ORAL HISTORY TRANSCRIPT

JONES W. "JOE" ROACH
INTERVIEWED BY CAROL BUTLER
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BUTLER: Today is January 24, 2000. This oral history is being conducted with Joe Roach, as part of the Johnson Space Center Oral History Project, in the offices of the Signal Corporation. Carol Butler is the interviewer and is assisted by Kevin Rusnak and Sandra Harvey.

Thank you so much for joining us today.

ROACH: Pleasure.

BUTLER: To begin with, if maybe you could give us a brief introduction of your early career, what you did before you came to NASA.

ROACH: I graduated in 1955 from Virginia Military Institute, and went to work for Union Carbide, or a division of Union Carbide, Linde Air Products. I worked there about eight months and then went to flight school. I was called into active duty in the Air Force and went to flight school, went to navigator training, finished navigator training in 1956…and then was there for a year. Then went to Biloxi, Mississippi, where I went to electronic warfare school.

I met my wife to be there, and we were marred in November, and in January we went to Alaska, Elmendorf Air Force Base, where I replaced a crew that was killed in an air crash. We stayed there for three years, and then got out of the Air Force and went back to Virginia, which was my home. My dad had passed away at a young age, so I felt like I needed to go back.

I wasn't really happy being in Virginia, and a year later I got called back into the Air Force due to the Berlin crisis… I heard about that while we were out shopping one day. At that time we had a daughter and a young son. And served almost a year.

The base, we were real close. Richmond, Virginia is real close to Langley [Reseach Center], where the Space Task Group was, and I had occasion to go down there frequently to deal with some of the problems we were having with the airplanes. I just stopped in and they said, "Hey, this is great. You're just who we need. Come to work for us." Well, then I couldn't get out of the Air Force until the situation in Europe settled. We were the only wing in the Air Force that flew three hundred planes to France and Germany without a mishap. We had never trained to fly over water; we trained over the U.S. It was pretty exciting. It kind of interrupted my life and family, but we did a good thing, and I think because of that, we stopped encroachment by the Russians. But that was kind of a good deal.

As soon as I got out, we came to Houston, which was in 1962. That's when I came. I guess it was the middle of September, 1962, and we've lived here ever since. So that's how I came. I went down, got the job, and then couldn't take it for several months. It was kind of frustrating. Came to work in the Mercury Program, worked for Gene [Eugene F.] Kranz and John [D.] Hodge right from the very beginning. [Christopher C.] Kraft [Jr.] hadn't been here but a short period of time and went to Mercury 8. We had a training site at Corpus Christi [Texas], went down there as a capcom [capsule communicator]. In those days, most of the capcoms were folks like me [rather than astronauts as they were later].

On Mercury [9], I was a primary capcom at Hawaii. That was [L.] Gordon Cooper's flight, where we flew for twenty-four hours. We had one crew and we carried along astronaut [M.] Scott Carpenter and a doctor who was stationed there in Hawaii and a couple of systems guys. I was on the [air to ground] when he called and said he got the 0.05G light. So we asked him if he could see any clouds. He couldn't see any clouds, so we knew that it was a bad light, but he had to fly the thing back. It was exciting time.

But I was gone, and in those days when you left you never knew when you'd come back. We'd just built a home and moved in it, no carpet on the floor, and the wife had to deal with two little kids and the overflowed toilets, you know. [Laughter] You stayed. I was gone for six weeks, and it was kind of hard for her to understand why we could go and have a great time in Hawaii. But we worked hard. Things paid off, because when we came back, things worked out really well. We started the transition at that time reviewing the specs for the new Mission Control Center.

But people don't realize we worked—if you've driven up Gulf Freeway [I-45], right there at Wayside is where we were. We were in the Houston Petroleum Center, but we worked in the old Oshman's warehouse. The E&D [engineering and development] guys, were in…a building on Telephone Road. The Farnsworth Chambers Building, the place was where all the heavyweights were, except for Kraft and [Sigurd A.] Sjoberg and those guys.

We had a good time. The thing that was really exciting about Mercury is that we had a lot of, I would call them mavericks. There were no rules. We wrote our own rules, we wrote our own systems book. I should have brought you a copy of the Mercury Systems Handbook, which was like a little address book. You may have seen it. I still have one of those. We worked really hard to get things done. We had a lot of creative people, and since we didn't have any rules, we could be creative and we didn't have a lot of problems.

We had a lot of folks that moved from England, because England had a real problem, they moved to Canada and worked for A.V. Roe, [a] big-name airplane company, but their airplane that they had built that was so great, wasn't sold, so they lost that company. And a large number of Canadians came [to the U.S.].

A funny story, we had Morris [V.] Jenkins. I don't know whether you've ever met Morris. Morris always had a headache and we could never figure out why. The problem was, he wore his shoes too tight, because he got the Canadian and the English size, so he always had tight shoes and a headache. Finally he realized that, got rid of the headaches

overnight. There were a lot of funny things like that that happened. People were really comrades in arms. It was a really good time, a good time to work. You don't have that experience anymore, I don't think.

Mercury was exciting, but we went right on into the Gemini Program. We went to the Cape [Canaveral, Florida] for the control center. That time I went down after Gemini I and Gemini II, and took the family, was going to take them another time, but…our son Joe, ended up with chicken pox, so he couldn't go, so the family stayed here.

On Gemini II, which was unmanned, we lost the plug and the thing didn't go. In the Mercury days, the flights just didn't work. The Mercury Atlas finally was a big deal between, and they used to call the Atlas, "At Last." [Laughter]

The Cape was a different place then, not as built up as it is now, but a lot of good people at the Cape, we came and started here. Gemini III—was it Gemini II or Gemini IV—we backed up the Control Center at the Cape, and then for Gemini V we worked here. My biggest job during the Gemini Program was to lay out the design for the Mission Control Center. We did all the requirements for the Mission Control Center and worked with Philco, who won the contract. It was Philco Ford, I guess, at that time.

We had problems with people leaning over the consoles and touching buttons and switches, and so we wanted a cover on the command switches. We had a good idea, but people didn't know how to do it, so guys would take the plastic home and cook them in the oven, and that's how we made the first ones. There was a lot of creativity by people like that…

Gemini IV, we had fuel cells on that—Gemini IV was when we had the first spacewalk. That was an exciting time, because there were ten of us that worked every day our regular shift and then we worked at night preparing for a spacewalk. You can't imagine, we had no computers, we had only the old way—I can't even remember what it was called—paper had about sixteen copies in it. You'd type a deal, and then if you made a mistake, you

had to pull them all apart, change them. We had one secretary and about ten of us worked on the ops side, worked with the flight crew every night, Jim [James A.] McDivitt and Ed [Edward H.] White [II], who lived a couple of doors from me and my family. We worked on IV doing that… We had another set of young people building the pack, they took a bail-out bottle and [made the life support] flight-rated that where he could go in and be outside. We worked on that probably four to six weeks, got everything ready, and were prepared to go, and a week before the Russians did a similar thing. But we pressed on and did that and it was exciting in the Control Center.

Gemini III, I guess, we backed up what went to the Cape. I was here with John Hodge and Glynn [S.] Lunney to make sure everything was right. We had fuel cells on III, and fuel cells had a problem. We were kind of excited, because our guy caught the problem with the fuel cells. Rod Loe caught that problem. We kind of one-upped them and were really excited about that.

But we got through that. IV, we did it here, we had the big spectacular of the space walk. The President [Lyndon B. Johnson] came after that and promoted them, you know, and it was an exciting time. Huge crowd where the duck ponds are. I don't know whether they even have the duck ponds anymore.

BUTLER: They sure do.

ROACH: But it was an exciting time. He came and was very gracious to the crew. That's when we started getting the patches for the people who worked in the control center. We knew we couldn't pay them for the long hours that they worked. Spent a lot of nights in the control center, sleeping in the horrible dormitory that we had there and eating the bad food.

I remember taking my daughter's Girl Scout troop through the control center. One of the kids' dads worked in the control center, too, and she was so excited and said, "They've got

the greatest machines." Of course, he thought it'd be the computers. He said, "What kind?" She said, "Well, there's a Coke machine and a candy machine." [Laughter] So you can see where the kids were from.

We worked hard on the Gemini. We worked a lot working on the operations for Gemini 76 [Gemini VI and VII rendezvous mission]. There was a big change in the philosophy. Mercury, you would go and you'd wait and you'd work and you'd wait and you'd work and you'd wait, and it'd finally go. Bill [William C.] Schneider became one of the leaders up in Washington, and he made a decree one time that we're going to launch ever six weeks, and we did. From that first EVA deal we had, we went on and we flew Gemini 76, where we had the first rendezvous.

We'd had a problem with one. One flight was up, so we sent the other up pretty quickly, but in a sense, we had two missions and we worked around how to figure that out so we could keep track of both. Had people sleep over and that ran for a couple of weeks. One was quick, the rendezvous was quick. I believe Wally [Walter M.] Schirra [Jr.] did the rendezvous, and Frank Borman was the commander on the other. He and Tom [Thomas P.] Stafford, I think, flew.

But we started working real close with the flight crews in the early days, probably from Gemini IV on. I credit Chris [Kraft] and Deke [Donald K.] Slayton for it. We were responsible to make sure that the checklists were all right, but we never saw them. I went and complained to Kraft one day, and said, "You know, we can do it, but we never see them until after the flight starts, and you can't do that."

The next day Deke called and said, "Hey, what do you need?" Told him what we needed, and we never had a problem from that time. That's what I'm saying; you didn't have to write a letter or have a briefing. It was more one-on-one and people responded.

The other thing that flight ops people did and we were instrumental and we developed some trainers that were cheap. We had a couple of training guys and we got old hardware

and stuff put together, made some single-systems trainers that went on and worked for Gemini and for the [Skylab] space station. It really helped the people on the ground, and it was pretty exciting.

You talked about—I think you asked the question, when did the back-room support start. That started in the Mercury Program. It started with just a small group of people because we only had one spacecraft. That was McDonnell Douglas. McDonnell [Aircraft Corporation] made the Mercury and the Gemini. And a lot of sad faces when Apollo came along, because McDonnell wasn't involved, because everybody thought they were the only ones that could make it, but [North American] Rockwell [Corporation] made the command and service module.

Then we had Marshall [Space Flight Center, Huntsville, Alabama], who build the booster. The early boosters were just kind of leftovers, the Mercury—the Redstone, and the one from the Atlas, they were things that were used in the early days for the military. Then, of course, the Saturn I and the Saturn V were developed and tested and done by Marshall. That created another interface. There was a lot of duplication at that time.

But we got through Gemini and we did everything in preparation in going to the Moon. We had a lot of clever people that were in the front rooms, a lot of good folks who were in the back rooms. We had some real problems during Gemini, and thinking of one, when Neil Armstrong was flying [with the Agena] and the rocket didn't do very well and so they came down early. We had some other problems, but they were mostly personal, personality problems.

Went into Apollo, and we flew Apollo 1—Apollo 501 and 502, and they were fairly close together. 501 went well, 502 went into orbit backwards. We had a problem because the engine people put wires incorrectly and one cut off one engine and the other one cut off, so we went in backwards. So the next flight, of course, was 503, where we wanted to go up around the Moon, a tremendous, bold step. You think of gutsball. I would think Chris Kraft

probably had the most influence in getting that to happen, but you need to remember that we had done the rendezvous, we had really looked at the orbital mechanics, and that was a new science for us.

[Howard W.] Bill Tindall [Jr.] was a real heavyweight in that, and he started these mission techniques meetings, where he was the king and he listened to everybody, then he wrote the minutes and really controlled the procedural process. And then we put them in the change control, and that's the way it was, and then we froze the programs and it worked well. We got that done.

I remember going to—it was a weekend, I remember going to the 503 final review for the engines at Marshall. I was the Johnson [Space Center] rep, and I got there, I had to fly to Atlanta and then catch a gooney bird to Huntsville, you know. It was horrible weather. Got there Saturday night, there's like one place in town, so I stayed there.

But it was so interesting, [most of] the people were all German. I was the only one practically without the dueling scar, but I thought this must have been the way it was in Germany during World War II, all the blonde ladies and their dueling scar husbands, and there I was eating dinner alone, which was fine. And then went to the review and then came home that day, and we made a "go" to fly 503. Another exciting time where we worked really hard together to make sure that things would turn out right, and everything did.

That was after we had had the 502 thing and got that done. The next one, of course, we were ready for the—and that was, of course, after the fire. The fire was a devastating time, but several good things came out of it. Number one, we got rid of the environment. Number two, the hatch was redesigned. The biggest thing that happened was the discipline that had to happen that wasn't there when we had the fire, and we never changed from that time. We used to do a lot of things where people really didn't watch the systems as close as they did. People at the Cape had watched them, but from a different point of view than the ones in flight.

But we had lots of good people that rededicated themselves to do it by the numbers, and that came from the crew side, from the people at the Cape, and from the people here, both in the engineering and the operations sides. The safety folks really got on the horse, too, and worked really hard. If you've ever been to the beaches in France and you've seen how the Normandy invasion was done, it was the same kind of effort by all the people that worked on Apollo.

