

NASA JOHNSON SPACE CENTER ORAL HISTORY PROJECT

ORAL HISTORY TRANSCRIPT

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INTERVIEWED BY JENNIFER ROSS-NAZZAL
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ROSS-NAZZAL: Today is April 2nd, 2009. This oral history with Dr. Jeff Hoffman is being conducted for the JSC Oral History Project in Cambridge, Massachusetts. The interviewer is Jennifer Ross-Nazzal, assisted by Rebecca Wright. Thanks again for making time for us this afternoon. We appreciate it.

HOFFMAN: Well, good, I'm looking forward to it. Let's get started.

ROSS-NAZZAL: Absolutely. I wanted to ask you about your interest in science and space growing up as a child. Can you tell us about that?

HOFFMAN: Sure. I grew up in New York City in a more or less well-to-do family. My parents took me all over the place to museums and concerts, and among the other places was the Hayden Planetarium. My father used to take me to see a new show there every month. There were a lot of things I enjoyed as a kid, but somehow astronomy just got to me. My parents could see that, so they encouraged it. I'm old enough now so that that was actually before Sputnik. So the only astronauts were Buck Rogers and Flash Gordon, but lots of people were writing about the coming of the space age in magazine articles, Walt Disney television programs. I lapped it all up and continued an interest in science and math.

I did well at school. At college I sort of figured I would do some sort of science. Didn't really know what. But I took an introductory astronomy course, continued to enjoy it, and just went on. Ended up with a doctorate in astrophysics. Became a professional astronomer. By that time, the space program was already in operation. The early astronauts were all military test pilots. I was never particularly interested in that career. In fact, I wasn't particularly interested in airplanes, because they didn't go high enough or fast enough. I always liked rocket ships.

Although NASA had taken a few scientist astronauts, not very many had flown. I guess the original four flew. [Harrison H.] Jack Schmitt on the Moon, and then the three Skylab science astronauts. I guess it was in '77, I had been following the development of the Space Shuttle. When NASA announced that they were going to look for new astronauts, including not just test pilots but scientists and engineers, I figured why not give it a shot. So I applied, and I was fortunate enough to get selected on my first attempt. That's how I got in.

ROSS-NAZZAL: Do you have any recollections of Sputnik or the first Apollo 11 landing? Can you tell us about that?

HOFFMAN: Oh yes, very very well. I remember my dad taking me out along with a few friends to the high school football field, and we watched Sputnik go over. The older brother of my best friend was a ham radio operator, and I remember he actually got in the local newspaper because he was able to tune in to Sputnik and hear the little beep beep beep. So yes, everybody was pretty amazed. It's funny. It was something that we always knew was going to happen. All through the early '50s we had been reading about satellites. I do remember how much of a shock it was to everybody in this country that the US wasn't the first, because everybody in the public

at least—obviously there were people in the government who realized what the Russians were doing. In fact they had announced that they were going to launch a satellite as part of the International Geophysical Year, but I think that was lost on most of the public. So the public reaction was pretty astounding.

I remember all the changes that occurred to the US educational system back then. In fact, it was one of the best things that ever happened to us. When the astronauts started flying, sure, we all used to watch them in school. I was always very excited about it. I never thought that I would do it, although it was a nice dream to have. But it was certainly not a realistic career prospect, if I could call it that. When we were going to the Moon, I remember the slightly different reaction that I had to a lot of my friends, because they looked at it as something almost miraculous, whereas I had always believed that it could be done. So I felt a great excitement that we were finally doing it, but I wasn't surprised, because I always knew that we were going to do it, and it was just a question of when.

ROSS-NAZZAL: Once you graduated from college you went on to graduate school. Can you tell us a little bit about your graduate work, and how it helped you in your career as a mission specialist, and your postgraduate work?

HOFFMAN: I was interested in high-energy astrophysics. It was a new branch of astronomy, putting telescopes up above the atmosphere so that we could look at radiation which had previously been invisible to astronomers. I think the things that appealed to me were twofold. The first was that you have a great chance of making some interesting discoveries, because you're looking at radiation that hasn't been so well studied before. So that was the intrinsic

scientific interest. Then I liked the idea of doing stuff involving space, because I still was excited about space and space travel and the space program. So those two things came together. In fact, X-ray astronomy turned out to be a very very exciting new branch of astrophysics.

I did postdoctoral work after I got my PhD at Harvard [University, Cambridge, Massachusetts], and I had built a telescope which we flew in high-altitude balloons. Interesting, but it turned out that balloons just weren't high enough to do the sort of science that we were trying to do. We didn't realize it at the time. Now we do. But I tried, and I learned a lot from that. I did a lot of work with my hands, building electronics, machining stuff. That probably stood me in good stead with NASA, because when they're selecting astronauts they want people who know how to work in a lab, who can fix things and build things. I certainly had demonstrable experience in that.

Then I went for a postdoc at Leicester University in the UK [United Kingdom] where we were using sounding rockets to take telescopes up. Also I started work then on designing the first satellite experiment. I worked on several. That was very interesting because I got some insight into the European space program. I have had a longstanding interest in European affairs, which ultimately culminated after my astronaut career in getting sent over by NASA as the European representative for four years, but that comes much later in the story. But that was the beginning of the technical interest in the European space program. I stayed there for three and a half years, came back with a wife and a son. So my life had changed considerably. Got a position here doing research at MIT [Massachusetts Institute of Technology, Cambridge, Massachusetts] in the Center for Space Research, in this very building [in which] we're talking now, just a couple floors above.

That was the most interesting scientific time that I've ever spent, because just about the time I got here we discovered a new phenomenon called X-ray bursts. I guess we wrote about 35, 40 papers about it. These are thermonuclear explosions on the surface of a neutron star. So pretty wild stuff. There's a lot of wild stuff going on in modern astrophysics, and this is one of the early phenomena that was discovered. So that was a lot of fun. I guess I fully expected to spend the rest of my career here, assuming that I could have gotten tenure and then the whole bit that you go through as an academic.

But NASA got in the way, because they put out the call for applicants. I always knew that if I had a chance to ride a rocket I would always do it. So I applied. Luckily, when I told my wife that I was going to apply to be an astronaut she thought it was just a joke, so we didn't really have to have a serious discussion about it at the time. By the time she realized I was serious, it was probably too late. She's been a very good sport over the years. Of course, Paris [France] was a nice payback.

