to do and so on.

Where we had problems was in operating the systems. We had some systems break. They had promised some things on data to certain experimenters that we couldn't deliver because of antenna patterns and so on. So it was very difficult.

I was lucky in my area that my people didn't start bailing out. As we got down towards the end, I had about five different companies working for me at the time. I had Martin, I had Bendix, I had Lockheed. I had different people. I started telling these guys, because I knew there were going to be no jobs for them, I said, "If you get a job, take care of yourself, because we'll make this work. You've got to go out and do that." So I was pretty lucky, not too many of

my guys left and it didn't affect me too well, but some of the areas started getting hit pretty bad with attrition.

The biggest problem I had was a thing called the teleprinter operation. We had a thing on board called a teleprinter, which was a method of sending up flight plan changes, messages, and so on. It was a very crude method, but it did work. The problem was that every piece of data that was going to be sent up had to be formatted into a certain way on the ground, typed and so on. You couldn't just send a page or so on.

This operation came under my section. It was decided upon to use secretaries throughout JSC that wanted to work overtime, who got trained in all this to do that. Well, I now had this massive amount of women with everything else going on in those days, which is different than today, who were being brought in to work overtime on this job. I really ran into a massive headache problem. They brought in this engineer, this female engineer, Shirley [Hunt Hinson]—I can't even think of her name today. She came in and took that all over for me and saved my life. So she ran all that and got it all smoothed out, got everybody trained, and they did a bang-up job. They used to work day and night, mainly at night, because that's when most of the stuff happened. And that was our big problem.

I think one of the lessons learned from Skylab is that Space Station is going to have massive attrition problems and it's going to be worse in a lot of ways because young people today are not career operations people. Most of them are not. They're not like I was, for example. You know, they've come out of school and all of a sudden they get hired at JSC in Flight Ops and all of a sudden some astronaut is calling them by their first name, and they're sitting at the Outpost drinking beer with some astronaut, you know, they're chug-a-lugging down and they're all big buddies and so on. Now they've worked about seventeen missions and

they've worked 4,000 midnight shifts and they say, "I don't want to do this the rest of my life," and they're moving on. They're moving on.

Well, when you get this thing going around and boring holes in the sky day and night for twenty years, you're going to have some massive people problems, and it's going to be tough. It's going to be very, very difficult. The attrition is going to be bad and the retraining and the recertification and all that is going to be very difficult. Skylab gave us a hint of it, and I think Station is really going to be tough.

Now, one thing they've got going for them, they're working on a lot of systems where they're automatic-type systems to operate on the ground and so on, but it's going to be very, very difficult. People are going to be difficult. How many Super Bowls do you want to sit through at the control center? You know? Your wife's having a baby, you know. Some engineer is having a baby, you know. She's not going to stop her life. There's no reason she should stop her life. She's married. She's going to have her baby. She's got a kid who's sick. Your father's passing away, you know. The different things that go on in life.

It's going to be difficult. Attrition is going to be really tough. And it's going to be costly. It's going to cost a lot of money. To satisfy attrition is going to cost a lot of money, because everybody's got to be trained and certified and hired, and that costs a lot of money. Going to be tough. That's one of the things I think we got out of Skylab.

The other thing is, they're going to handle a lot of data. How is that going to work? Collecting all that data, shifting that data, processing it and shipping it to the users who want that data, that's going to be a big task.

RUSNAK: What about in terms of structuring the way the crews operate for long-duration missions?

FENDELL: The onboard crews?

RUSNAK: Right.

FENDELL: I don't know what they're going to do.

RUSNAK: I guess from your Skylab experience, in terms of controlling crew activities and that kind of thing—

FENDELL: One of the things that came out of there, if people go back and think about it, was the crew would like some time off. They're trying to incorporate that in the time lines and so on. Well, understand that every time you put someone up there and he doesn't do anything, it's kind of like an American Airlines airplane sitting on the ground not flying. That's the way I like to look at it. If you take an airline, their idea is to keep that plane in the air as much as you can to make money. If that astronaut is not working and he's supposed to be trying to run experiments and so on, that's lost money, to me. That's the way I look at it. Now, hopefully they can work around that and do that, but it's going to be tough. Going to be very difficult. Going to be some real challenges in that whole personnel area, both on ground and on board. It's going to be difficult.

The part of it now where you're putting it together, that's fine. You send the Shuttle crew up, they stay a week, put stuff together and so on, but it's going to be constant, because you've got to service this thing. It's not going to just sit there and bore holes. You're going to have to work on it. It's going to be a difficult task, going to be very, very challenging. But it's also going to be boring.