Apollo was an exciting time. We flew 503, and then a month later we flew Apollo [9], and [9] was when we had the lunar module. We were really concerned because the lunar module didn't have a heat shield, and so what we did then was we built some procedures called lifeboat procedures. We were so proud of them, we took them to Kraft and he said, "You guys are crazy. You're nuts. I don't ever want to see them again."

Well, we completed them, kept them, didn't have to use them to rendezvous on, 7 was good, and then we flew—I guess, 503 was really Apollo 8. I can't keep the numbers straight. Apollo 7 was the guys flew around the [world] three days, I guess. Then we had the lunar module flight and then we flew the lunar module with the command and service module. I think that was Apollo [9]. Jim McDivitt flew, was the commander on that one. He and Rusty [Russell L.] Schweickart separated and we had the lifeboat procedure.

We flew Apollo 8, which was 503 launch vehicle, which went around the Moon, and then we had 9. I can't remember the numbers. Nine, I guess, was the flight with the two vehicles together, and then 10 we flew around the Moon with Tom Stafford and Gene [Eugene A.] Cernan and came real low [over the lunar surface].

There again it paid off, because when we flew the guys on board, put the wrong switch and then swore they didn't and we knew they did, but we told them what to do, you know. But it's got to be nerve-wracking when you're 250,000 miles away and you think everything's going, and the wrong planet's coming at you, and then you know that everything's going to be okay, and they came back.

[Apollo] 11 was another big deal. We had some young folks in the control center. We had four situations during the lunar landing when we could have called an abort. We had a young guy who had done a slosh model, and, of course, as you move the lunar module, the fuel uncovered a lot of the sensors, and when you did that, you'd get a bad warning. But we had had a guy who had watched the slosh work, had developed his own little model, and he was the expert and he kept saying, "Keep going. Keep going. Keep going," when we had the alarm problem, and everything worked out.

So then we got them back and everybody was a hero. Big parties, all that good stuff, and we were really confident and cocky, Apollo 12's going to be a piece of cake. During the launch phase, we were struck by lightning. At that time a couple of us were in the back with the Spacecraft Analysis Group, and one of the things that we wanted to do was to marshal all of the engineering talent, but do it in a way that it was controlled. So we were the focal point to all the contractors to the mission evaluation room and to Marshall.

MIT [Massachusetts Institute of Technology], we had a guy named Steve Copps who was with us. I don't know whether Steve was there that day or that shift, but the platform was ruined on the spacecraft, so we did the same thing. We had a backup at MIT and we dumped the platform. The whole plan was to bring it back, get it straight and fire at the end of the first revolution. Well, the Marshall people were dragging their feet, dragging. They needed not three nines, but ten nines to make sure, because they didn't know how bad things were. But we had the guys at MIT who did that, and we worked that through and got the data to Kraft, and we pressed on.

So then we were really cocky because had had two successes. Of course, Apollo 13, probably the only time in my life that I've ever seen people put away their own motives and work together. In fact, my wife and I were so confident, our daughter was in the hospital to have her tonsils removed. [Laughter] I called and told her that we'd had a really bad problem and I didn't know when I'd be home.

It happened right at a critical time, we had two choices, we could either press on and go around the Moon, or we could fire the command and service module. We probably had enough to bring them in the Indian Ocean, a long wait. We didn't know what the damage was to the command and service module.

Kraft had just gone home and was taking a shower, and he got the call and, of course, he came right in. First question that he asked, "I guess you've got your lifeboat procedures." [Laughter] "Roger." We did.

BUTLER: It's great that he remembered that you had them.

ROACH: Well, we were just thankful. He was a guy that challenged a lot of people, but he did it in a kind way, and he allowed people to grow and really be exceptional.

The thing at that time, it was really critical because we had run—you know, the lunar module is supposed to live for three days, and we had to make it live for six. There were lots of problems that if you've seen the movie *Apollo 13*, which was probably as realistic as it could be, but there were a lot of things that went on, like Ken [Thomas K.] Mattingly [II], it showed in the movie, where he went and did a reswitch to make sure that everything was good, made sure nothing happened. But we had got the first thing to press on, that was the first big deal.

The next thing was, how do we conserve the power and the water in the lunar module so the guys could live and how we keep them warm. Then we had the CO_2 problem, and the guys from the environmental systems came through. There again, I guess we had a couple of hundred problems that we dealt with from the analysis to the different controllers and the different evaluation teams.

I remember we had gotten to the—we ran a simulation. I got a call from one of the directors. I was in the SPAN room at that time, and that stands for Spacecraft Analysis, you know. It was from Bob [Robert A.] Gardiner, and he said, "You're going to kill the guys."

I said, "What are you talking about?"

He says, "We've just run a simulation and the docking ring is going to break, and they'll die, and we won't hear from them after we made the maneuver to come home."

See, we were ready to fire and as soon as we fired, we were thirty minutes in no communications and then they would either come back or we'd never hear from them again. So I said, "What weights did you use?"

He said, "I don't know."

I said, "Well, we've just run a simulation with the weights that are on board," and in the background you can hear ten, nine, eight, you know. I'm about to die, but one thing we learned in this space thing was if you don't know what happened, don't do anything. We had done the best we could. They were ready. They were all ready to go, and they did.

Well, I sweated bullets for thirty minutes and then the first thing it was, "Apollo 13, this is Houston," and they said, "We're coming home." Well, I was a happy dude, to be very honest with you.

Then as we came closer, we went through another series of problems. An exciting time, got them home, and really was a neat experience.

Then we started, we flew Big Al [Alan B. Shepard, Jr.] the next time. That was an interesting flight, no problems.

Then we had our first experience with the Marshall folks, not only with the rockets, but with the lunar rover. We had had one our guys go to every training session that the flight crew did with the lunar rover. He was a contractor, Harry Smith, Jr.—no middle initial—from Poplarville, Mississippi. Harry was one of the smartest people I've ever known without a formal education. Poplarville's claim to fame was where they had Inspector Number Eight

that did the underwear. [Laughter] That's all I can remember of Poplarville. But Harry would say, "You're wrong," like that.

They could not get the lunar rover right and they had these big tethers, or tabs, that you had to pull—if you didn't pull—and we were running out of time, running out of time, and the Marshall people kind of gone duck dead in the water. We were working with them. They were now in the Spacecraft Analysis Room, but they couldn't get a response from the Boeing people at Marshall. Harry finally said, "Pull this tab," and the people at Marshall wouldn't come through, and finally he said, "Do it," and they did and the rover popped out and we were back on the time line.

Well, the people at Marshall went bananas. [For each mission,] we had given patches and little deals to the guys [as] a little memento. They didn't even want Harry to have one of those. That's kind of the problem. But in the meantime, to give you the different ways—the Director of the Marshall Space Flight Center was there, and he was just kind of watching over things. People were so busy, and we have, of course, the pneumatic tube system and you sent stuff, and somebody said, "Here, take this and send it to station number nine." The old director, good old German guy, took it, stuffed it in the thing, dialed it up, and sent it. And that shows you that nobody was wearing their stripes, except a few people, but that started the differences, I think, between the Marshall people and the Johnson people. But that was not a big deal, it was just kind of a healthy competition.

But we got that flight done, and then on [Apollo] 16 we had a real problem again. Ken Mattingly flew the command module and John [W.] Young and Charlie [Charles M.] Duke [Jr.] [were] the lunar module pilot[s]. There again we worked with a problem. We made a maneuver when we separated and the command and service module engine didn't work right. So we were really concerned. Of course, the guys had separated, and we needed to argue it a bunch of times and we needed to bring it back together so they could all come home.

In that same period of time we went through all the records at Rockwell. We had all the Rockwell engineers, we had all of our systems people from E&D, and we found out that the engine was good, so they separated again and then landed, and that was a really successful flight. Of course, Apollo 17 was.

In the meantime, we started working on—in that same period of time, flight operations and flight crew operations were joined together, and Kenny [Kenneth S.] Kleinknecht, who was one of the best, Kenny had been the Mercury project manager and the Gemini project manager, and a really wonderful guy. He became the head of flight operations and that had both the flight crew and the mission operations folks. Gene Kranz was his deputy and I was underneath Gene. I worked for Gene as his assistant for about sixteen or seventeen years, I guess. As he went up, I don't know whether that was good or bad, I went up. Then Kenny moved over to the Shuttle Program Office, and then George [W. S.] Abbey was brought in to…head [our] that group.

One of the really neat guys in the Apollo Program was George [M.] Low, and not George Low, Jr., who's the astronaut, or used to be an astronaut, whatever it is, but George Low was one of the most brilliant managers I've ever known. He had—I can't think of Judy's last name, Judy was his secretary, and he would dictate his letters and never read them. That's how confident he was with his dictation and she was with recording it, and then he would sign them the next morning.

George put the discipline in the Apollo Program, and we had some real problems early days getting the discipline in the Apollo Program, because it was a gigantic program. The Cape had to be redone, the Mission Control Center had to be redone. A lot of different things happened. George and Chris must have had a blood oath, but they worked so closely together and they brought things together. We had a really good working relationship with those two guys and they really supported us in what we did. In the Apollo situation, very

little second-guessing went on with what happened in the Mission Control Center during the flights.

At that same time, Gene and I started a thing that we called Marvin Manpower. We started figuring out how we could track how much energy it took from our people to get ready for a flight. Flight mission rules were really important. They grew from just a few pages to a document that big, and that's what we used to train our people with. The operations handbooks that we had, of drawings of all where people took the logic drawings and recreated them, they'd cover the wall, and they were all hand-drawn at that time. Had to be checked, because that was what you saw.

I remember taking, when we got ready for the Shuttle, I remember taking John Young and Charlie Duke, and we showed them what we watched. We had problems with the pilots to get and use electronic stuff rather than the meters and the dials. We showed them we had two screens with all the lunar module data, not the trajectory, but all the systems. Even though we played the tape, the descent tape to the Moon, listened to the voice, watched the systems burn, they didn't believe it. Here are the guys who landed on the Moon, they wouldn't believe it. But we were trying to convert them for the Shuttle system to get rid of dials, because they only show one thing. The cathode ray tube can show you any system. And they finally submitted to that years later. I think they still have the eight-ball in the Shuttle, in the Orbiter.

George Low allowed flight operations people to have a voice in how the systems were developed and how they ended up on the spacecraft, and that was a huge step. Of course, then we were working so close with the flight crews that it really made the flights a lot easier.

But on 13, I'm convinced that those people depended so much on our guys on the ground that if somebody said, "Open the hatch and jump out," they would have done it without question. They did their job and we did ours, and there were a ton of folks working

together. Like I said, never in my lifetime before or since have I ever seen that kind of cooperation.

I think how much better our country and our world would be if we could get people just to say, "This is really what needs to be." I've thought that the people we had at that time, if we wanted to feed the world that are hungry, we could do that, provided we don't have all the hurdles we have now, we would have done it the way we did it in those days. People went across their interface and asked enough questions and played what-ifs.

Our training people were another brilliant set of folks who didn't get the glory that the folks were inside, in the Mission Control Center, because their pictures were taken all the time, but they were just as important. We had simulations. One thing we did, we debriefed each other. We'd say, "I'm the procedures guy. This didn't happen right, this didn't happen, I made this mistake." And we found through that kind of debriefing that people remembered their mistakes and they didn't make them again, because they were doing it in front of their peers. That was encouraged. Our simulation people figured out ways. They'd start a little leak and then it would manifest and then something that was guaranteed never to break would break. Let me tell you, that happened on the flights. You know, people said it's not realistic, but it happened, and it saved a lot of lives.

We went on into—go back to Marvin Manpower. We figured out if we flew this kind of flight, then we ought to be able to do it with less people, so we took some of those people after the flight and started working on Skylab. So we were ready for Skylab when it did [happen]. We took a few other people and put them on the Shuttle. It's probably automated now, but at that time we tracked it, we wrote it all down and we knew more where the people were than when we briefed. At budget time, we never lost a budget battle. We always got what we asked for, because we had the data and nobody could question it, and it was pretty realistic.

Skylab, we ended up with Marshall building a big chunk of the hardware, so they wanted a place in the Spacecraft Analysis Room. It's the old SPAN room, or the Spacecraft Analysis just expanded. That was a problem, and we also had to fly for nine months.

There was an interesting thing happened. Dr. [Robert R.] Gilruth, who was another really pioneer here, you had to know that guy. He was very quiet, but a brilliant guy. His wife was a balloonist in the thirties and flew with [Jacque] Piccard. But he wrote my wife a note, thanking her for what she did [during Apollo]. Really neat.

BUTLER: That's really special. It's great that he recognized her contribution.

ROACH: Because there were a lot of families that just exploded and disappeared. Our family had a special problem. Our son was born a dwarf, which caused a lot of trips to Johns Hopkins, a lot of different kind of things. But Joe's done great. He's an accomplished, high-paid lawyer. He just retired from—he's in the [Houston] City Council. But he's had some of the similar problems that we had. He and his wife lost two kids. Well, they lost [two] kids, full term…and one [early on]. Now they have three kids, and it's really unique, they're the same [ages] had they [not lost] their natural family. But it's amazing how well they're doing.