So I did get selected. That was more or less the end of my personal research career, because NASA made it very clear that they were not looking for people to come to be research astronomers; they were looking for astronauts who had to be generalists, because there were a lot of different things we were going to have to learn how to do. They did make some attempt to allow people to maintain a bit of expertise in their field. I got some travel funds so I could go to meetings of the American Astronomical Society, but in order to do real research I would have needed a lot more time away from NASA. [I was] just so busy as an astronaut that I couldn't do that. So as I said, that was pretty much the end of my individual research career. Some of my former colleagues ask me didn't I miss it, and the answer is yes, I did. Actually now I'm in my fourth career. I was an astronomer, then an astronaut, then a diplomat, and now I'm an engineer

and a professor. Each time you have to give something up, but you get something in return. So I don't have any regrets. I've been quite fortunate. Actually, as we go through the story of my career, you'll see that fortune and luck [have] actually played a significant role on a few occasions.

ROSS-NAZZAL: Why don't you tell us about the application that you filled out and then the subsequent interview that you participated in.

HOFFMAN: Well, I think the most unusual thing about my application—I'm not sure if I'm the only person, but I very well could have been the only person who was selected as an astronaut who admitted in their application to having been convicted of a crime. It turns out that when I was living in England, one of my friends had a friend who owned a large boat, a 110-foot converted Norwegian coastal steamer, it was now a diesel. I could talk about this for hours. But the upshot was that he enjoyed taking a bunch of friends across the North Sea. So I had actually learned celestial navigation when I was in graduate school. It struck me as one of the few useful things you can do with astronomy. I had always been fascinated by the idea of locating yourself by the stars. There was a woman on the staff there who taught a navigation course. I couldn't take her class because of a conflict, but she gave me private tutoring, and I learned celestial navigation. I also enjoy sailing, so I got a chance to do some navigation on sailboats with a former student of hers.

Anyway, when I got over to England and they found out that I could navigate, I knew about radio navigation as well, they asked me if I'd come along as navigator. So I navigated for a few trips successfully. Then it came time to take a trip to Norway. We had had an offer from a

Norwegian captain who had met the owner of the boat that if we could bring the boat over, he would take us on a tour of the fjords. So the owner would hire a captain for the boat periodically when we would be getting ready to go. Well, the captain canceled a couple days before the trip. So [the owner] called and asked me if I would be willing to be the captain for the crossing. I said, "Well, I don't have any certification. I can't really do that." But he knew a lot about maritime law, and he showed me the relevant documents that I don't even remember all the details now. But he made a convincing case that because we didn't have any paying passengers—and one thing led to another. But anyway the upshot was that you didn't need a certificated captain, and he said he would take full responsibility.

So we went over. We had a wonderful trip. Went through the fjords. But when we got back, the coast guard decided that they didn't like what we were doing, and so both the owner and I were served with arrest warrants for operating a vessel without proper certification. We went to court, and we had to pay a ten-pound fine. But he said, "No, we're going to appeal." I said, "Graham, come on, pay the ten pounds, and let's get on." "No, got to appeal." So we actually had to go to Crown Court with the wigs and the whole deal.

It turns out that although his interpretation of the law on the one hand was correct, there's another law that said more or less that in order to be the captain of a British flag vessel you had to be a British subject, which of course I wasn't. So in any case, they upheld the conviction and we had to pay 250 pounds' court cost, which he took care of. But I remember when I was filling out the application and they said, "Have you ever been convicted of a crime," I thought, "Boy, should I fill this out, because they're never going to find out about it." But then I thought, "Well, it's not like I had murdered somebody. I better put it down, because if they ever did find out"—and sure enough, the background investigation that they did was unbelievably meticulous. They

sent people up to the University of Leicester where I worked, and I'm sure somebody would have mentioned it.

In any case, when I came into the selection board somebody piped up, "Here comes the criminal." So obviously they knew about this. It was a nice story to tell. I remember I was the last one getting interviewed that day. They had been running late, and they hadn't had any dinner, and I was thinking to myself, "Boy, they're not going to be in a good mood." But it was nice to be able to tell a lighthearted story which had a happy ending. Obviously it didn't hurt my chances because they took me and maybe even helped, because it gave them something to remember me by along with all the other qualified applicants who were down there with us.

ROSS-NAZZAL: Who else interviewed with you when you were down at Houston?

HOFFMAN: Well, let's see. We had a lot of astronomers my week. Sally [K.] Ride and George [D. "Pinky"] Nelson were both there. Actually in our group of mission specialists we had four astronomers, which we thought was extraordinary. Steve [Steven A.] Hawley wasn't there that week. He was the fourth astronomer who got selected. He came up a different week. But yes, Pinky and Sally and I were all there.

ROSS-NAZZAL: What do you remember from that week? Anything stand out? You make any friends that week?

HOFFMAN: Not really. Everybody's looking at each other, saying, "Do they have something that I don't have?" What really impressed me was how good a lot of the candidates were. [With] at

least half the people who came down, I was sufficiently impressed that I would have said that if they got selected rather than me, obviously I would be disappointed but I wouldn't have felt that a great injustice had been done because they had taken somebody who I was much better than. They had a lot of good people to pick from. A lot of people applied. It was the first time NASA had selected new astronauts for about ten years, so there was a big pent-up demand.

I think normally during the Shuttle era they were typically getting 2,000-3,000 applicants each selection, but we had I think 8,000 qualified applicants for the '78 selection.

ROSS-NAZZAL: Tell me about that phone call that you got from George [W.S.] Abbey.

HOFFMAN: We had expected to be notified in December. That's what they had told us. Obviously [NASA] Headquarters [Washington, DC] was taking their time making the decisions. As you can imagine, there was a lot of speculation on why, which I won't go into. This was a very different astronaut selection, because for the first time we had women, we had racial and ethnic minorities. I guess they wanted to be sure that they got everything right because it was going to get such a lot of attention. So came January, and we go skiing every year. Our family likes to go skiing. So we were off in Sun Valley. My parents honeymooned there, and so they planned this vacation with the family for a long time. Somehow NASA managed to track me down, and we got a call I guess the night before just confirming where we were in our condominium, and would I be there the following morning because I was going to get a phone call from NASA. So at that point I started to get excited. What can you do?