RUSNAK: Moving on from Skylab, you had the Apollo-Soyuz Test Project [ASTP] flight. I understand you worked on that.

FENDELL: Yes, I worked on that. One of my guys was the lead comm guy on that, by the name of Harry [Harold] Black. Harry did most of the planning and coordination in how we were going to do business and work with the Russians and the meetings and so on. A lot of the comm gear on board the Russian side of it was our gear. You're probably aware of that. The VHF was a LM system that we gave to them.

The camera work was very simple, you know, because how much can you go? How far can you go? You're inside this tube, that's about it. So the TV was there. We ran the TV on looking at the Earth and all that, like we normally did, and there's some really interesting pictures there. There's a great picture there from ASTP that I don't know whether you've ever seen, of coming up over North Africa, over the Mediterranean, and you get this incredible shot of the boot and Sicily. I don't know whether you've ever seen that picture. That's one, I think, of the real great pictures I've ever seen because it really says the map is right. [Laughter]

But we also did a lot of work on that mission with a scientist by the name of Farouk el-Baz. Farouk was—I believe still does Earth observation training with NASA and working with

astronauts, a very interesting guy, an Egyptian, very, very great guy to work with. We did a lot of work with him on that mission. That pretty much was it.

It was an interesting mission. It was a lot of difficult times. It was very difficult getting data out of the Russians. They played the real political game to the hilt, because probably other people have told you that. We had some really interesting interpreter people working for us in JSC that were really neat people, and that worked good. It was just another mission.

It was nice to see Deke [Donald K. Slayton] fly. That was really great. Vance [D.] Brand was really the key to the whole mission. He was the guy who really did the majority of work from the crew's side. There was not much else to say about it. There's really not too much to say.

We used a satellite system for the first time, called ATS-F to communicate with, a Goddard satellite. That was pretty good. The biggest problem was the television change from their system to our system and the communication hookups that people put in. Did a good job on that, the ground side of it. And that was about it. Not much else to tell you. Not many interesting things.

RUSNAK: When did you start working on Space Shuttle?

FENDELL: Well, what happened was, when we started flying Skylab, Kranz formed a team in Flight Ops to work on the Shuttle design, which I consider a great move on his part. He decided that one of the lessons he had learned on Apollo and Gemini and so on is that if you get the operations people involved in the design of a vehicle, that the vehicle, when it gets built, will be operational. In other words, you'll have the tools and the systems, the switches or the

commands or whatever you need, or the systems are built to give you the telemetry you need to operationally manage the vehicle. He was pretty brilliant in coming up with that.

So a team was formed, and most of the guys were lunar module guys, ex-lunar module guys, I think about eight or ten of us, under a guy by the name of Dick [Richard A.] Thorson. Dick is dead now. These guys each had an individual system. We were the only ones that were out of his branch, the branch that he worked in. We were the comm guys, myself and Gary Scott, who worked for me.

So the way we laid it out was that Gary and I would work the launches and the landings during Skylab, because we could do that, because we already knew how to do that from Apollo, it was the same vehicle and so on. I had Lee Briscoe go running the daily operations, and I worked on the Shuttle design with the comm systems. Okay? So Thorson's team basically was working directly with E&D and with Rockwell on the Shuttle design while Skylab was flying, and we were working the com stuff, the switches, the commands, data, and so on, and going through the battles and everything that was going on. That's how we got involved in the Shuttle in the beginning.

So when Shuttle came along, we were a little better prepared than we had been in the past. We weren't handed a vehicle and say, "Go learn how to live with this." The software, as we got further down the line, there was a software tiger team formed under Phil [Philip C.] Shaffer, and one of my guys was assigned to do the software for the comm system, and that was Al Pennington, who is now a flight director. He handled all the software requirements and everything, so we had an input into all that for our comm side, because we had never worked software heavily before. So we got involved with it right in the beginning and it paid off. It's paid off over the years real well. A lot of the stuff that's on board were put on board through our

requirements that we wrote on board, that we wanted things, changes we wanted made, so on, that we actually worked through the system as they were built.

RUSNAK: With Shuttle for the first time you've really got nearly continuous communications going around the Earth.

FENDELL: We didn't get that till [STS-]4.

RUSNAK: So how did the introduction of the TDRS satellite change the way—

FENDELL: TDRS changed everything as far as ops goes, because when you started out with STS-1 and 2 and 3 in the beginning, and actually 4 also, you were doing just like you were when you were in Earth orbit or with Apollo or Skylab. You went over the site ten minutes, went over the next site, and so forth.