So a lot of the things that happened during that time my wife had to take care of. Our daughter is older and she helped a lot, too. But a lot of…[families] just disintegrated, just too much stress. And that happened also with the flight crew.

But we got into Skylab and we had some interesting experiences there. We had really grown tight after Mercury, Gemini, and Apollo. We had two dilemmas in Skylab. The [ground] software packages weren't working. IBM was the contractor and they worked really hard. I can't remember whether it was CDC or who it was— [Brief interruption]

We told Kraft—we had a huge meeting up in [his] conference room, and this is one of the times where he pulled his [Nikita] Khrushchev trick, which he was prone to do. There

were two things you had to remember about him. He had a coin purse, and if you had one of your troops briefing him—and we always believed we would have the smartest and the best person brief him if we had a problem, and we would watch what he was doing and kind of try to orchestrate, or control, what was said. If he took his coin purse out and started counting his coins, you knew time was up, no matter what you were doing or who you had there. You know, cut it off, Charlie.

The other time was when he would hear something that he thought you were wrong on, but he would really kind of take his shoe off and let you know you were wrong.

But this time we had gone—Flight Support Division, which was part of flight ops—terrible time getting the [ground] software system together, because what we had was in Skylab you had a long recording period and we were out of touch, so you used all that recorded data to play back and then evaluate. And it wasn't working. The front-end computer that brought it all in was on its knees, and they had beat the poor guy to death, so we thought [it] had [to be] evaluated.

So we went around the room and IBM said, "No go." Somebody else in flight ops said, "No go." The guy who had the huge problem said, "We are ready to go." Everybody about had a heart attack. Kraft said, "That's the kind of spirit I want." He says, "I'm going to give you guys forty-eight hours," bang with the shoe, "or I'll replace everybody." So a miracle happened, you know, and the [ground system] worked.

We flew…the first launch, remember the…[solar panel was stuck]. The guys who were from Marshall were literally crying in the control center, and rightly so. You know, they'd spent ten years trying to get that rascal up. We had the optimists in the Mission Evaluation Room and over in tech services figuring out a way to make it work. Guy had a fish pole, stuck it through [a hatch] and put the heat shield out to protect it.

The crew came back and, of course, at that time they had been in isolation. So here's a hundred people, maybe fifty people, were all sitting in the room with the mask on, reading

this. You can't hear anything that anybody says. Then pretty soon Joe [Joseph P.] Kerwin, who smoked a pipe, had cut a hole in, you know, and he had the pipe sticking out. Well, after about four days, you know, and that seems kind of silly, but that kind of togetherness kind of broke all the stuff down.

Well, long story short, we figured out a way to launch the other one. We put the crew in there. We figured out a way they could cut the band that was holding it, the thing snapped, but we still had the toxicity problem of what happened inside because of the heat. The Marshall folks, in their good old German way, had figured out a way to build a [fix], but it was so heavy, we could hardly carry it. We were afraid the guys couldn't manhandle it and do it. They ended up drilling holes in it and making it lighter, and it worked. Got the thing stabilized and went in, got it all set and we flew a thirty-day flight, a sixty-day flight, and a ninety-day flight, but there was a period of time between that, so it ran out in nine months.

This was in the days before PCs [personal computers]. You think about the power of the computing system in the control center, the system we used to go to the Moon now fits in a PC, that's how much power. And that was the top of the line.

But when our guys worked—and we lost a lot of other people, but we had a team of North American, or Rockwell, McDonnell Douglas, who built a big chunk of it, one of the universities that built the ATM [Apollo Telescope Mount] computer. We learned how to load computers really good from the ground. That worked like a top.

But I remember[ed] something that Dr. Gilruth did [during Apollo], and that was write a letter to my wife. So I personally wrote a letter to every wife in the flight ops. It was four hundred letters, I guess, maybe five hundred, that I wrote, to thank them for what they did. And that was not on a PC; that was all handwritten. [Laughter] People didn't know what a PC was in those days. They would have been nice to have.

But we had some difficulties with Marshall, but they all worked out and it strengthened our team. We learned how to do EVA in the early days. We trained guys over

here. We had the recovery group in flight operation. We had a barge and enough rope to wrap this building three million times. Everything. You can't imagine. I remember one time we said, "Well, how do you get a guy to the command module once they land and they're hurt?" So the tech services folks built a huge, I call it a shoehorn, but it was a fiberglass deal that they could put behind the crewmen's back with handles, because if you've had trouble, if you've known someone that's been real ill, it's hard to pick them up when they're dead weight.

So we were in a place, a little cylinder full of water, and we'd dump them in the phase two position, which is top in the water, which means if you don't turn it up, you're going to drown. But we said, "Put on a helmet." And fortunately they did. They put on their helmet, and they ripped the guy out, is the way I looked at it, and sent him sailing over to the metal pool top, and his helmet, you've seen a kid who's run into a wall riding a little motorbike. But we learned that way. We learned how to do it, you know, and it worked out.

Skylab was a really a huge success, and it's a shame that the U.S. didn't have enough money to keep that up, because we would have beat *Mir* and we would have learned, but we learned so much from the medical standpoint that people really, really in our country have had the advantage of.

The thing that I used to always stress when I talked around the country are the real benefits, the computers, medical. You know the square fat ambulances that we have are all direct from there. The telemetry can tell you what the problem is. The miniaturization. I have my own pancreas right here that keeps me alive. It's an insulin pump that takes care of diabetes.

But it was a group effort, and probably one of the huge strengths was a lot of people together from different backgrounds and different mores and values, that came together because there was a goal. There were some really special people, guys like Bob Gilruth,

Chris Kraft, Gene Kranz, who I worked with really closely for a long time, George Low, Kenny Kleinknecht.

George Low got cancer and died, I think with melanoma, but the kind of guy he was, he went to M.D. Anderson [Hospital], and while he was sitting in the waiting room he wrote down the problems the patients have, segregate the patient so if you're going and don't know what you have, you don't have to see the patient that's eaten alive, or has no ear or no arm or whatever. Chuck [Charles A.] Berry, who was one of the early doctors, was at that time, I believe, in charge of the health center down there. He wrote probably fifteen, twenty pages of problems and solutions. It was unbelievable.

I felt like when we walked from our building over to his, we needed to be working and thinking about what we were going to talk to the chief about.

But they were gracious people. I can remember going to see Chris. Before every flight we had to take the mission rules and tell him what the problems, what the changes were. So you really got everything squared away, every I, every T, everything was understood. You understood everything. Sometimes he would ask you a question, sometimes he would just sign it. [Laughter] You'd say, "Boy, I wasted five good days," but you knew that if you didn't, he would ask the one question. But he had a knack for sensing. But he was also a good guy.

I remember the Senior Promotion Board, we'd put a guy in, and then we heard he wasn't even talked about, and we were really upset, because the guy had done a magnificent job. I saw [Kraft] that night going on, and he said, "What in the world [is wrong with you]?"

I said, "I am really disappointed," and told him.

He said, "I make mistakes. Come see me Monday." We went to see him Monday, and he signed it. [Laughter]

Then the other directorates were mad because we had one-upped them, but, you know, they could have done the same thing. But he was a neat guy. He still is a neat guy, a special person.

It's interesting, I talked to him one day, I was disappointed in an assignment, and he told me when he worked at Langley, he'd been a GS-13, I think, for fifteen years, and he said, "My boss was so bad, I got ulcers and I almost died." So I'm sure it was true, what he said, but I got to thinking, it's not too bad what I've just been through, because it really wasn't. But he is a special guy. Gene Kranz was, too. Gene has been a special friend for a long time, he and his family. But there were so many.

I remember one of the things that we learned from the lunar module after [Apollo] 13 was to take—in the old days, computer programs, if you had an error, it would manifest itself. So we ran the programs twice as long as they needed to be. If it was a three-day flight, you'd run it for six days and then check your errors.

Fortunately, we did that on the lunar module and rationed the water and that kind of stuff and it worked. When we went to review the Viking, Bill Tindall who was the head of the data directorate, and Jim [James C.] Stokes [Jr.], who was Flight Support Division, we had an Air Force guy with us and Steve Copps from MIT, who did the on-board software, and myself. The director of Langley, who built the thing that went to the Mars surface, asked us to come, and one of the things we asked them was, "How long have you run your descent program? Just the descent period of time." Well, we said, "Run it twice as long." Well, they really got angry, but in the end, the director from Langley, a guy by the name of Ed [Edgar M.] Cortright, said, "You know, these are our guests and they're not getting a hero medal or anything else. They want you to learn from their mistakes." And I think we them did a good job.

The neatest return from that for me, I have a picture…that was taken by Viking that landed on Mars. Not the lunar surface, but the Martian surface. It really is red, unless they

put a color film in there. But we went to one of their operations and watched them work, watched them simulate, and they went through a lot of the same problems that we did, and we just helped them [solve] the problems. That was a neat experience.

I also did a lot of the stuff for pulling flight ops and flight crew ops together. That took about a year of discussions with the different managers, because everybody thought they were getting cheated, but they accepted that. That was an interesting experience, because we had to bring some other folks into our Marvin Manpower system, and if you are sensitive to the way people are, the more they have, the stronger they are, but what we were trying to do was to make it a lean organization, because we knew cuts would come. It's going to happen, so [you had to] get your organization [in shape].

Then we also had an idea of training your deputy to take over so you can move. And that's kind of why I left. I had done of it all I could do in the space program, and I was also a little nervous about what Ronald [W.] Reagan going to do with the retirement.

A guy met me in the parking lot one day and he says, "Would you like a job?"

I said, "I hadn't even thought about it."

He said, "Well, you know, they're having an opening and you can retire and keep everything." So I thought about it over the weekend, and decided to do that, and I went to work for McDonnell Douglas for about five years, and then I went to work for Computer Sciences Corporation for about five years, and then retired and did some consulting.

But the people that I came in contact with were really something. I grew up with Glynn Lunney and Cliff [Clifford E.] Charlesworth, and I worked for Glynn on the Shuttle program on the first four flights. I did the same thing for them. Of course, the Shuttle had had more things than Skylab, and the first four flights were pretty spectacular. We had a few nervous moments during the approach and landing tests.

But there again, Kenny Kleinknecht was a guy who worked with us really close, and he was the chair of the change boards where all things were controlled and invariably the

crew would come in, we need to change the light from green to purple, or polka dot to chartreuse. That costs a lot of money. I'm being facetious when I say it was those colors, but they were trying to make it easier for them[selves].

When we flew the Shuttle training airplane, that came under us and we were spending tons of money. I mean, it was like a three-million-dollar deal up to twelve or fifteen million and Kenny Kleinknecht came in. They had no schedule, so the first thing we did was we had a schedule and we briefed every morning, where are you, where are you going?

We were flying the plane up there in Long Island, and we had several of the training pilots from Joe [Joseph S.] Algranti's shop. The flight is, I don't know what you know about flying, but the Grumman 2, it's not the Gulf Stream, it's the jet version, it's like a strafing dive to land, and then it pulls out and lands. That's just how the Shuttle does. If you've watched enough Shuttle landings, you don't realize, but if those landing gear don't come out, you're dead. I mean, you're dead.

So we had a problem. The crewmen that flew, of course, the stick was the same way as the Orbiter. The guy said, "I need a thing to rest my arm on." So we asked Grumman, "How much is it going to cost?" It was exorbitant. So we said, "Tell you what, go down to the hardware store and buy a piece of PVC that's got an angle and you could put it on the arm [rest] and gray-tape it and then you just have your arm lean on that." Worked, and it cost ten dollars and ninety-five cents.

Then the guys in the flight crew said, "We need the real hand controller." So Kenny devised a Cinderella deal. We had ten crewmen come in, we had the real [hand controller] and a mock-up one, and he blindfolded them, and eight out of ten picked the mock-up. So that's what we used. The price there was like three million dollars versus twenty thousand dollars.

So Kenny, he was another neat guy who went to the Cape. We had the tile problem. I don't know whether you know, but those tiles on the spacecraft—and it reminds me of a

fish. It would be like catching a fish and taking all the scales off of it, and then trying to put them back on. Every tile has a part number. I remember being down there, they were going to open the [landing] gear to see if everything cleared, and everybody was clear, and they popped the gear down and it shredded those things off like scales on a fish. So Kenny [defined] some real procedures. He went to the Cape. He would take on any job that needed to be done. He was a real workhorse in the space program. Neat guy. He got the Cape squared away, which was another dilemma, and got the Rockwell people squared away and got the Orbiters started through the pipeline and we started flying.

But we had to learn a lot different, and the problem still goes on. If you know now, the cockpit has all of the things on the cockpit—I can't think of the word—that you can look. You don't have to look at your things, it's got the airspeed, the wind velocity, all of that stuff. I can't think of the—

BUTLER: The head's-up display?