We didn't know what the protocol was. As it turns out, if the call came from George Abbey, it meant you were selected, but if it came from Duane [L.] Ross then it meant you

weren't selected. Well, I didn't know that anyway. So the call came from George Abbey. We put off going out to ski because I wanted to wait for the call. Picked up the phone, and it was George Abbey, and he said, "Jeff, are you still interested in being an astronaut?" That didn't take very long to answer. So he said, "Well, congratulations. We've decided to give you a chance." Then he put me on the line with somebody who started discussing salary. They could have offered me \$2 a year and I probably wouldn't have—probably was a good time to negotiate with the people, because you're in a state of shock, and I would have accepted almost anything they offered. But what they offered was more than I was earning at MIT in any case.

It turned out that my father, bless him, had put a bottle of champagne in the refrigerator just in case. So after the phone call, we cracked it open and celebrated and then went skiing. It was actually a nice time to be away for the week, because I was told back at MIT that the phone was just ringing off the hook because I was the only one from New England I guess who got selected from the local area. So all the news media wanted interviews. I would have been completely overwhelmed, but instead I got to go skiing for the week. By the time I came back, still there were a lot of interviews, but the frenzy had died down a little bit, because it was now week-old news.

ROSS-NAZZAL: Yes, I was curious; I was going to ask if you had a press conference. Some people have mentioned that.

HOFFMAN: No. Like I say, I was safely ensconced in Sun Valley. So I had a week of peace before I had to come back and face it. Of course, all my friends and colleagues were excited. It was hard to really imagine that I was going to do this. Of course, the conception of what life was

going to be like as a Shuttle astronaut—in those days people were still talking about the Shuttle was going to be flying 30 times a year. I remember one of the questions people kept asking. When are you ever going to get a vacation, because you're going to be flying so frequently? Looking back on it, it was very very heady times. But NASA did send two interview teams. They made some recordings of us, films that they could use, little five-minute clips of our life here and what we were doing. We still have copies of that.

I remember particularly the local television actually did about a half-hour program with us at our house out in the country. There was still snow on the ground then. Our son was two and a half at the time. The three of us were sitting, and so my wife was talking with my son. He was very cute. Like W. C. Fields says, never get on stage with a child or dog. When Barbara, my wife, asked him if he would like to ride in a rocket ship when he gets to be a big boy, he looked right at the camera and said, "I'm a big boy now." That just cracked everyone up. The next day everybody to a person said, "Hey, Sam was really great on TV last night. You were pretty good too, Jeff," but he definitely stole the show. So that was fun. We still show that occasionally at family get-togethers. So it was very exciting.

Then of course we went down shortly thereafter in January. The whole group of 35 went down. That's where we met one another. That was exciting. I still had a beard at the time, so I was very much the academic. I kept the beard. My wife and son had never seen me without a beard, and most of my friends. I had it for ten years. When I was back in graduate school, we went on a canoe trip up in Canada and that's where I grew it. I had kept it ever since. So in any case, the group got to know one another.

We had a little bit of looking around the area for real estate. I went back with my wife, and my parents came down as well in April, that's where we actually found the house that we

were going to live in. It was right on the water in Clear Lake. Very nice. It was close enough so I could ride my bicycle to work along NASA [Road] 1, which was a little bit dangerous, but I did it anyway. Then I gradually wrapped up the research I was doing here, and we sold the house and loaded up the moving van and off to Texas. It's hard to believe that we were really doing it.

I guess they make you come down in the middle of the summer to hit you with the worst that Texas has to offer just to make sure that you really want the job. It certainly was. It was funny because my wife being English, all the time we were living here in Boston [Massachusetts], when people would first find out that she was English immediately the first thing that they would say was, "Oh, you must feel right at home here because Boston is so much like England." Of course, for her everything was new and different. So she'd say, "What are they talking about? It's very different from England." Then we moved to Houston. After a few months she would look back wistfully up towards the north and say, "Oh, now I know what they were talking about," because Houston is just a totally different world.

ROSS-NAZZAL: Tell us about those first few weeks coming into the astronaut office. You mentioned you were the first class in about ten years. What was your reception like from these older astronauts who'd been in the office for so long?

HOFFMAN: First of all, I have to say that being in the group with the six women took a lot of the publicity heat off the rest of us, because they were always first in line for the interviews. So we had a little bit of relative peace compared to what they had to put up with, which I really came to appreciate how the media can work. I remember one interview. Boy, I forget which of the women gave it, but women's lib was still very much in the news back then. The interviewers

asked her whether she felt that the women's liberation movement was responsible for her getting selected as an astronaut. She said more or less, "I'd like to think that it's my own professional qualifications which qualified me for the job." The headline came out: "New Woman Astronaut Says Women's Lib Not Necessary." You really get a sense of how the newspapers—there was one newspaper in England that asked for an interview, and they were not granted an interview, so they just made it up. We got a copy of it because we had family over in England. They sent us this. The woman had never done the interview; it was a real education in how the media works. So that was something that was very new for almost all of us, because we had never dealt with that kind of publicity before.

The other thing, immediately in the office everybody called everybody by their last name, it was very military. I became aware of the hierarchical structure of NASA, and I thought to myself, "Boy, this is like being in the military, isn't it." But then I listened to my military astronaut colleagues who were just coming in from active duty, and they were saying, "Oh man, we're out in the free world at last." So I realized that NASA is sort of halfway. It's obviously a lot more relaxed than the military, in terms of a hierarchical command structure, but it's a lot more organized than university life. I was caught in the middle.

The presence of the women I think had a real impact on the older astronauts, because they had been at NASA—Texas is a much more conservative society than on the east or the west coast. Nowadays there's lots of women in the military, but back [then] there wasn't. The idea of calling the women by their last names just didn't work. They couldn't do it. So that was really kind of nice, because within a month or two everybody in the office was on first name basis. So that was a good outcome there.

There's a lot of sizing each other up. All of us were told that we could all expect to fly. We were well aware that back in the '60s there were more astronauts than flights, and so there was a lot of competition. Clearly there would be people who flew earlier and people who flew later. But it was a little different. Also there wasn't the same antagonism towards the scientist astronauts which we had heard about in, for instance, the '67 group that was selected with Story Musgrave and Bob [Robert A.R.] Parker and Joe [Joseph P.] Allen and those guys. Because back then, if a scientist flew, it meant a pilot didn't. Like Jack Schmitt going to the Moon and Joe [H.] Engle getting bumped from that flight.