When we got TDRS up and you locked up on TDRS, you now just sat there and had continual data pouring in. You had voice, you had command, and you were able to change your way on how you did things, because you didn't have to try to figure out, "I've got to get this stuff over this site at this time," and so on. You had great amounts of coverage. When you got the next satellite up and you really expanded your coverage, your whole way of doing business changed. The things you could do, what you looked at, how you worked problems, your whole attitude, your whole philosophy, everything changed. TDRS changed everything and has for a lot of different programs around the use of TDRS. JSC is not the only one who uses TDRS, you know. It's really very different with TDRS.



RUSNAK: Are there any of the Shuttle flights that you wanted to comment on or have any particular memories of that you'd like to share?

FENDELL: Well, the first thing I'd like to say is I never have figured out in my mind, with my simple little mind, why we could drop that thing off a 747 and not crash into it. I haven't figured that out yet. I've had it explained to me 500 times, but I haven't understood that yet. [Laughter]

One of the things that John [W.] Young talks about with the comm, with Shuttle, when he went to fly, I told him to keep his hands off the switches or I'd break him, because we were going to control everything from the ground and so on. One of the things, an interesting story that happened with all that is that when Shuttle was built, it was supposedly, quote, going to be this autonomous vehicle. I don't know whether you've heard that or not. The big idea, Shuttle was going to be autonomous and we weren't going to need all these people. Well, naturally that's very hard to do and so on. Well, in the communications area, it's really difficult to do because you're configuring ground assets to match up with airborne assets and you're doing different things.

The other thing you have to take for granted is, do you want the crew spending time managing communication systems, running recorders, sending data down, doing all that time-line work, or do you want to take that responsibility away from the crew so that they can work on their other things. And what do you do when you have a problem? How does the crew work the problem? Is the problem the antenna on the ground? Is the problem on board? How do you chase those kinds of problems?

So when we got into this whole thing, we kept putting in our requirements for a command system to do all this on the ground, because that's the way we figured we were going to operate. E&D kept saying, "No, no, the crew's going to do that. It's going to be autonomous."

We kept saying, "No, it isn't." So this massive battle kept going on. It was going on from the bottom level up to the top level in E&D and so on.

So finally Kranz got fed up with it all, because we couldn't proceed on with what we were going to do, and he had me put together a pitch that we were going to take the Center Director to get this straightened out, because we couldn't get it past square one.

So I started putting this pitch together, and this pitch was massive. It was a two-slide-projector pitch. It was like an inch thick, you know, and it was really involved. As I worked up through my boss and the next boss and through Kranz, everybody kept changing it and so on.

Finally, this pitch gets done and I got scheduled to go present this thing to Kraft. So the day arrived and we got up there to his conference room up there on the ninth floor, and here comes all the bosses, you know, [Maxime A.] Faget and [Milton A.] Silveira and all these guys, all the big wigs that were there, and all these guys that were against it and so on.

Well, Kraft is a very interesting guy. He has a capability, one, to know everything, and how he has ever done that, I don't know. The guy just absolutely amazes me. Somehow, I guess someone had explained all this to him or he had gotten this data and everything, but I had no idea he even knew what it was about. So we're all in the conference room and I'm up there and I've got my suit on, and I've got two slide projectors going and I've got which slides are going on which projector, ready to present this thing. Kraft walked in with his cigar, with Cliff Charlesworth, who was his deputy at that time, he took a look at this thing, he said, "Is there

anybody in this room that doesn't think we need command control of the comm system on the Shuttle?"

Dead quiet. You know, it was another one of those. Looked around the room, he said, "Well, I guess we don't need to listen to this pitch." Turned around and walked out. [Laughter] And that's how it all happened. It was all over right there like that. He said, "Is there anybody in here that doesn't think we need to do this?" And all these people that were fighting me and everything knew right then and there, "I don't think I'd better open my mouth here." And it was over. It ended just like that. We're talking about maybe a year and a half of battles. That's how powerful he was. It was incredible. And we ended up operating all those systems, my guys did mainly.

I think the thing, if you want to talk about something in general, that I've always taken great pride in, probably more than anything else, the television camera or anything else and so on, is that I was able to bring on a lot of really great young people, and I've taken great pride in that. I really feel strong about that. If you look over there right now, right over there right now there's probably a half a dozen or eight guys over there that are in really nice jobs, big jobs at JSC, have done extremely well for themselves, that worked in my section. Maybe I was a good guy at hiring people or maybe I was a good guy at training people or setting a way you did business or something, but I'm really proud of an awful lot of young guys that worked for me and have done really well over there, that I've hired and trained and worked for me. That's really the thing that I'm proud of.

RUSNAK: That's great that you're able to serve as a mentor to these people.

FENDELL: I really feel good about that. That's something I really feel good about, and it's good to see these guys doing real well. Some have done very well.