ROACH: Head's-up display. We had just been through—and the change boards are there all the time. You meet in the morning, you find out what's going on at the Cape. In the Shuttle Program I spent a lot of time in 602 watching all that foolishness, and then go to the noon change board, and then, of course, there was the PRCB [Program Requirements Control Board] and the CCB [Change Control Board] in the level three, and all that junk. So you spent most of your time in the meeting, listening and then passing the data back and forth to people. Now you could go and type it and send it on the Net to whoever needed to be there with all the data. I would imagine that's what they do now. I don't know.

But I can remember being there one day and a guy said, "We will never"—this was one of the flight crew saying, "We will never be back for any more changes." We wrote that in his log, "Never be back." A week later, the guy comes in with the head's up. "If we don't

have the head's up, this plane will die, you know." I thought Glynn Lunney—if you know Glynn, Glynn's face gets red every now and then when he gets—and he looks a lot older than he really is, and he'd say, "In the log I have written, 'Will never ask for another change.'" But they'd made that and that's a good thing to do, but it was just so untimely, so untimely to make it. They've done a good job. There again, they've got a lot of good young people that I worked with that are still there, that are not young people anymore, but they really do a good job.

I would think that things that are really neat about the space program that I've witnessed is the people who stood out. George Abbey was another guy who worked for George Low, and he was a big help in providing access to Low when he was Apollo Program manager and George worked for Chris to provide access, because we never went unless we had a problem that we needed to get a blessing. Then sometimes he'd say, "You're right, but you don't understand all the facts." And we could understand that. He said, "I've got to do this." We understood that he at least had listened to us. He wasn't somebody who just punched your card and didn't listen.

Another guy who probably a lot of people don't even know was Sig Sjoberg. Sig was Chris Kraft's, I call him—I would never say it to either of them's face, but his alter ego. He was very reserved, but very, very smart. Sig, I don't think has been well for the last few years. But he always asked the most probing questions and got people to think that maybe there was another way or maybe it wasn't the right time to do something. He was a special guy and still is. We'll remember him, because he was as solid as Kraft and Gilruth, but just was more quiet.

Dr. Gilruth was very reserved and very quiet, but he was one brilliant guy, and had chances to get a lot of things done. He was wise, I think, because he picked people and let them do it, and then kind of held the reins kind of loosely, but didn't worry so much that it

wasn't going to be done. And it takes a big person to do that. You don't need a control freak doing that.

I look at the people that are in flight ops there or mission ops, I guess they call it. Randy Stone. I knew Randy and his wife before they were married. They've been married thirty years. He's matured and grown to be just the right kind of person to keep the tradition going.

One of the guys that we met was a famous painter, and I can't think of the guy's name, but you've seen his murals.

BUTLER: McCall.

ROACH: Bob [Robert T.] McCall. We talked to him, got interested in him, and he initiated the first patch for flight operations. It was an exciting time. Probably won't be as exciting, it probably isn't as exciting now as it was, but I think that people that are there probably think it is. They probably think we did things, and a lot of the things we did were Dark Ages approaches, but we got it done with what we had and the money that we had and the people that we had. But the people were just, it was a special group of folks.

It's interesting now to see that the barriers have been broken and to see the women having a lot of good jobs. It's timely. They were just starting when we came, when we were there, and it's interesting to see that that's improved and gotten larger and larger, because there's probably no one smarter than my wife. [Laughter] Our problem in our family, we needed some Indians; we had all chiefs. Our daughter was a chief, our son was a chief, my wife was a chief, and I was a chief. It's interesting that our grandchildren are the same way, the three adopted ones, you would have thought they were the natural ones. Our daughter has two girls, and one is going to be seventeen in a couple of months, and she's really a great

athlete, great student, and a great kid and will do well in life. It's so happy for my wife and I to have two kids that are both really good citizens. Just, boy, really lucky.

In fact, my wife and I were shopping last Friday and ran into Carmen Kranz, Gene's oldest daughter, and we didn't know she'd had a little baby, beautiful child. It was good to see her. In fact, she recognized us…it was just a neat time.

I don't know whether that's enough for you, or whether you want to talk again.

BUTLER: We're right at about the time that our tape is running out, so we do need to stop for that. Then it's up to you. There's probably a few things that, if you have a chance, that I'd like to go back and go on a little more details with. We can either do that now or at another time, whatever works better for you.

ROACH: Why don't we do it now. Then you'll be through with me.

BUTLER: Great. Okay.

ROACH: Then you can do whatever you want to do.

BUTLER: All right. Well, we'll go ahead and take a quick break here then.

ROACH: Okay. [Tape change.]

ROACH: ...and if you've seen some of the old pictures, we all had short hair, we had skinny ties, and we wore short-sleeved shirts. And we all had hair. [Laughter]

Huge briefing. I guess it lasted three, four days, out at Berkeley, University of California at Berkeley. Well, we had never seen people with rope belts and barefooted in a

college [classroom]. The guy that was running the machine that day, the viewgraph, he would just sleep between. They just drove some of the conservative folks right over the wall, because here they were in the hotbed of all the people from California. But there were things like that, like that same way with the thing with the face masks on to keep everybody from getting contaminated.

So what else can I do to help you?

BUTLER: Well, if we could, you've given us a great overview of your career with NASA, and I thought maybe to go back and touch on a couple of things in a little bit of detail.

ROACH: Okay.

BUTLER: Starting back with when you came on with Mercury. Now, you said you were in Hawaii on Cooper's flight?

ROACH: Yes.

BUTLER: Was that the only one that you had worked on then?

ROACH: No, I worked on Wally Schirra's flight earlier, which was 7. That was at Corpus Christi. Then they shut that place down.

BUTLER: So you were working at Corpus Christi during that mission.

ROACH: Yes. If I remember, that was just like a month after I got here, but we would have our briefing, and a lot of the things that they were doing I had done in the Air Force, so it was not a big change. It was just changing the names. It wasn't an airplane; it was a spacecraft.

Of course, we had a training session where I had to learn all the sessions. Now, the Mercury systems were a piece of cake compared to the Apollo systems and the Gemini systems, but we really needed help into getting everybody to work together. I was involved in a lot of the work for Gene, Gene Kranz, and did a lot of that.

BUTLER: Looking at that and bringing everybody together and the transition from Mercury to Gemini, were there big pieces that you remember, like some of the biggest challenges of making the new program possible and building the control center?

ROACH: Well, the big thing in the control center was to get people to put the right things in the pneumatic tube. You couldn't put hot dogs, coffee cups, and Cokes. And that was a real problem. We had another problem, since it's a mechanical system, they for some reason put the spring on the wrong way. So that rascal flies through the tube about twenty-five, thirty miles an hour, and the thing comes open and it just would scarf that tube and, of course, that was really expensive. But once they did a few tiny things and got people chewed out enough to not put dumb things in there—let me tell you, there were a lot of dumb things sent through there—it saved us an enormous amount of money. I think at that time that thing cost about a million dollars, and everybody said, "Oh, golly, that's a lot of money." But we didn't have to have twenty-five or thirty people, if you take twenty-five or thirty people do salaries, benefits, etc., it pays for itself pretty quick. Once they got the bugs out of it, it was pretty neat.

We had a lot of the same problems. To talk to you about the flight crew, some of our people on the Mercury deal, Mercury remote sites and at the Mercury control center, we had

meters just like a meter would up and down if they'd see a pressure. When we did our first cathode ray tube, first computer-generated, guess what we had? We had the meters on the cathode ray tube.

Then we got people saying, "Let's draw the entire propulsion system and make a schematic." Put your sensors, put your pressures, what's it supposed to be, and then, of course, we had to get the people to go from the left-hand side to the right-hand side. But we learned how to do that. We did that in the propulsion system, in the environmental systems, and we didn't have anyplace to learn from except our experience in Mercury. We had a lot of people from the Air Force. We had a lot people that had been technicians. [And most did well.]

In fact, it was funny, when I was in Alaska, we were flying an airplane up and down the Pacific Coast, we'd fly from Elmendorf Air Force Base to Moffett Field in San Francisco. One day this plane showed up and they said, "We need you guys to fly these missions. Here's all the stuff." So we had to fit it [by] hand, and what we were doing is taking the pieces of equipment and making it look like a satellite. If you remember, years ago, you probably don't, but one satellite was lost and the Russians recovered it and everything. We did that, and it's funny, some of the people that I had talked to on the air-to-ground came to work from up in Alaska. So we knew what needed to be done. Nothing had ever been written down. Very few people knew about orbital mechanics.

We had one time over here, we had one of the spacecraft land very long, and we went back, we tried to blame it on the pilot, and it wasn't the pilot's fault; it was the ground people's fault, because they had not changed the [computer] constant correctly. So we learned from that mistake. So we created a group of two or three folks and they were the only ones who could change the constants, and part of our checklist before launch was we'd call Shirley [Hunt] Hinson and say, "Shirley, have the constants been changed?" Never had another problem with landing long.

So we kept asking, we played what-if until we were blue in the face, and by doing, that we eliminated, we started with this many problems and we came down and then we trained, and then the sim folks would read the procedures that we had and reviewed the checklist, reviewed the systems, and they would open that crack back up and ask those questions. They did everything. They would fail the intercom in between the people. You know, we used "Are you go or no go?" It was a negative report. But if you had a problem sometimes you'd have to come from the back room and say, "Hey, here's the problem. Show the people."

We had a way to make a copy, a hard copy of the cathode ray tube. People thought we were crazy, but that saved our lives, because you had a history of what was going on. So we just kept doing it and doing it and asking ourselves the question, and sometimes we would be like the sim people and ask the same kind of questions so people would think. People learned to think on their feet. They learned how to listen to a lot of intercom [channels]. They learned how to tune out stuff that wasn't necessary. Then they also learned that if they only needed to listen to the guys talking to the crew, they'd punch everything off and take the wrath of the flight director or whoever was screaming and hollering at them.

You also had to learn to deal with the top row and tell them what they needed to know and not tell them too much, because then the press guys—I don't know whether you ever remember Paul, we used to call him Cadet Paul, was the PAO guy for years. He was always daydreaming or asleep. We'd brief him. Gosh, what was his name? But he was here for a long time. Not [John A.] Shorty Powers, but he was—I'm not going to say anything about him. [Laughter]

BUTLER: A lot of that creativeness that you had talked about earlier came into play.

ROACH: But we had a group of people, and those folks kind of grew and were really the people who managed the different things. The personalities of those people sparkled enough that they commanded the respect of the others. Primarily they worked harder and just did a better job than some of the other folks. We had some other folks that who were just solid in the systems and that's all they wanted to do. But we had some fun times, some good times.

BUTLER: It sounds like there was a pretty good rapport between everyone.

ROACH: Yes. We played hard and we worked hard.

BUTLER: Good combination.

ROACH: Yes.

BUTLER: The move to Houston. You had mentioned earlier that you had gone back to Virginia after the Air Force, because that was your home. What did you and your family think about the move to Houston?

ROACH: We were delighted. We were just delighted. Even though I'd gone back to help my mom, it just wasn't right for what I wanted to do with my life and my family, and this was a wonderful opportunity. It was new. I had listened to Al Shepard. In fact, I was driving to Langley on Air Force business when he flew. I thought, hey, this is pretty cool. "Cool" wasn't a good word then. Cool was when you were almost cold. [Laughter] But I really thought it was neat and I looked forward to it. Then when I met some of the people that were really working on it, I thought I would fit in okay.

BUTLER: Had you, as a kid, had you had an interest?

ROACH: No, there wasn't anything. You know, airplanes. I grew up in Virginia, went to school there, and Langley Field, you know, Sam [Samuel P.] Langley was a big person, and if he had gotten a little help, he would have been the guy who—in fact, Smithsonian held his airplane in higher regard for years, and the Wright flyer was in England in a museum. Then finally they got the history right. Kill Devil Hills [North Carolina] is close to where I grew up. It's hard to believe. Everybody thinks those guys were bicycle people. They were brilliant engineers, because they saw the lateral control by reviewing what [Octave] Chanute had tried to get across, but Chanute never put an engine on it until after the other guys did, I think. But I figured if they could do it, you know, I could do it. I was fortunate enough to be part of it. It's pretty neat.

BUTLER: It's pretty neat. You've had some very interesting times.

Looking at, again, with Gemini, you had talked about a little bit about what was going on with a few of the missions in there, for all of the missions were you in the control room?

ROACH: Oh, yes. Yes, I was in the control center for every Gemini flight. Gemini I was an unmanned flight, I was there. Gemini II, this was at the Cape. Gemini III, I was here and we had a group at Kennedy [Space Center, Florida]. At that time it was Cape Canaveral, I think. I still have a hard time calling it Kennedy.

BUTLER: You're not the only one.