But for the Shuttle, there were two pilots on every Shuttle. So the fact that there were going to be scientists and engineers flying along wasn't going to take flights away from the pilots. So I never felt any sort of antagonism towards me because I wasn't a pilot. I know there are probably some people who were wondering, "Who are these academics?" My beard didn't last very long, because as soon as I got to the altitude chamber in preparation for the T-38 flying it became pretty clear that you can't make a good face seal with a full beard. So off came the beard. My wife shrieked when I walked through the door, and my son said, "Where did you put your beard, Daddy?" But easy come easy go. I kept a mustache. I actually kept that until about three years ago. When the last black hair turned white my wife suggested that maybe it's time to get rid of it, and so I did. Now I'm once again clean-shaven for the first time since 1968.

ROSS-NAZZAL: You mentioned something that I thought was interesting that no one has mentioned before. You mentioned that NASA had this hierarchical structure. Can you talk about that in terms of the office?

HOFFMAN: Sure. Well, the Center is divided into directorates, and there's a center director and directorate chiefs and then divisions and division chiefs. The astronaut office had a chief of the office. It was a big hierarchy. You reported up through the hierarchy. It was made clear to us that you don't go talk three levels above where you're working, you report to your supervisor. People didn't think in those terms at universities, you talked to whoever you need to whenever you need to. It was not oppressive in any sense at all, it was a just a different life.

ROSS-NAZZAL: Have you read Mike [Richard M.] Mullane's book [*Riding Rockets: The Outrageous Tales of a Space Shuttle Astronaut*]?

HOFFMAN: Oh, sure, I have to read all those books because all my students ask me. I warn them that this is Mike Mullane's view of the astronaut experience. Don't take it as the definitive history. Take it as Mike Mullane's view of the world. He got a few things right, and he remembered a few funny anecdotes. I think he didn't get it—well, I won't talk in public about Mike's book.

ROSS-NAZZAL: That's okay. I was curious what you thought of his portrayal of the mission specialists, these scientists coming in.

HOFFMAN: He told me that I showed up looking just like a university professor with a beard. He said I had patches on my elbows, which I don't think is probably true, because I don't think I ever had a patch coat, but the metaphor was perfectly right. I was an academic. I guess he had serious doubts of whether we could hack it. I've been mountain climbing and skydiving, and

I've done plenty of things which required a lot of physical strength and a certain amount of exposure to risk. So I didn't have any qualms about it, but I clearly wasn't military. It was an interesting feeling, because the people that I was working with were all in the Vietnam War, and up here in Boston we were demonstrating against the war. Politics are very different down in Texas than they are up here in the northeast. We tried not to get into too many political arguments. Obviously a lot of us disagreed about what happened in Vietnam, and what we should have been doing. By that time, the war was long over, and everybody who was there was basically now focused on something else. But it was interesting.

Certainly it was the first time I had ever had any contact with the military. So I learned a lot. I found it quite fascinating, learning the differences between the Air Force and the Navy and the different other services. So in general I found everybody very welcoming. The military families tended to take the lead in organizing social activities, because I guess they were used to it, because you get shipped around from base to base and it's part of a lifestyle is you have to organize welcoming parties. So they were used to doing that. For the first couple years we definitely had a lot of parties and really built up a big rapport. I think that our group in particular, the Thirty-Five New Guys, TFNG, we've kept that, and in fact we're the only group that has had regular reunions just on our own. We had a ten-year reunion and a 20-year reunion in Houston, and then last year for our 30th reunion in 2008, since we were all Shuttle astronauts, we figured that by the time our 40th reunion came around the Shuttle wasn't going to be flying anymore, so we had our 30th reunion in Florida and watched a Shuttle launch. It was great. I think about 20 people came. A large number of the group showed up. I guess there's still 29 of us are still alive. So yes, I think you get quite close.

Over the years, as we started to get assigned to missions, people go off in different directions, and we didn't have quite so active a group social life as we did the first two or three years, but it's an important way to bond with the people you're going to be working with, and I really enjoyed that.

ROSS-NAZZAL: You pointed out you called yourselves the Thirty-Five New Guys. Do you recall how that came about?

HOFFMAN: I really don't. I really don't. But I don't even remember who designed our—

ROSS-NAZZAL: T-shirt?

HOFFMAN: The T-shirts. But whoever did must have come up with the TFNG. I don't remember who did that. If you ever find out let me know. Somebody might remember.

ROSS-NAZZAL: I think Anna [L.] Fisher thought that Judy [Judith A.] Resnik had drawn that. Maybe Jim [James F.] Buchli.

HOFFMAN: I just don't know.

ROSS-NAZZAL: I just like to ask everybody, because different people have different recollections. Your class was so big, I understand, that you were split into two teams.

HOFFMAN: Yes, the red and the blue. I was in the red group.

ROSS-NAZZAL: Whose team was that?

HOFFMAN: Whose team was that?

ROSS-NAZZAL: Was that Rick [Frederick H.] Hauck or John [M.] Fabian? I understand they were the elders of the group.

HOFFMAN: Yes. I think it was Rick, but if you wanted to convince me that it was John, I'd probably believe that too. Obviously I don't remember.

ROSS-NAZZAL: Did that have any sort of impact upon your group having to separate things out?

HOFFMAN: I don't think so. It was a nice little bit of rivalry sometimes. We would have the baseball games and food fights at parties and things, the reds versus the blues. But it certainly didn't have any impact on crew selection or the really important job assignments and stuff. Those were pretty much independent.

ROSS-NAZZAL: Who was your first officemate when you came into the office?

HOFFMAN: [S.] Dave [David] Griggs, who also lived right across the street from us. So we became very friendly with the family. They had two girls who were just a little bit older than our

son. Then let's see. In the office right next to us and adjoining were Paul [J.] Weitz and Joe [Joseph P.] Kerwin. So I got to know Joe Kerwin pretty well, spoke to him a lot. In fact I saw him at a meeting last December, and he reminded me of that boat and my criminal conviction because he was on the selection committee. Just out of the blue he said, "Gotten arrested again for anything, Jeff?"