RUSNAK: I think that's all—

FENDELL: That's it? We're all done?

RUSNAK: That's all the questions I have, but I did want to give Rob and Carol an opportunity to ask any if they had some.

COYLE: I just have a couple. You were talking about the Shuttle antennas and so on, and it just occurred to me we were having transmission difficulty this week.

FENDELL: On the K-band?

COYLE: Lost some of the broadband ability. Could you give us a quick layman's overview of what that means?

FENDELL: Well, let me give you a little history of the K-band to start with. You want to hear that first?

COYLE: That'd be great.

FENDELL: Okay. Somebody, I don't remember who it was, decided that we ought to have broadband capability through TDRS with the Shuttle when it came on. They also wanted a radar capability to do rendezvous and so on. So after going through all the hoops and everything, Rockwell let out an RFP to build a Ku-band system that was compatible with TDRS and also to do radar tracking. The initial briefing was held at the Rockwell facility in Seal Beach [California], which is now Boeing, and I was at the briefing. There were a lot of people there. Then as the end result, we thought we were just going to have possibly one, maybe two bidders. We ended up with, I think, four different teams bid on it.

When the bids came in, a bid came in from Hughes that we didn't even know were working on the thing. We had no idea they were working on it. Hughes came in and had solved all the problems that everybody was having trouble with, quote, on paper. Well, Hughes was selected to provide the system. The scar was put on—actually, on the Shuttle there's scar for Ku-band on either side of the vehicle. I don't know whether you're aware of that. It's there. It was supposed originally to have been two K-bands, and because of cost and weight, we did away with one. So the basic scar is in the vehicle.

When they got going on it, trouble started to happen and they had a lot of trouble with it, the contract, the design, and so on, and it kept getting more and more expensive. The way I like to explain the way the K-band came out, it cost the equivalent of two Astrodomes. [Laughter] The Astrodome cost like 52, 53 million dollars to bid, which probably God knows what it would be today, and it cost about twice that.

The K-band is a neat system. A lot of people have some real voodoo fears about what it does to their vehicle being radiated with K-band, and there's only been, I think, one program that's ever done any real testing and found out it didn't bother them. But they have all these

constraints on it. It's got a lot of single-point failures in it. It's not built to be a redundant crew safety system. So when you have something break, you don't have too far to go. You just lose it. I believe that's what happened to them the other day. I don't know the exact problem or what happened, but there's not much redundancy in the system. I don't know whether that answered your question or not.

COYLE: Great. I was listening to you a while ago talking about your satellite dish and the marvels of modern technology. What could you do today with the little mini digital recorders and technology?

FENDELL: You know, let's say you were trying to fly Gemini. Okay? If you had the capability to talk to a satellite up and down and so on, I mean, Gemini would have been like day and night, you know, because the communications were the thing.

What's going to be interesting to see, I think, based upon what the agency decides, the government decides to do based on money, most likely, not on technical, as you well know, I don't have to tell you that, what they end up being able to do com-wise going way out into space, by the time they get around to doing that, like let's say some day someone comes up with the money to go to Mars, which I don't see in the near future myself, you know, what is it you're going to be able to build with the technology that's available to get things like voice command and television and so on on a mission like that?

Do you know much about JPL [Jet Propulsion Laboratory, Pasadena, California] and how they do business? Well, when JPL sends a command, you know, they start this countdown to send one command like three hours ahead of time, and they read it in and they read it out and

then finally they come down and they go, "3, 2, 1, Mark," and they send this command. And maybe five hours later they'll get one second or two seconds of telemetry back from sending that command. Okay?

Now, the question comes, when you get ready to go somewhere like Mars, if we ever get around to doing that, what is it you're going to be able to do? How do you communicate? How do you collect data? How do you do that? Because it's a little different than looking at Mars Surveyor than looking at an astronaut on the Mars surface, and that's what's going to be interesting to see where we are technology-wise at that time. I think that's going to be real interesting.

COYLE: So is JPL still using technology developed for—?

FENDELL: JPL continually updates their systems and improves on it and so on, but they're not looking at live humans on the Mars surface, as an example. What is it you want to see? What is it you want to do? You watched that little Surveyor thing, which is really about two feet by two feet at the most, and that's happened three hours ago. You know. What is it you want to see? What is it you want to talk to? You've got a crew that's got a problem. You want to work that problem. How do you work that problem? What do you do? It's going to be a big challenge. I think it's going to be a massive challenge.

RUSNAK: Okay. Carol? Okay.

FENDELL: That's it?

RUSNAK: I'd like to thank you for sitting down and talking with us for a few hours this morning.

FENDELL: Enjoyed it. Thank you.

[End of interview]