ROACH: Kennedy was a funny place to visit, because it was an Air Force base, so you had to have an Air Force clearance, and many times they would goof it up and you'd go—and you

know, if you've gone from Cocoa Beach, in those days there was only one road. You drove up the beach. It seemed like a hundred miles to the middle of nowhere. If you didn't get in, the rest of the troops, they were okay, they'd leave you at the gate house. Lots of times, people, you know, I thought a wonderful place for *Candid Camera*. But they finally realized, and since they were Air Force people, they didn't care if they hadn't gotten word from you, you didn't get in, so there you were. But we finally got that squared away, but it's still funny, now there's gates all over the place. It's a nice, nice facility.

If you've ever had a chance to go in the vertical assembly building and seen how they stack the Shuttle, it's truly amazing. We used to laugh about when Kurt [H.] Debus was the boss down there, and he was another one of the German guys. I can see him in Congress then. We'd got this thing and it weighed seven and a half million pounds, and a tiny little tractor that drags it out, you know, at two miles an hour. The stones that they use on the roadway as lubricant are amazing. It's all television from every [point]—it's an enormous thing to see. But if you're afraid of heights, don't go to the top of it.

We asked our crew to get on the top and hook up to the wire, then come sailing down. That's probably the spookiest part of the whole flight for them, although sitting on top of all that fuel takes a lot of courage. But I think they're probably safer than driving their Corvette up and down the highway. [Laughter]

BUTLER: Very definitely, I'd think.

ROACH: Ed White was a neighbor of ours, and so sad, and Neil [A.] Armstrong was. Neil Armstrong's wife taught our daughter the synchronized swimming.

BUTLER: That's neat.

ROACH: He was a good guy. Reminded me from what I've read about Charles [A.] Lindbergh, he was about the same kind of person. Nice guy.

BUTLER: Yes, he does seem to be.

ROACH: Yes.

BUTLER: Looking at, again, some of the intricacies of the mission control room, and you had talked about the Gemini VI and VII mission, how they did the dual and the rendezvous, and that wasn't something that had originally been planned for Gemini.

ROACH: No, that was another thing that was done very quickly. We had an opportunity, see, I believe the—I can't remember which, VI was scheduled to go and a plug fell out of the bottom and it had a false start. [Gemini] VII was coming down the pipeline, so we got it and tried to compress the schedule and then fixed VI, so VII went first, and then VI went and rendezvoused. I believe that's the way it was.

But that was a big, a huge leap, and it took a lot of courage for the decision to be made, because there again it pressed everybody to have the procedures ready, have the flight rules ready, what are you going to do, and so you worked and worked and worked and got it done.

Then we had to have two sets of teams to work. [Gemini] VII, I think, went for two weeks. I believe it flew for two weeks. That was a big mission for the medics. They wanted—can you live for two weeks? I think they did survive for two weeks. The other one was kind of up, rendezvous, and come down. But it was a huge step for Apollo, because it proved that we could rendezvous, it kind of set the stage for the flight where we flew

McDivitt and Schweickart, and rendezvoused around the Earth. That proved that the lunar module computer worked and the CSM [command and service module] worked.

That was a big milestone and it caused a lot of work, a lot of extra work or unscheduled work for people. They were going to do it, they just were going to do it in a little bit more leisurely fashion.

But that was another thing, the work ethic of a lot of people was really unique. It was substantial. It really was, what they did. We were blessed. I think that was the leadership of Kraft and some of the program office people and some of the people that we had in our own organization. The folks over in the engineering directorate were yeomen also. Guys like Don [Donald D.] Arabian, who you'll visit with, uncanny guy to figure out ways to skin a cat. He never gave up. He really had a lot of neat ideas and could work with people and get them to produce. He did a lot of problem-solving and problem-understanding.

That was the other thing. If you had a problem, we tried to understand what the problem was, and then, of course, you not only wanted to fix this flight or control it, you wanted to get it into the next cycle, so if it was a major problem, it wasn't going to impact your launch date. You think about when the design was finally fixed on the Orbiter, even years later you'd go to a change board and the guy would open, when you'd talk about the maneuvering system, he'd first say, "Now, if we had the maneuvering system that I wanted, we could have just opened these hatches and we could fix these little things."

God bless Aaron Cohen. He'd say to the guy, "Guy, we don't have that system. This is the system we have now. What is your change? Quit talking about history. We don't have that. We couldn't afford it."

Those kind of folks really kept things going, and the country and the agency were really blessed. They had those same folks at Marshall, same folks at Kennedy, and that's what kept things going.

BUTLER: Good combination of people.

ROACH: Yes. I don't know whether you've ever interviewed Rocco [A.] Petrone at the Cape. I don't know whether he's alive anymore. But he was the guy, I think, I can't remember whether he was the boss down there when we had the fire, or one of the problems, and he said, "I don't want you to tell me that so-and-so told you. If that's your system, you go look at the connections and you write it down. There are no mistakes. We can't afford them."

On the Apollo fire, there were a lot of people who really were heros, burned themselves trying to open that hatch. Just such a sad thing, because—good people.

Of course, the [*Challenger*] thing, I was gone when that happened, thank goodness. I was at the Princess Hotel with my wife in Acapulco [Mexico], and couldn't believe it. Couldn't believe it. Wonderful set of folks on that flight. I knew Judy [Judith A. Resnik] well and I knew the commander and the pilot [Francis R. Scobee and Michael J. Smith], and Elli [Ellison S. Onizuka] were just cream of the crop.

BUTLER: Unfortunate that that had to happen, but at least people were able to pull back together and bring the program back.

ROACH: Yes. That was another time when people really dug down, and it's fortunate that it became better because of it. It really is.

You question. I'm talking and I shouldn't talk.

BUTLER: No, yes, you should, this is your oral history. You're doing great.

Looking at the transition from Gemini to Apollo, you talked about how with having two-manned spacecraft and how Gemini did a lot of the EVA and learned on that. Were there again major changes to the control room between Gemini and Apollo?

ROACH: No. See, that's when we designed it, what we wanted to do was to change the basic software and keep the hardware. Now, we might have added a couple more positions. See, we had more systems, we had larger systems, but the control center did not change. We had on the front row, we had the guidance ops, we worried about the guidance, and they worried about the guidance on both the command and service module as well as the lunar module. We had to enlarge that section of guys. The flight dynamics people was the guy who took the maneuver and moved whatever needed to go. They also worried about the rendezvous maneuvers. Then the retrofire guy worried about bringing them home. So that just was an addition of one person.

The booster systems were more complex, because we not only had the Saturn I and the Saturn IV, we had the Saturn II and the Saturn IV, and the other one we just had one guy that worried about the booster. So we expanded that a little bit. We had the doctor.

At that time, we had so many crewmen, they were the capcoms. They were the spacecraft communicators, like I did in the old days. In the Mercury days, we had some folks that thought they were better than the crew, and in lots of cases they were. But if you remember in Gemini, we only had seven astronauts and one was flying and one couldn't fly, that was Deke Slayton, and he had to be here to make sure nobody goofed up, and one who was flying the next flight. So you only had four, and most of the time they were training or doing different things, so they didn't really want to do it. So they were the people.

Then when we got the second group and we flew Gemini, and then during the Gemini Program then we got the third set and we had enough that we could send them around and we used them in the control center. It turned out to be better. My humble opinion. We would have probably used them earlier, but we didn't have anybody. We just didn't have many folks. But that was one of the things.

Then on the next row we had two command and service module engineers, one who worried about the electrical and environmental and one who worried about the propulsion systems. We called them GNC [Guidance, Navigation, and Control]. Then we had two for the lunar module, the electrical communications and, of course, the propulsion system. Because the propulsion has to work going down, and if it doesn't work coming up, you're in deep serious trouble.

Then we had the procedures guys, assistant flight director and then the people who worried about the system within the control center and the system around the world. Then he worried about the folks, we had the folks in the basement, in the IBM group, that worried about the software. We tied all those people together on the intercom, and we worked very hard with that, trying to make sure that people said the right things and did the right things and there were big books of procedures to make sure that people were trained and that kind of stuff.

Another big thing that happened in Skylab was how do we train this many people? We started off with just lectures, and we found out that too many people slept. So we made the instructors do videotapes. You could come to work, they ran about an hour, you could come to work at seven and watch the tape, and they were so much better. You could do it on your lunchtime, you could do it in the evening. That really paid off, that and the systems trainers that we built where we put the people and did taped exercises, you're going through lunch phase, this is liftoff, and then you got to chance to visually see and do a lot of the functions that the crew was doing. Same way with entry, same way with being on orbit.

They were very inexpensive ways to train our folks and make them more comfortable in dealing with the flight crew. I think those two things really paid off, because we had so many more, they were a lot of new people that we'd brought into the system. That paid off, it really paid off. In fact, some of the training was so good that some of the newer astronauts

would come over and train on that, because they were so far down in the pecking order, they didn't get any simulation time, which is a huge expense, a huge expense.

BUTLER: Talking about the training and the simulations and you're mentioning for Skylab, for Apollo how did you, especially for the individual missions since they were so close together and—

ROACH: We had two floors. When we were flying Apollo 11, we were training Apollo 12 crew on the second floor or the third floor, whichever was—and that paid off, because we didn't miss a beat. It's hard not to be on Apollo 11, be on Apollo 12, but somebody had to do it. Our crew liked that and our training people liked it. But that's the way we did that.

BUTLER: The mission rules, we've talked about those a couple times and procedures, of course, continued to evolve the whole time as each—would you sit down after each mission and evaluate them?

ROACH: Yes. There was a formal debriefing with the flight crew, and that's more for show-and-tell and hero worship, but it's necessary. We did our debriefing at the section level and the branch level and then brought it up to the division and the directorate and started the changes. In fact, in some cases during the missions they were redlined if something went wrong. We did that during our training exercises. They tested like when you were ready to go, no-go, to launch toward the lunar surface, translunar injection. They would test, they would break something just to see if you'd violate the rules. If you had a backup or something, things would work out and you pressed on. But we set them up where we were level and we needed these things to press on.

I can't think—the only time we had a problem was on Apollo 16, when we were nervous about the landing because of the engine maneuver, and we wanted to make sure the command and service module could, number one, make its maneuver to rendezvous and then make the burn to come home. We had a little set-to with the flight director. He was nervous, he didn't want to do it, and then we finally got him convinced by having the head guy from Rockwell come out and said, "It's okay."

It was nerve-wracking, because the crew hadn't slept for a long time, they needed some rest, so they landed on the Moon. Of course, we had to change the time line, we had to change the time line for Ken Mattingly, who was going around. We did those things in simulations. Most instances the simulations were more realistic than the flight, because—not more realistic, because it couldn't have been, but what I'm trying to say is that the training really stressed the system, the people, the procedures, the communications, everything that we needed to make it all in sync. So it worked out pretty well.

BUTLER: You mentioned you were going through the control room and the different positions and talking about training and all. You served for several missions as assistant flight director. During the break, you were telling us a little bit about that, but if you could expand on that and tell us what that all—

ROACH: Well, you were kind of the keeper of the flight rules, and Kraft trained, then he went off, and we had Kraft and John Hodge. Then John got ill and then he left and went to Washington. Kraft stayed. Then we created a new position called the director of mission operations, director of flight operations, gave him a console at the back and let him deal with all the heros. Then we had Kranz and Lunney and Charlesworth and we had the team colors. We had red team, white team, blue team, and then as we down—I guess they're to chartreuse by now. Then we retired the colors. If you've been in the control center you'll see—I don't

know whether they retired all of them or not, I have no idea, but the first few guys, Kraft and Hodge and Kranz and Lunney and Charlesworth were the primary guys to get us started in Apollo. Kraft, of course, was in Mercury, the only Mercury flight director. Hodge was in Bermuda.

See, in those days we had to use teletype. There were no such things as data lines. Everybody had to type "I love you," cut a paper tape, and then you ran over and put the paper tape in and you looked at a teletype machine. It made a horrible amount of noise. When we first built the control center, we were still on teletype. We heard through the grapevine that the nuclear subs had a silent teletype machine. We couldn't get one, so we got a regular one and built a soundproof box around it with stuff. It worked like a top. Later on we got rid of that silly tape, because a paper tape doesn't look like there's anything on it but a bunch of holes in it. But we lived that way. That's all they had.

Then as communications got better, we made the move here, because this is where everyone was. By working hard to design it and put all the square pegs in the round hole, we got four here and it worked.

But you were the keeper of the rules and you were trying, and you had been involved in practically every discussion between the flight director and the flight crew and the systems people, and you knew what the logic was, why we did it, because even in the flights sometimes we'd say, "Well, what about that?" So we started writing a little logic book and a history book of who created a rule, so there was some history. This, of course, was before procedures, all hand-typed by some poor little contractor. But it was all proofed. There was no thing, you were the spellcheck. It grew. Your value was noted by were you on the distribution list.

Finally, it got so expensive we just had to cut it to who really needed them, because you don't need a big expensive hand-done thing just as a bookend. You really don't. But you were trying to help. You tried to help the flight director. I worked with Kraft a lot, and we

had a good working relationship. You could talk to him if you thought something needed to be done or, "Hey, I'm going to go and talk to those people in the analysis room and see where they are, when we can have a meeting."