Of course, for me I think the most unique thing was learning to fly the T-38s, because I was totally new. I had never flown. I had jumped out of airplanes, but I'd never flown. To fly a high-performance jet is really a pretty incredible thing. It took a lot of getting used to. It was a completely different world. When I first got up there, I couldn't understand what anybody was saying on the radio. I would get fixated on certain things and forget what was going on. That's one of the reasons why they put us in that environment, because spaceflight is very much an extension of high-performance aviation. So for the first time we didn't all have to become pilots, so they didn't send us off to a military flight school like they had done the previous group of astronaut scientists back in '67, but we had a complete ground school and a flight training program. So there was a syllabus of like 15 or 20 different flights that we had to complete with a lot of different skill sets. It was really exciting. It was just a lot to learn.

After a while, you can become a little bit blasé about "Oh jeez, I got to get my flight hours this month, what am I going to do, I got too much other stuff." But at the beginning, any flight I could get to do anything anywhere, it was just the most exciting thing that we could imagine.

ROSS-NAZZAL: Was there any one astronaut in particular that you trained with and flew with on a regular basis?

HOFFMAN: I flew a lot with Dave Griggs because he was a neighbor and it was quite convenient. Since I rode my bicycle to work, we only had one car, which was a rarity in families out there. So wherever possible, I'd get rides out to Ellington [Field, Houston, Texas] with pilots and then come back. It was very convenient with Dave because then he'd drive right back to home, and I could just walk there. Also, he was a superb pilot. All the pilots are good, but some are even better than others, and I think he was one of the best despite the fact that he tragically was killed in an airplane.

ROSS-NAZZAL: Tell us about the rest of your training. I understand there were classes and you traveled to the rest of the NASA Centers.

HOFFMAN: Well, yes. They really wanted to give us a good exposure to NASA. I think that's still pretty much standard for all the new classes of astronauts. So we did visit all the different NASA Centers. Again, it's a good opportunity to party together and get to know your friends as well as getting to know NASA. Everywhere we went, particularly since we were the first Shuttle astronauts, I think it was much more of a unique reception probably than Group 12 or Group 13 who went ten years later. Everywhere we went we were followed by the media. I remember we went for water survival training. We were supposed to be by ourselves in little one-person life rafts. Ten feet away were these big boats with the photographers clicking away, mostly at the women of course, but my raft was right next to Judy Resnik's. We were surrounded by photographers. It was really quite something.

Then just a lot of background stuff. Lectures in biology and anatomy, in astronomy, in geology, as well as in technical engineering subjects. The idea was to try to bring everybody up to a certain basic level. Obviously I didn't need the astronomy lectures, but the MDs in the group didn't really need the physiology lectures, so it was a little bit for everybody.

Yes, it was pretty intense. Back in those days the education was pretty informal. It was the tradition that astronauts never had to take written exams. That's not true anymore; there's so many internationals now with the Space Station. There's a much more formal curriculum with exams and the whole bit, but for us it was just great fun. I always liked school, so it was like going back to school and learning lots of new stuff. The more you would learn, when you finally had learned enough about a system that you could go into the simulator and actually start throwing switches, that was a new level of excitement. You gradually work your way up through the hierarchy.

At the beginning everything is new and exciting. There's just so much to learn that it definitely was a full-time job.

ROSS-NAZZAL: Did NASA provide any sort of media training on how to handle the press or television reporters?

HOFFMAN: They did, the so-called charm school. I don't honestly remember how far into our training they did that. But they contracted with one of these training organizations that comes in and gives you an intense two-day crash course in how to deal with the media. It was quite good. I think most everybody who went through it felt that they had a lot of useful hints about

preparing certain talking points in advance and how to fend off microphones that are being shoved in your face. There's a lot of little tricks of the trade.

ROSS-NAZZAL: Our research indicates that you worked with Story Musgrave for your first on-the-job training activity. Do you recall what you did under his tutelage?

HOFFMAN: I thought that I worked my first on-the-job training—

ROSS-NAZZAL: We never know if things changed.

HOFFMAN: Well, let's see. What did they say my first on-the-job training was? Do you remember?

ROSS-NAZZAL: They didn't know. We have a sheet where everyone has been assigned to an astronaut, and you and Ellison [S.] Onizuka were assigned to Story.

HOFFMAN: Because the first one I remember working with at all closely was Karl [G.] Henize, because I was working on the instrument pointing system [IPS], which was an astronomical type thing. So that made sense because Karl was an astronomer, and I was an astronomer.

My first T-38 ride was with Story. I'll never forget that, that's for sure.

ROSS-NAZZAL: Will you tell us about that?

HOFFMAN: Yes. Well, he took off in full afterburners and climbed. Probably we were only going up at about 30 degrees, but I felt like I was in a rocket going straight up. It was really exciting. Story is a good pilot. He's a unique guy. I've spent a lot of time with Story. He's an interesting person, to say the least. I like him. He's a good astronaut. So I've talked with him a lot over the years. I absolutely don't remember the initial on-the-job training, what it would have been. He was also a skydiver like I was. We discovered that we had taken our first jump with the same instructor, which was neat.

ROSS-NAZZAL: Tell us about your work with Karl.

HOFFMAN: The instrument pointing system was built by the Germans as part of the contribution to the whole Spacelab that was a European design and construction. I never went over to Germany for any of these meetings, but I do remember going to a few big meetings with a whole bunch of Europeans who came over. That was when I started to learn how much time at NASA is spent going to meetings. Everyplace you go, there's more people in meetings than probably sitting in their offices doing work. Lots of times you look around at a meeting. There's people sitting along the walls who never say anything. You wonder what's everybody doing here, but that's just the culture. That's the way it works.

Yes, it was an interesting introduction into both how you deal with technical developments and also the international flavor of it all. I learned a little bit about it. They rotated us from job to job pretty frequently. Some of the early jobs I remember—the first one that I actually remember, now let's see, for—because I was working on it in '81 for first flight when I was working on the OMS/RCS [Orbital Maneuvering System/Reaction Control] System,

so it was part of the propulsion system. I also spent quite a bit of time in the Flight Software Lab [FSL] out at Rockwell testing mostly the on-orbit software. That was very good training, because you actually get cockpit time working procedures. A lot of time traveling time away from home, but I had done a lot of that as an astronomer as well, so it was nothing new.

The other early on-the-job training assignment I had was to work actually with the training people, because they didn't really know how to train people to fly the Shuttle. In Apollo, [the astronauts] worked on the development, and then they spent time in simulators, but there wasn't so much of a formal training program. They tried to have a formal training program with us. Typically they would get engineers to come and talk about their systems. Of course they would talk about it from an engineering design point of view, what kind of aluminum alloy is this piece of material made out of, which as users we didn't have to know. But what we really wanted to know was what are the operating characteristics of the system. So it became apparent that the techniques for training were going to have to evolve. Maybe because of my educational background I think I made some good contributions there.

In fact I actually wrote a new training workbook to show them what a user-oriented manual should really look like and that got folded into the actual OMS training workbook. Twenty years later, a lot of the stuff I had written was still there.

ROSS-NAZZAL: I've heard that from a lot of your classmates. I think Anna Fisher mentioned that the last time we talked to her that you guys really helped to shape that environment, that it was free-form at that point.

HOFFMAN: Yes, they didn't really know how to take in a big group of people like us and really train us because they'd never done it before. The trainers were as naive about it as we were in some ways. They knew a little bit more about the systems, but how to teach us how to use the systems was new.

What's interesting, unlike in the Air Force where pilots teach the other pilots but you have lots of pilots, astronauts don't by and large teach the other astronauts. That's changed a little bit in recent times. There's a lot more mentoring now I think than there was back then. But you're being taught by people who are never going to fly in space, but their job is to figure out what we needed to know in order to operate this equipment. Some of them had a better sense of it than others.

By the time several more groups had been trained, we were in the late '80s and '90s; the training was much more methodical and it was working a lot smoother. Then I think the biggest shift was—it was just coming about about the time that I was leaving the office—when we started training for Space Station, and they realized that with all the international participation, both the international astronauts and the fact that we were going to have international modules, that we really needed some more formal ways of confirming that people really understood the material. So that's when they decided that they were going to have examinations. In that sense, it became a little bit more like the traditional Russian program was, because the Russians always were examined in training. But the US astronauts, I guess it was just considered well, we know more than anybody else and nobody's going to examine us. That held for a very long time.

Obviously you still had to show your competency, because in the simulators if you screw up and can't solve the problems they throw at you then your simulator team is not going to certify you for flight; that's not something that normally would happen, but I do know there are

times when people have been told that they've got to brush up a little bit or work a little harder. The simulator teams by and large are very very conscientious and the [systems works]. Your training team works very hard. They feel a personal stake in your success. They monitored us very closely to make sure that we knew what was going on. We're getting a little ahead of ourselves. But still.

ROSS-NAZZAL: I did want to go back and ask you about the FSL and the time that you spent out at Downey [California]. What were your hours like? Was it similar to say working in the SAIL [Shuttle Avionics Integration Laboratory]?

HOFFMAN: I tried to get the second shift, from 4:00 until midnight, so that I could go and get some good beach time during the day, that's what I tried to do.

ROSS-NAZZAL: How long were you out there for when you would fly out to California?

HOFFMAN: Typically a week. Occasionally we'd be out for two weeks and I'd stay over the weekend.

ROSS-NAZZAL: Was there housing provided?

HOFFMAN: We stayed in the Empire Motel, I remember. Mrs. Chen ran the Empire Motel. We all got to know her. She was very nice to us. I don't want to call it a fleabag, because it was clean and everything. But it was a very simple Motel 6 type place. We were on pretty small

government per diem. Nothing fancy. You get a rental car. We'd fly in to usually El Toro Marine Air Base [California]. That was the famous base in Independence Day that got wiped out by the aliens.

ROSS-NAZZAL: Oh, was it?

HOFFMAN: Yes. Then they had a kind of a Rent-a-Wreck rental car there. So we'd get our cars and drive out to Downey. Like I say, I enjoyed it because during the day I'd go swim on the beach. In the evening I'd work.

ROSS-NAZZAL: Who else was working shifts with you, do you recall?

HOFFMAN: Well, it was one astronaut at a time, and then they had their own test pilot, whose name I don't remember, but he was a very friendly guy. He'd been doing it for a long time. So it was nice to work with people who knew what they were doing. The two of us would work together. For me it was probably more educational, because I didn't know a whole lot about the procedures or anything. So it was a great opportunity to learn and just get comfortable sitting in a Shuttle cockpit simulator.

ROSS-NAZZAL: How was the FSL different from the SAIL, or were they pretty comparable?

HOFFMAN: They were very similar, very similar. It didn't have quite the same physical layout that the SAIL did, but I guess there was so much software that had to be verified that they

couldn't do it all in the SAIL. So the SAIL did mostly the ascent software. The FSL did the on-orbit and the entry software.

ROSS-NAZZAL: You also mentioned that you worked on the OMS pods and the RCS systems. At what stage were they when you started working those?

HOFFMAN: They were pretty well developed. Astronauts get assigned to a lot of the different systems. Then the idea would be when they would have engineering reviews, you would just go and just see is there anything funny going on that we should know about. Tragically, nobody was ever assigned to work the solid rocket boosters, so when *Challenger* came around—we had lots of people paying attention to the main engines, because everybody knew about turbine cracks and potential pump problems. But the general feeling about the solid boosters [was] that solids don't fail and there's not much you can do about it. So no astronaut was ever to my knowledge assigned specifically to cover the solid rocket boosters, tragically, because had we known what was going on there, things might have been different. But you never know.

ROSS-NAZZAL: Some of our research—again we don't know if it's accurate or not—indicates that you worked on prox ops [proximity operations]. Did you do any work with that?

HOFFMAN: Yes, that's right. That may have been one of the first things. Dave Griggs and I got assigned to work on-orbit, that's right. They were developing the Shuttle engineering simulator, and so we got involved in setting the requirements for the orbital simulations. Yes that's right, I

remember that. That was probably the first independent assignment that I got, now that I think back on it.

ROSS-NAZZAL: How did you set those requirements?

HOFFMAN: We had to try to talk to the other astronauts and find out what it was that they expected the Shuttle to be doing once it got to orbit. So what did we want the simulator to be able to duplicate? It became pretty clear. The rendezvous and proximity operations were the most critical thing that had to be tested. So we worked a lot on that.

Again, the people who were designing the simulator knew a lot more about it than we did. But our job was just as operators to make sure that the things that we felt that we would need to get out of the simulator it would be capable of providing.

ROSS-NAZZAL: Were there any major challenges that you had to overcome?