Then we got the headquarters people involved, where we met every morning and told the world what was going on, because there was a lot of interest here during those programs, a huge amount of press interest. Then we put the press guys in the viewing room. We worked on those kind of things.

I remember on Apollo ASTP [Apollo-Soyuz Test Project], we were working on the gift exchange between our astronauts and theirs. It was the ugliest-looking thing I've ever seen in my life, and the guy says, "It's going to work like a top." One would take one half and one would take the—couldn't get it apart without using a hammer. So they said, "Guys, I think the briefing is over. You've got to come back next time with a better device."

When we flew that, too, we were really concerned were the Russians going to do their job, so we did a lot of work with the engineering directorate folks to make sure, and then, of course, we built the docking ramp, so that we knew that our crew would be safe. Not that they're not, they just have a different view of how to do things, and we're seeing that now. They want to go back to *Mir*, which is probably a good idea, but that's going to sacrifice the International [Space] Station.

We just tried to make sure all the holes in the dike had a finger in them. That's probably the easiest way to say it. We worked with a lot of people to integrate and get rid of the mysteries and make people be up front.

BUTLER: Certainly provided for some interesting times.

ROACH: Yes, it did. Thinking about them is kind of fun, too. This is more interesting to me than it is to you guys.

BUTLER: Oh, I don't know, it's very interesting to us.

ROACH: I was amazed. I said, well, what am I going to do? I wrote my oldest granddaughter all the funny things that I could remember, and the good times, and my second granddaughter. Now, we've got three more, and I don't know whether I'm going to do that again. I've been looking for the diskette, because I have some time, and I'm going to keep looking for it and see if I can't find it.

BUTLER: Or you'll be able to share this with them, too.

ROACH: I may do that.

BUTLER: I'm sure they would get a kick out of listening to it.

You mentioned the Apollo 8 mission earlier and Apollo 11, both of which were very big steps. Actually, out of all of the Apollo missions, did one of them make a bigger impression on you than any of the others?

ROACH: I think thinking back, probably 8 was the biggest jump, because we had just had the problem on the 502 flight with just the deal. It would have gotten us into orbit, but I don't think we would have gotten to the Moon. Going on Apollo 8, we were able to check out the computing system, we checked out the guidance system, we checked out the propulsion system of everything, as well as the communications around the world. Our navigation system worked, the orbital dynamics worked. Even though we had trained to reenter, this was a real entry and, of course, you know that when you came back in, if it wasn't right, you'd go up into the hinterland. So that was probably the biggest step in Apollo.

Then, of course, 11 was a big one because you really had to bite the bullet and go down. I'm glad that Neil Armstrong was flying the thing, because he'd had a really close call out at Ellington [Field] on the lunar landing and survived that. So we knew that he had had that experience, and he was a really cool pilot. He had a lot of training and he was probably the best selection for that.

It's interesting, a couple of flights after that, we had another group of astros come in, and I remember in the control center, he said, "Boy, I'm glad I'm about out of here, because these people are so smart." He said, "They will destroy guys like me." [Laughter] He was a neat guy, low key, and was the right selection. I credit Dr. Gilruth with that. He just had a sense about him, was a tremendous manager and understood what needed to be done. He didn't have that same feeling about all of them, I'll have to say that, but when it was crunch time, he knew who to select so there would not be a big crunch against the agency. That's a real skill. It just worked out great.

BUTLER: It did. It all came together.

ROACH: It did.

BUTLER: With the end of the Apollo Program, were there disappointments or were you ready to move on to the next?

ROACH: Oh, we were already working on Skylab. Do you remember me telling you, we knew this was coming, so we started plotting our Marvin Manpower curves, and we knew what our organization was going to be. We were already working. We had systems guys on that. There again, they'd done super jobs and we moved them off to other things and they were just as enthusiastic, just as energetic and worked on those things. We had to figure out

how we were going to do the flight rules there. We had different procedures, because we had more people, we had more hardware to monitor. We had a different set of folks at Marshall to work with, we had different folks here at Johnson to work with.

We were trying to have a better ground system. So we worked as hard we could to—I don't think—we lost a few folks, but some got promoted and went on to different things, but there was no hard feelings. I don't think people—the disappointment in Skylab was the first day, but by the end of the day everybody was pumped back up and then the Marshall folks got included, they came back from their disaster, and things worked out.

We learned how to train. We had a full-sized mock-up. It used to be here in the facility. Skylab was about the size of a three-room home. Lots of ingenious things, you know. They wore like sneakers with triangle deals where you could stick your foot and you wouldn't float around. Lots of hand-holds. But it's a lot like swimming underwater on zero gravity, and that's the big thing we learned to train with. There just were a lot of good folks that worked really hard.

I think probably the Shuttle caused more problems, because the engine development was done so differently than the engine. There's probably not any wildlife left down at Michoud [Assembly Facility, New Orleans, Louisiana], where they tested those engines. They blew up every alligator and fish or every bird around the area. But I'll say this, that those folks tested the Saturn I and the Saturn II until that really worked. It worked out okay. The engine development, the main engine development and the booster, there were some real difficulties, and it took a lot of agonizing over whether or not they were really ready to go. But if you look back, we were really gun-shy on the length of the first orbital flights.

I remember when the first orbiter was delivered, they said, "How are we going to get it here?" Thought we were going to have to power it up, and the payload bay doors wouldn't close. They had put stuff in backwards, so that didn't close. So I suggested that they—I said, "Let me just draw you a little sketch. You've got the bulkhead in the back that's got the

power, and we can run the power from the Shuttle carrier craft up and the stuff in the Shuttle carrier, the 747, can run the power in the Orbiter. We can turn the fans and stuff on and you can check the deal."

So I drew this little thing. Well, it came back as a changeover. Rockwell took credit for it. I went ballistic over that. Finally, I said, "Well, it won't get here if they don't do that."

It worked. It told us what the temperature in the cabin was, it gave us a good checkout, and we wrote flight rules for the guys who flew Shuttle aircraft, the carrier aircraft, of what they should do, what altitude they should be, because I was more worried about the thing falling off and then there we were with a lot of mud on our face. But it worked great. In fact, when it flew by here, it was an exciting thing to see. They made a little [low] pass [over BC]. Pretty neat. Of course, the systems guys and the crew were nervous wrecks, you know.

Then, of course, we went through the big tile problem, getting that first one. But anytime you have something that big—and you know the Shuttle is as big as a DC-9. That's a big spacecraft. They also got the payload bay doors to close. But, see, a payload bay, you're dealing with another country, Canada was building it [the Remote Manipulator System (RMS), robotic arm], so we had to integrate Canada. Then they wanted a seat, you know. We trained one of our folks to do the stuff. Mechanical systems became a big deal. EVA became a big deal.

We trained the guys over there on the RMS, remote manipulator system. They used an air-bearing table. We had a training facility that was two-dimensional, and we had the balloon over there, the balloon for the payload. Guy was almost ready to be captured and somebody would open the hangar door and the balloon would go sailing up. [Laughter] So they put a little thing, "Do not open this door."

It's those kinds of things, you think you've got it all made and everything is straight, but it worked. That sucker worked, because the people, they took all the what-ifs and they

kept knocking them down one at a time. Then we can handle three or four more that we didn't think about. But people got to thinking like that, and it really paid off. It really and truly did. It really did.

BUTLER: It certainly did. Talking about Shuttle, it was such a different vehicle from what you had worked with before and so many different procedures and rules and engineering to bring it all together, but yet its first missions were manned, whereas the others had been unmanned. Was there any discussion on that?

ROACH: Oh, yes. We went, we had a big to-do, manned, unmanned. A whole group of us went to Boeing. Boeing has the ugliest paint job on their test airplanes. It's kind of like purple and yellow. Of course, the Shuttle—the 727 is about the same configuration, same kind of wings, and they had done more dead-stick landings than anybody in the world. No problems. So we went out there and checked that out.

We also went out to make sure we understood what the 747 could do, and went through their flight test program of how they ran the test program for the 747. We took a number of pilots and crewmen and let them train and watch what the crews did on the 727, watched their procedures. They took that information and modified a plane up at Langley and gave them additional training.

That's how the Shuttle training airplane came about. Grumman [Aerospace Corporation] made a bid on building that. I want to call it the Gulf Stream, but it's the G-2, I guess, is what it is. Then that started where you've got a safety pilot with the real controls of the airplane and the Shuttle training pilot, Shuttle training aircraft pilot, with the Orbiter controls. It responds just like the Orbiter does when you are making your final approach. And it's a pretty scary approach.

You know the Shuttle training airplane's got engines. The other guy doesn't have any engines. We would go through all that stuff. The computer, we felt, the two sets of computers that we had on the Orbiter, we felt like were better to land. We had a huge controversy of the flight crew, because "I'm the only one that can do it," you know. They did some silly things, like one time they were getting ready to land and they're switching pilots, so they can have just as much time in each seat. But all that was done.

All the orbital mechanics came out, and you're doing the heading alignment circle and you line up, and once you start in, you come on down. I mean, you've committed yourself. So the wind's got to be good, you've got a chase plane, and you've got photographers. The first times we did it, we did it out at Edwards, and we had some real problems at Edwards. Fred [W.] Haise was landing, and one of our things was to land within so many feet from the threshold of the runway, and he got head-up and locked on landing there rather than landing the airplane, and we thought he was going to die.

It was a different system from what we had in the simulator, the way the rate command system that the Orbiter had, the more input you put in, the more reaction it does. The other one doesn't make changes if you use a computer, it don't make changes unless you make changes. That's why we felt like hands off, hands up, but the airplane landed itself. Study after study showed it would do it, came back and ran through it and showed where it could happen.

We trained people in flying the 707, because we now have a crew, you got two pilots. It's not like the fighter jockeys that all these guys were. You got two pilots, so you got to be careful how you land and how you work together.

[Charles] Gordon Fullerton was one of the crewmen that had a lot of multi-engine time. He was a good guy and he helped a lot of people understand that thing is a lot bigger, it's not like coming home in a blunt-nosed job that you land in the ocean. And we had trouble with tires. They're like 25-ply. God knows how much those things cost. Then the

next question was, how do we know that there's air in the tires after they've flown a period of time. The landing gear, how much—you know, all of those things were asked by people, and they'd go and short it out to make sure that it's understood. Then you wring your hands for three days or six days or ever how many days until you see those babies pop out and you see the smoke on the runway and then you know that it's okay.

We had lots of problems with when we land, what do we do? We spent weeks and months doing that, building all the stuff to take out the APU [Auxiliary Power Unit] fuel. How did we get all the other stuff out? How do we get the crew out if they're incapacitated? So once those guys land, we had a real deal. We worked on all the requirements to make sure that the things—then the problems that we had in the flight are put in the next flight or the one after that, and everything was managed by schedule and by people with responsibility.

Another thing I did was we were having real problems with the simulator requirements. The requirements were written like, "Build something that flies like the Orbiter." They were spending a ton of money, so we said, "No, what we're going to do is we're going to develop a set of a requirements with all the phase, all the stuff that we need, and then we'll get a price for that." So we did that and put it under change control. Nobody could change it unless you go to the board. Because if you don't, then you'll end up it'll look like an Orbiter, but it won't fly like the Orbiter. That's the real discipline that flight operations tried to maintain in the program office, that you must keep track of the stuff.

Just like the tiles. There's God knows how many tiles. Every one has a part number, every one has a drawing. Then there's a tool to put them all and the stuff to put on and there's a tool to take them off, because they're expensive. At that time, that I can remember, they were all hand-made. See, in the selection, there was Rockwell or North American Rockwell, there was Lockheed [Aircraft Corporation] at that time, and there was Grumman. I think Grumman built the wings that had to fit into the Orbiter and the tiles, I think, at one time or

one of those, something like that, were all done by Lockheed. So how do you make sure those dudes are talking and getting them delivered on time, and then you've got a million subcontractors.

You need to go and see what an Orbiter inside looks like. I don't know whether the SAIL [Shuttle Avionics Integration Laboratory] still has all that stuff, but the SAIL was a replica of all the wiring, and they ran those computers until they thought they would kill themselves, and they worked. We always worried about the software, but the hardware and the software of the computers had really been magnificent in the Shuttle. That was just because there were a lot of folks dedicated with hard work, "I ain't going to go to sleep tonight until that sucker works right." And that was the real key. There were enough of the folks who looked for the snakes under the rocks, and then told people what they saw under the rocks or that there was no problem. "We don't need to worry about that snake anymore, because it's not there." Or, "Hey, we've got a huge problem."

The thing about the upper management, they listened and they responded or they told you, "We don't want to worry," but at least they listened. Most of the time the folks underneath discovered it. We used to have our buddies at the Cape or at Marshall that we called practically every day, so we knew when something went—we'd tell Kraft before he knew about it. It drove him crazy. But he was good about that. He was a neat guy. Neat man.

BUTLER: Very much so. You mentioned briefly the Viking Project and that you had consulted on that.

ROACH: Yes.

BUTLER: You just worked that in with your other duties?

ROACH: With everything else, yes. We went for a couple of days and that worked out fine. They would send the stuff, we'd review it at night, and then we'd listen to their briefings and ask questions, and then they kept records and told us what they had done. Like I said, the neatest thing is to have a picture of Mars. Not many people have those.

BUTLER: No, not many at all. As the mission was landing, were you able to follow it all in real time?

ROACH: Yes, we knew what they were going to do. It was exciting. But, you see, it takes twenty minutes, I think, or longer than that for a signal to come, so when you see it, it's too late to fix it, unless it's something that you can work around. We had similar problems with the Skylab, because if you didn't get the data in, something could have happened twenty minutes ago because of the way the orbits went around the Earth. So it worked out well, finally after their boss told them they ought to listen.

Tom [Thomas E.] Young left that project and went and was the director of Goddard for a while. I think he lives on the ocean and sails a lot now. But it's good to have good memories.

BUTLER: That's very good. It's very good to be able to look back and say you were able to enjoy the times and the people you worked with. Very fortunate. Looking back like that, over all your time with NASA what would you consider to have been your biggest challenge?

ROACH: I think the first one was getting ready for Gordon Cooper's flight, because I was supposedly in charge of the systems guys and trying to keep track of Scott Carpenter. That

was a chore. And making sure that we did the right things, because we were at a [remote] site, probably the—well, we were the site before the States picked him up.

Then after that, it was getting the requirements for the control center and making sure that we had a good set of requirements that could fit within the budget. Then working with the folks in the directorate to make sure that we listened to them and we responded to what they needed.

I guess the next one would be in Skylab to make sure we had everything ready to fly Skylab, because that was a huge investment, and making sure that the interface with Marshall would work. Then make sure that we selected the right people to take over as their organization. When I came to work, we had, I don't know whether it was a section or a branch, and we had horrible quarters. When we moved down here, we went into our own branch and then we went to a division and then we went to a directorate. Then we took two directorates and put them together, had to manage the airplane operations and turn down crewmen who wanted to go on the one-shot buffalo hunt and take a T-38, when that didn't make a lot of sense, in my humble opinion. I said, "You're going to fly into some crazy airport? Why don't we fly you first-class." You could call Kraft and say, "Chris, I've got a problem with Teddy. What I did, you'll probably get a phone call." He said, "You did the right thing."

When we took over the earth resources things, we had a C-130 and a B-57 and all that stuff. Of course, they spent a lot of time in Colorado. That was when Coors beer was the biggest thing in the world. Lo and behold, our guys brought back tons of it in the belly of the airplane. It just so happened that as they were unloading it, the guy driving the tractor dumped it over, and there they were, and everybody's [nervous]. So you had to deal with that. We had a guy stuff the deer that they had killed into the baggage thing in a T-38, and it comes back with the blood running all out of it. But those were the funny things that

happens everywhere. We had a lot of fun times just thinking about those things, but at that time in our life it was pretty crucial because they knew better.

We had one time an airplane, C-130, coming in for a landing and it just passed its big maintenance check. I don't know whether you know the doors for the gear probably is as long as that wall. I think it has thirty-two Zeus fasteners that you push in and turn it and it keeps it on. Well, when they did it, it was all signed off, they had put three, and when the doors popped open, the thing went right back and hit the horizontal stabilizer, hit the pilot in the stomach, the yoke snapped back. We thought we were going to get cow debris and kill some exotic animal. Fortunately, well, they fired the guy. That's what we had to do, because he was the supervisor, and the guy who did it, so we got through that. We got through a lot of those silly things.

That's just an aside, but we were able to work through those things and keep things going and gluing things together. We had enough good folks that it kept the glue strong enough to keep everybody going. That was the neat part. It was tough to go to the directorate, because we spent a lot of time with the divisions, because that's where the work was. We were fortunate to have enough good people to keep going. As far as I know, it's still going on. So that's our legacy, I think. It's been a good time.

BUTLER: Some very good times. Would you say there's a time that was the most significant point for you in your career at NASA, or that you feel you made the greatest contribution, or would you say that's it, the legacy of teamwork and good people?

ROACH: That's probably right. It was good times in every program. The earlier days were better, I thought. You didn't have as much responsibility. There were some crewmen—Jim McDivitt's another guy who stood out, he was Apollo program manager after George Low. We never thought anybody could replace him, but Jim did and he did a superb job. He was a

really good crewman. Ed White was, too. There have been so many good ones. Jack [Harrison H.] Schmitt, we called him "Dr. Rock." Jack was an excellent guy to work with. The people that did the lunar surface thing, [Dr. Eugene M.] Gene Shoemaker, who was a world-renowned geologist, and a guy from the University of Texas [Dr. William R. Muehlberger], we got really close to those guys and worked with them so that they would be successful.

We had a good bunch of doctors that were good. It was interesting, when we were doing the training for Mercury 8 there was a guy named Bob Moser who was a colonel at the Tripler Army Hospital. The tracking station was on Kauai. You had to drive, at that time, probably an hour from the hotel and you can't think of Kauai being that large, but you had to go up a mountain like that. Right at the top you go by a big deal that's…like the Grand Canyon. You can see the mountain goats and everything. It's a beautiful place. We were up there and he treated all the staff there, all the natives and everybody. There were a lot of Hawaiians. Of course, it was funny for us to see Hawaiians, real Hawaiians.

So Bob had his wife over and they were real good friends of so many people. He treated, looked after them, and they would bring us rice cakes wrapped in seaweed and stuff like that. We met the guy who owned—one of the neat places is the Waimea Canyon, and you go up there on a boat and they sing the Hawaiian wedding song, in this gorgeous grotto. Then we had a real luau with this Hawaiian family. Of course, they had the raw fish and the poi, and the kids, the little kids, like my grandkids, were trading us. We didn't want the raw—I think one piece of raw fish was enough for my lifetime. We'd trade that for anything else that we could.

But they were such loving and wonderful people. Their name was—the husband's name was Walter Smith. He looked like King Kamehameha, and his wife was just as handsome. Beautiful. I tell you what they really looked like were Apache Indians from this country. You kind of think maybe they got in the canoes and went one way or the other. But

they were lovely. In fact, one of the family members ran a monkey pod tourist deal. Have you ever seen monkey pod tree?

BUTLER: No.

ROACH: It's a gorgeous…tree, and they make salad bowls. So a couple of us went down to the place and bought a monkey pod salad bowl. It's still good. This has been, gosh, forty years ago. Just wonderful people. I've often wanted to go back there and just see if people are still there.

But probably I've covered what was really important to me was the association with a lot of people. It also gave me a chance to do things that I would have never been able to do in my lifetime had I not taken a chance. I thought when I got called back in the Air Force, that was the end of my life. Then I didn't know what to do, and then this happened. I was there on business and I went and visited these people. They were enamored with me and I was enamored with them. It was just a question of time when I could get it. It was really good.

There were so many good people. There were great secretaries that we worked on a deal where they would not be secretaries, but be administrative assistants, and they had upward mobility, and they were genuinely worthy of that. They didn't have a lot of formal education, and that was one of the big problems that you had, you had to have a piece of paper.

I remember another time we were looking for people and I had a tableful of things, and I found a kid from Texas that had all As, and the only reason he didn't have a job was because he was the wrong color. We called him and we hired him. He went on and did extremely well. There were a number of them that we hired because they were good. Joe Fuller's his name. Joe Fuller owns his own company now. He probably doesn't even

remember it, but he went to headquarters and worked, had a good job at headquarters. Was an excellent systems guy here. He now owns his own company. I can't think of the name of the program, but he's done extremely well being the president of his own company.

It wasn't that I did it. He should have had a job, but he was just at the wrong time. I remember it was right after Martin Luther King [Jr.] died, and he came and told us, he said, "I would be here, but I'm worried about my family, so I won't be here for a couple of days." No problem with that. We understood. A real sharpshooter. You need more of those than you do the other. You need the other people, too. But it was just a wonderful time. Wonderful time to be there.

BUTLER: Sounds like a great time and a great group of people.

ROACH: They weren't all that great. [Laughter] It's probably just the same percentage that you have in the Girl Scout troop or the Boy Scout troop or at your church. There's the good, the bad, and the ugly. [Laughter]

BUTLER: Unfortunately, yes.

ROACH: That's true in your own family. You know, sometimes our friends are closer to us than our family, because you can pick your friends, you got dealt your family. [Laughter] It's really true.

BUTLER: At least with this program, like you said, the good people really did shine out.

ROACH: Well, there were a lot of people that were excellent, like the guy I told you that did the slosh model [on Apollo 11]. He took it upon himself, he said, "I can figure that out," and

he did it. It was amazing, he was a big boat enthusiast and he started his own business down here in El Lago. He was the biggest Mercury boat guy in the world, then went on, resigned and quit, and had a half a dozen of them. That's what he wanted to do. He'd kind of done his thing and he moved on.

At that time, we had another dilemma with our people that were really good. We had our first RIF [reduction in force]. Unfortunately, it took all of our good young people, brand new, that had really made a mark for themselves. We had been guaranteed on everything that was holy that that would not happen. When they got the letter, boy, you talk about some sad troopers on a Friday. That's when they always do it, on Friday, and it's like the stock market, they close and then they tell you what the deal is and then it's too late to do anything, so you've got to commiserate all weekend.

But there again, we went to bat for them. Our boss, Kraft, got the right people in the room and got it changed on Monday morning. So that was as big a highlight as some of the other things, because we would have lost a real strong cadre of young people. Those young people now, they've gone on and done great things, really did.

But the guy who was the boat guy was a guy named Bob [Robert] Nance. God knows where Bob Nance is. He's probably back in Atlanta someplace having a wonderful time. A real neat guy, just a young guy, and he took that on himself and developed it. Just like Harry Smith, "I'm going to know better than the crew what happens with the lunar rover," and he did. He knew it in spades.

We had enough of those kind of people who got very little glory, other than their own self-reward that they knew they had an assignment, and they did it by the numbers and in spades, and interfaced with the crew and brought the procedures that we needed, and when it was crisis time they responded, and did it quickly, and then took the heat because of the situation between centers. He was more glad to have said the right thing rather than going

through all protocol, because we were really in a bind. It takes a different kind of person to stand up and do that kind of remarkable thing. A lot of tiny things make a big thing.

BUTLER: Hopefully with our project we'll be able to at least recognize some of these people.

ROACH: I hope you do. I really do. It's a special group. Some got rewarded and some didn't. I think we tried to reward everybody in some way. We spent a lot of time giving them extra money, giving them good assignments and giving them a lot of responsibility. I think it paid off, because we're still flying.

BUTLER: That's right.

ROACH: And safely. Every time we have a launch, I watch it, but, boy, it makes me nervous, because that rascal's getting old. [Laughter] It's getting older.

BUTLER: Well, hopefully it and the people will be able to hang in there a while longer.

ROACH: Hope so.

BUTLER: I want to thank you so much for joining us today.

ROACH: My pleasure.

BUTLER: It's been quite a pleasure. Is there anything that you think we didn't touch on?

ROACH: I don't know. If you think you want to talk again, I'll be glad to come. I'm sure there's some other things.

BUTLER: Do you guys have anything that we didn't—

HARVEY: I just have one question, actually.

BUTLER: Okay. Do you want to switch the tape out?

HARVEY: I have about three minutes.

BUTLER: Why don't you go ahead and switch then. [Tape change.]

HARVEY: The question I had concerns Mercury 8. I know that you were one of the remote site communicators on the Mercury 8, but Wally Schirra flew at a time when the United States was about to enter the Cuban Missile Crisis. The tensions had already been really high between Cuba and the United States. Did you all take any special precautions? Were there any special concerns?

ROACH: I don't remember that. We did later on. One of our mission rules was don't fly through the South Atlantic anomaly where all the residual radiation is. We had to go to the CIA [Central Intelligence Agency] and work that out. That was a funny experience. CIA building is really strange. There's no sign. At that time there was no sign, and you drive down the highway and we couldn't find it, so we stopped at a gas station, the guy said, "You're looking for something?" I said, "Yes. We've driven all around here for the CIA

building." He says, "It's one block this way, take a right, there you are." So it was not a secret to anybody but us.

We went in there, a thousand rooms, just like going through a maze, and the guy that we dealt with was a guy named Floyd Sweet. "Sweet Floyd" was what we called him. His big deal was, he monitored the world for nuclear events. If it happened and he had to go to the President and the President had to go to the administrator and the administrator had to call us to tell us that there had been an event. The biggest problem we had with our allies, the French. But we never had to scrub a flight, but we had the rule. Those are the kind of things you never would have thought of. We had to go around the world and make sure.

HARVEY: What problems did you have with the French?

ROACH: French were the guys that [set off nuclear weapons]…and never [told] anybody. Remember off of Tahiti, they had a missile range down there, they woke up and they said, "Oh, let's fire the bomb off." But we didn't have a problem with that. Maybe somebody did. I didn't know anything about it.

HARVEY: I have another one since we changed the tape. Actually, during the summer we had a tour by Sy [Seymour] Liebergot.

ROACH: Oh, yes.