HOFFMAN: Not really, because it was not fundamentally different from other simulators that had been built. We understood orbital dynamics. The Shuttle had been modeled already in a mission simulator. It was really a question, since this was not going to be quite as complex as the mission simulator, some of the questions were what do you really need, can we eliminate this or that or the other thing. I don't really remember technical details of things getting eliminated. In fact, over the long run it became a very very capable simulator. It could do just about anything it had to do. In many ways it was better than the SMS [Shuttle Mission Simulator].

ROSS-NAZZAL: Did you also work on Spacelab 2? That was another assignment we had seen.

HOFFMAN: That was what I was doing with Karl Henize. Yes because that was with the IPS. That probably came a little later. Again, it's all a blur.

ROSS-NAZZAL: Well, that was over 30 years ago, as you pointed out. Your biosheet also indicates you worked on Shuttle navigation. What did that entail?

HOFFMAN: Let's see. Early on, GPS [Global Positioning Systems] was just getting started in 1978. I remember on our trip to Rockwell—Rockwell made the original GPS constellation. They showed us this picture of this new global positioning satellite that they said, "This is going to transform the way we do navigation." I was intrigued by it, because as I mentioned before, I enjoy navigation. The Shuttle Program decided that it might be a good idea to acquire a GPS system for the Shuttle. I actually got appointed to the source selection board and learned a lot about GPS back in the early days. I don't remember how much time we spent on it. But the problem we ran into was that Rockwell wanted \$20 million to install it. So we would cut the requirements down, and then they would go off and study it again, and it would still come back at \$20 million. Then we'd go and scrub it again, and it would still come back [at the same price]. Finally NASA management decided that the Shuttle is working okay without GPS, and we're just not going to spend \$20 million.

Finally 30 years later the Shuttle finally does have GPS, but it took a long time. We did get two GPS switches put into the Shuttle, which for many years people in the simulators would look at those. "What are those for?" "GPS," I would explain if I happened to be in the

simulator. “Yes, we put that in because we figured someday the Shuttle is going to have a GPS.” Sure enough, it finally does.

But it was interesting for me, because again, it was the people who do the navigation in the—I guess they were not mission planning but orbital planning people. Anyway, these were people who really did a lot of heavy-duty mathematics, which I was intrigued with. So it was fun working with them. In particular, a lot of people back then were people who had of course worked on Apollo. So these were the people who did the Apollo navigation, which was quite fascinating.

ROSS-NAZZAL: The one other assignment I noticed on your biosheet was that you helped develop satellite deployment procedures.

HOFFMAN: Yes. Let’s see. At one point we were working on a new Centaur, which would be used to launch satellites. I don’t think I actually worked on the procedures for the PAM [Payload Assist Module]. But yes, I remember working when they were going to fly Centaur. That was a little bit later, because that was in the early ’80s I remember. We had a lot of safety questions about [Centaur]. After *Challenger* it went away [from the Shuttle Program].

ROSS-NAZZAL: Let’s talk about STS-1. Where were you when that flight went off?

HOFFMAN: I was working OMS/RCS at the time, and I was working for Ken [Thomas K.] Mattingly. So he had us as his troubleshooting people. In fact, one of the OMS positioning devices had a partial failure during the mission. So he sent me off to learn everything I could

about no-back devices to prevent it from slipping. We watched it all on television. Pretty much everything, all normal work came to a halt. That was actually true for the first few missions. It gradually sank in on people that if the Shuttle was really going to be flying as frequently as everybody said it was, you really could not afford to bring all work to a stop every time the Shuttle was in space. But I guess that's the way things had been during Apollo, maybe not Skylab, because Skylab was up for a long time, but the other missions, everybody had been just paying attention to the mission and nothing else. So it was a strange feeling the first few times. I don't remember how many missions it was before this started to happen, where if you had a meeting scheduled you would go to the meeting instead of watching the mission. You knew you were sitting at this meeting, but hey, they're up in space, they're doing stuff, what's going on up there, and so on and so forth.

But it's certainly true, the Shuttle was supposed to be operational. One interesting thing I ought to talk about a little was this whole attitude about the Shuttle, how often it was going to fly. In retrospect, of course, we can see there was a lot of groupthink going on where people had had to say that the Shuttle could fly as often as they said it was going to fly because that was the only way you could close the economic argument, which the Office of Management and Budget was requiring in order to get approval.

So a lot of very unfortunate compromises were made, which have been very well documented. We don't have to go into the detail here. But when we showed up, they would talk to us about how we're going to turn the Shuttle around in two weeks and it's going to fly. Each Shuttle is going to fly ten times a year, and we're going to have 40, 50 flights a year. We were a little bit skeptical. But I remember we were saying, "Fifty flights a year, that's a flight every

week. It's hard to imagine they're ever going to do that. But if they only get 30 flights a year, still that's plenty."

The groupthink was really pervasive. It wasn't until after the Shuttle was flying that the engineers who were responsible for all the subsystems started to get cold feet and said, "Well, we said we could turn this around, and we could fly engines for ten flights before each inspection, but we better take them out and inspect them [after every flight, instead]."

I always remember one of the lectures we got from—it was from an engineer who was responsible for the Shuttle turnaround at the Cape [Canaveral, Florida]. She gave us a detailed hour-by-hour breakdown of what was going to be done to the Shuttle on every day for the 14 days of the turnaround. At the end of that she said, "Now I have to make an admission to you. I'm telling you that we can turn the Shuttle around in 14 days, but I don't really believe it. I've looked at these numbers over and over again. I don't see how we can possibly do it any faster than 16 days," which again is totally outrageous. It takes minimum of three months to turn a Shuttle around, and that's pretty quick. But it's just typical of the way people were thinking back then.

There were people who should have known better who were saying that flying the Shuttle is not going to be any more dangerous than flying in a 747. On the one hand, it was very exciting, because this was a new way of doing business in space. But well, like Richard [P.] Feynman said, you can't fool nature in the long run. So that was later in the story.

But it was a very heady time. Certainly for STS-1 it was just brilliant. I did get involved with the media for STS-1. Since I was in Houston there were a few—let's see. I didn't go to one of the major TV stations, because I noticed that there was a team from National Public Radio [NPR] there, which I always listened to. So I volunteered to do that, and the guy who was the

interviewer is still one of my close friends. He lives in New York City now, and we've known each other all this time. I remember that he was moaning about how he couldn't find any bagels down in Clear Lake. My wife knew where to get some good bagels. So she went out and got him some bagels and cream cheese.