HARVEY: Sy Libergot told me a story and I wanted to ask you a question in relation to it. He told the story of how you helped him get his promotion, how Kraft didn't want him to have a promotion, but you fought for him. So it made an interesting point, which is, how did you

work as a liaison between the flight controllers and the flight directors or the flight operations crew?

ROACH: I was the division—I can't remember where I was at the time. I think I was the deputy division chief, and Sy worked, and I had been responsible to finally put him in. We tried to pick a person that we thought could manage the rules, and we were trying to get them to the next level. Sy didn't have—he needed to go to charm school. He drove Kraft crazy.

I got a call. They were having a promotion board and they said, "We need you in the office right away," in Kraft's office. So I put my coat on and ran across the playground there to get there. I knew there were probably having promotion board, but I didn't know. They said, "Hey, this guy came up and Kraft had some strong words for that." I had worked with Chris for a long time and I knew when to shut up, Sy didn't. And I just made the point that Sy had really worked hard and everybody in the room knew that Chris was a tough boss. They were all the division chiefs, or all the people that were on the promotion board there for him.

It was a nice promotion for Sy, and I thought he deserved it. I said, "He was our top guy." I said, "But the only thing I can think of that wouldn't, is he has a different personality than you. His is strong and yours is strong," and that won. But I went to bat for the guy because I thought he deserved to be promoted, not because the chief thought that he had driven him crazy. You know, Chris drove us crazy sometimes.

I was telling you this story about the one guy who Kraft wanted everybody to say we were a go, and the one guy who didn't know what "go" meant, his system was down, was the only guy in the room that said, "We're okay," and he was lying. I'm sure Kraft said, so he gave us another forty-eight hours to get our minds right, because he did not want the Johnson Space Center to say we couldn't fly, because the hardware was ready to go. So we figured out how we could do it, and we figured out how we could do it if it didn't work in those next

hours, because we'd been working on that. It's kind of like the lifeboat procedures, the same guy told us to throw them away. [Laughter] And if we'd thrown them away, I'd probably be dead now.

That was a set of folks that said, "We're going to do this," and by God, they did it. We monitored them and worked with them and helped them and expanded it and put it on the shelf in case we ever needed it. Boy, it paid off. Paid off. Everything we needed to do had been done. That's why we played the what-if game all the time, because when you're in a crisis, you can't think. You've got somebody terminal at your hospital, your family member, you can't even think about praying, that's why you have a prayer chain. You need somebody else to do it for you. That's the league.

I'll tell you another story about Sy. Sy got divorced. The crew during Skylab would always—I think it was Skylab—would always—Sy was the first person I knew that got an answering machine. He was single now. So the guys would call it and say, "Hi, my name is Sy, please leave—" So they taped that for the full time of the recorder, and then played it back and that's all it said. It drove him crazy.

Another thing we would do is—and that would break the monotony, because let me tell you, some of the nights you were just dying, and all of us were—I ate so many eggs during that Skylab thing, I thought I was a chicken. The crew would say, "Today is so and so day." So that night we decided to create Sy Libergot Day. Sy Libergot is controller of the day, which was not true. Well, they had written it in his log, and the logs just stayed there with all the things that happened. So you could come on shift thirty minutes early and read through, summarize, and then the person would leave. They had in there, "Crew called down today, Sy Libergot Day." Well, he went and listened to days of the aerogram transmission to get that. He was going to record that. Finally, he realized he had been duped. [Laughter]

Have you ever heard of a guy named John [S.] Llewellyn?

BUTLER: Yes.

ROACH: Have you talked to John?

BUTLER: Not yet, but we're hoping to soon.

ROACH: They used to do that to John, too.

HARVEY: We were talking about Skylab. Did you work Skylab 4?

ROACH: Yes.

HARVEY: When all the guys had the problems and [Gerald P.] Carr called down and they said, "We've got to have this meeting." How was flight operations during that time that the problems were occurring between Skylab 4 and flight operations?

ROACH: What problem are you talking about?

HARVEY: Well, Carr and [William R.] Pogue and [Edward G.] Gibson talked about the fact that their mission was just too full.

ROACH: Yes. Well, they had signed up for that. That's what the flight plan was, and the first thing they would do is to call and get the next day's flight plan. They never complained about it until they got behind, and all they had to do was call and say, "Hey, could I have a discussion?" Once it was changed, they just narrowed it down. It wasn't a big deal. They probably thought it was more of a big deal than the rest of them.

John [Llewellyn] did not care for Scott Carpenter, because John was a retro officer, and he said when he landed in Mercury, his only flight, "I didn't know where I was and neither did they." That's not true. John went ballistic. So a number of years later, Scott Carpenter became an aquanaut and he was in a submarine off the West Coast. You have to know John, and don't tell John this story, please, because he'll go ballistic, probably kill the three of you, and then come and search me down.

BUTLER: Well, we don't want that.

ROACH: They wrote in the log that night that John was not going to count down to retrofire, that Scott Carpenter was going to do it from the submarine. John went bananas, stomped around, then everybody was just like this, hysterical. Then he finally realized that he had been thrown a hook and had bit totally.

But John would do things. One time he came late and he was supposed to be there for reentry. And he was really good. He was really good, but he would get things loose sometimes and he didn't have a parking spot. So he just pulled up and parked on the sidewalk. The next person that came in was Dr. Gilruth. So John couldn't drive on the center for a long time. Then he started riding a horse, you know. But John was one of the characters that worked with us. He's a real case. You might need to wear your ear defenders when you listen to John.

BUTLER: We'll be well prepared.

ROACH: John was a smart guy and did a lot of good. John was a veteran of the Korean War and was bayonetted in the trench. He was a Marine and bayonetted and left for dead by the North Koreans and survived. We had guys like that all the time. I could tell you a really

funny story about John, but I'm not going to tell you. No, I don't think I should tell it. I will tell you, but turn the tape off.

BUTLER: Okay.

HARVEY: I think Kevin had some questions first.

ROACH: Okay. Excuse me.

RUSNAK: Well, actually, you were answering my question. I was going to ask about the flight controllers since you talked about the flight directors, so I was curious to hear these kinds of stories about any of the other flight controllers like Sy or John Llewellyn or maybe John [W.] Aaron or Steve [Stephen G.] Bales, some of these guys. So if there are any other stories you want to share.

ROACH: John Aaron was a neat guy, still is a neat guy. John was a guy during Apollo 12, when we had the launch, John had been on the console when we had one of the pad tests where we interfaced with the Cape with that and had watched the fuel cell go down. When it happened during the launch, he knew exactly what to do. So there's a lot of providence, but John was so smart, he would have probably figured it out anyway. He was real laid back. You knew when John spoke, he was worthwhile to listen to. John was an excellent systems guy and real bright, just a neat person, went on and did a lot of work for the Orbiter software, really put his arms around that. I don't know whether John still works over there or not.

RUSNAK: Actually, he's getting ready to retire.

ROACH: Is he really?

RUSNAK: Yes.

ROACH: He's a neat guy.

Gary [E.] Cohen was another systems guy. We called Gary "Gross" all the time. Jim [James E.] Hannigan was a sharp guy, he ran the lunar module group. Don [Donald R.] Puddy worked for him and went on to become a flight director.

HARVEY: What did you think about the trench?

ROACH: The trench was where John Llewellyn was.

HARVEY: I had from stories that they used to have matches made up that said, "The Trench."

ROACH: Oh, yes. In fact, I just finished one, throwing it away. I had kept it for years, and I'm trying to just throw junk away. Jerry [C.] Bostick was a good guy. Carl [R.] Huss was the first guy in the trench. Carl is dead now. He was from Mission Planning and Analysis Division. Floyd [V.] Bennett was the guy who did so much of the guidance work and picking the landing sites. [R.] Scott Hamner was the booster guy. He committed suicide. Frank [L.] van Rensselaer was the booster guy. I don't know where Frank is now. A lot of people like that. Dick [Richard A.] Thorson just passed away. He was one of the LM systems specialists. Dick was a really bright guy, just head and shoulders over many of them.

Sy was on the console on the flight, "I've got a problem," and he did have a problem and no one had ever seen one like that. If you ever get a chance, you need to look at the

photograph that the crew took of what the explosion really was. You wonder how they survived, and all it was was a loud bump. It was a bump in the night.

But we were, I think, blessed with good folks in the mission control team or the flight control team, because we really spent a lot of time interviewing and we felt, I think, that our guys and girls had the right stuff, too.

Steve McClendon [phonetic] was a sharp young guy. I'm thinking a young guy. I remember when I went to Lamar to interview people, and the head of the electrical engineering department said, "How many do you want?" I said, "Well, just let me talk to them." He said, "The whole class is good." I said, "Tell me about some." Steve McClendon was just a student, but graded most of the papers for the professor. So I thought, this is a good guy, and he worked out really well. There were a lot of people like that.

The group over there, Wayne Hale [phonetic] is a sharp guy. They just got so many good, bright folks. They've had a number of ladies that were flight directors that were very good. Ed [Edward L.] Pavelka was another guy in the trench and Ed was a squared-away guy. He really knew what he was doing. Gosh, I can't remember. I'm having a senior moment. But there were just some really good folks, and, like I said, we still have a yearly get-together and that's a good thing to go to. I think that some of them are probably still trying to have chili cook-offs.

Rod Loe is another guy who was really steady. Rod was the guy in Apollo 4 that picked up the fuel cell problem. The spacecraft kept maneuvering, and this was our first flight with fuel cells and the fuel cell vents, and just enough of that vent threw it off. There was good competition when Glynn [Lunney] and John [D.] Hodge were here and so he was, John or Glynn, I can't remember, "We think that the reason for the attitude changes are the venting of the fuel cell," and the light went on. People realized that was true, but Rod was the guy who picked that up, or one of the troops in the back room who watched that thing and watched that thing and watched that thing.

When we had the [*Challenger*] disaster, I don't know whether that was it where—no, it was another thing, where we had a telemetry parameter. It was Apollo 13 where the heater cycled on and off and the heater cycled on and off, and they think, I believe, that the heater was what caused the problem, so they went back and looked and there was the problem, and nobody picked it up because they had never seen it ever before.

Paperwork was another important thing. Boy, it's amazing what you can find in the records. It is truly amazing. With computers now, you can find it in a microsecond. We just had to dig through it.

Really, the more you think about the exciting things, working on Gemini IV in secret was remarkable, because we couldn't believe our young people in the E&D, in the engineering directorate, could develop a pack that a crewman could survive outside. In fact, Kraft had to tell Ed White to get back in. That was such a dilemma. Ed was one of the most gifted athletes, and when they did the surgery on him, the autopsy, they found that he was just full of heart disease, and he would have probably died anyway, if it hadn't been [for the fire]. But when we prepared for a flight, everything is ready. Something happens, we were ready. Very few people know that. We were ready no matter what. We almost lost the ASTP [Apollo Soyuz Test Project] crew because they didn't follow their checklist.

I'll tell you another funny story about Ken Mattingly and Hank [Henry W.] Hartsfield [Jr.]. I can't remember which flight they were on, I think it was the third Shuttle flight, maybe the second. Third. I can't remember. [STS-4.] Ken needs his glasses, didn't take his glasses. Hank begged him to take his glasses. When he got there, he could not see the control panel. But guess what? Good old Hank had his glasses. He said, "If you ever do this to me again, I will kill you." [Laughter]

Now, Deke needed his glasses, and there was not a better guy than Deke Slayton. He was a genuine article. He was a tough guy to get to know, but once you knew him, he was sensational. When he finally got to fly, he was a hero of a lot of people because he beat the

medical system. On ASTP during their training, you'd be talking, no response from Deke. So we had a word to get him to find his glasses and get him to get squared away. But he was one special guy. I'll tell you, you could trust him with your life. He was solid as they come. It's unfortunate because a lot of people didn't know him and he didn't walk around saying, "Hey, I'm Deke Slayton," he just did this thing and was a neat, special person.

That's really the message, as far as I'm concerned. There were some folks who were capable of doing far beyond what people thought they could do, and I wonder sometimes if Nike didn't, not just do it, they did it. You think of Kraft who'd been stymied for thirteen years. Dr. Gilruth saw how great he was, tapped him. Walt [Walter C.] Williams was another guy. Jeepers. Walt Williams is carrying his oxygen tank around for years. You'd be in a meeting with him you'd think he was going to die. Once they got hooked, you couldn't get rid of them. You just couldn't get rid of them. That's why it was time for me to do something different, because there were a lot of other people that needed a chance. You can't wait for everybody to die.

Any other questions?

RUSNAK: No, that was fine.

ROACH: Okay. There's a lot more. If I got a—gosh, I can't think of the young—he was a young kid when I left over there, that wears the big suspenders with a little moustache and striped shirts. But there's just still a lot of good folks over there, and ladies, too. I hate to not say that, because they are just as good. You think of what goes on in Israel can go on here in any avenue of life. I see what my daughter does with her life and my son, and there's nothing you can't do.

Okay.

BUTLER: It's great. Well, thank you so much.

ROACH: Oh, it's my pleasure.

[End of Interview]