I did interviews. They arranged an interview with Chuck Yeager right before landing, so I got to talk with Chuck Yeager. Yes, and that was very exciting.

ROSS-NAZZAL: I can imagine. What sort of things were you talking to NPR about?

HOFFMAN: All of the media, they want astronauts first of all for a little bit of authenticity. But what I was able to provide, because by that time I pretty much understood how the systems worked, and so I could give a good explanation of here's what's happening now, here's what's happening, this is the critical thing at this point. The payload bay doors have to be opened within 30 minutes, or they won't be able to get rid of enough heat. This is what's going to happen next, essentially interpreting for the public. I'm pretty good at that, so I've actually done a lot of media work over the years.

ROSS-NAZZAL: Once STS-1 actually flew was there any relief in the office? You had come in in '78. They expected the Shuttle to fly so much sooner.

HOFFMAN: Well, yes, because we came in. NASA loves to select astronauts, right? So we came in. Celebrate the fact that the Shuttle was going to fly in '79, but it didn't fly in '79, because all the tiles kept falling off and a lot of other things weren't ready. Then when it became apparent

that it probably wasn't going to fly until '81, they went and selected another group in 1980. That is the biggest shock. Actually they told us this would be true when we first showed up. We passed that on to every group that comes in. The biggest shock will be when you haven't flown yet, but NASA selects another group of astronauts that's already behind you and you haven't flown. Sure enough, none of us obviously had flown, and in came 19 new astronauts.

Also then they had the first Europeans who joined the training because the—and in fact Claude Nicollier is still one of my closest friends. We hit it off very well. I was also very friendly with Wubbo [J.] Ockels, although I haven't seen Wubbo so much the last few years. So that was a new experience.

But there always was the question. We knew what was involved in the first test flight of the Shuttle, the first manned flight of any aerospace vehicle. You never do a full-up mission in a new airplane or new spacecraft, except with the Shuttle. We'll probably never do it again. But John [W.] Young and Bob [Robert L.] Crippen, they did the whole thing. Particularly because of some of the questions about the tiles, there was this is it really going to work, is the main engine going to hold together, are the tiles going to stay on.

When everything worked there really was an elation that it would be that this was a vehicle that really did what they said it was going to do. Then of course we had to wait a long time for the second flight. That was another over six months. I think it didn't fly until November, if I remember correctly.

But that was really fun for me, because I got assigned to be on the chase team for the second flight, and that was really fun. Because the idea of the chase team is you have the T-38s which try to rendezvous with the Shuttle as it's coming in on the approach and landing, both so that you can take pictures of the tiles before it touched down in the lakebed—because they know

there's going to be a lot of tile damage from the little grit and pebbles getting kicked up by the lakebed, and we wanted to take pictures of it before that. Then also just in case the altimeter and air probes don't work properly, the T-38 can call out altitude and airspeed, which is very useful to the pilot coming in for a landing. So we spent a lot of time out in El Paso [Texas] and out in [Edwards Air Force Base] California and [Kennedy Space Center] Florida just going up and poking holes in the sky.

One plane would go up and be the target, and the others would go up and rendezvous. We had to train the radar controllers, because they were the people who would pick up the Shuttle, and they'd have to give us the vectors to get in. Probably the neatest thing that we did when we were out at Edwards, they had an SR-71 flying at the time. We couldn't go fast enough, but they could actually simulate the Shuttle's reentry speed. We asked if we could do a chase on them, and they said sure. That was great. Flying right underneath the SR-71. I'm not sure if we were supposed to be taking pictures of it, but we took a lot. It was great.

So that was really fun flying. I got a lot of interesting T-38 experience and also good camaraderie because it was a small group. I think there were only six of us, and then in the end we got stationed at El Paso. I was with Dick [Richard O.] Covey on that. Of course the Shuttle on STS-2, there wasn't much chance that it was going to land in El Paso. So we didn't actually chase it, but the training was fun.

ROSS-NAZZAL: Did you spend most of your time working with Dick Covey then?

HOFFMAN: No. We alternated. There were three pilots and three mission specialists, and we would alternate. But then probably George Abbey made the assignments. I don't really know.

So Dick and I went to El Paso, and I think Hoot [Robert L.] Gibson, who was the lead on [the team], was with Kathy [Kathryn D.] Sullivan in California. So they actually did the chase. Then the other team would have been in Florida. I don't remember who was on that. I think Steve [Steven R.] Nagel, [but] I don't remember.

ROSS-NAZZAL: Did you have any other assignments with STS-4 or STS-3?

HOFFMAN: No, not to my recollection. STS-4, I worked with CBS television, and so they sent me to the Cape, which was nice because my father-in-law was visiting from England and so we made a big Florida holiday out of it. Disney World [Orlando] and all that stuff as well as watching the launch. I was with Dan Rather doing the commentary, and they got to be in the VIP [Very Important Persons] stands. So that was good fun.

ROSS-NAZZAL: That must be exciting. Do you have all these clips of your interviews?

HOFFMAN: Yes, I've got lots of stuff. They're all in boxes, and God knows what I'm ever going to do with them. Do I really want to listen to an interview from back in 1984? I don't know. Certainly my kids are never going to do it. So maybe I'll give it to the Astronaut Hall of Fame. I got inducted into that two years ago, and they said that they would be willing to be guardians of any stuff that I had. Maybe that's the best thing to do with it. I don't know.

ROSS-NAZZAL: Don't put it in the trash.

HOFFMAN: But it's nice. No, it's nice. I've certainly got lots of scrapbooks and things with newspaper clippings and all that stuff. But we live in a small townhouse, and there's not enough room for everything.

ROSS-NAZZAL: I understand you started working on the ASTRO mission in '82.

HOFFMAN: Oh, right. That was actually even before getting assigned to my first flight. There was a lot of controversy early on about payload specialists. There was a lot of [competition] between the Johnson Space Center and the Marshall Space [Flight] Center [Huntsville, Alabama]. Very unfortunate. Payload specialists were Marshall's astronauts, and they were always pushing to get payload specialists on flights. There was a lot of potential resentment at JSC, because if a payload specialist flies, then a career astronaut doesn't fly. So George Abbey asked me to go to a preliminary meeting of the planning for ASTRO, to go with Joe Kerwin because he had experience, but I had the astronomical knowledge. Just [find out if] these people [were] blowing smoke, that it was really as complicated as they said it was? So we went there. I learned a lot about the mission and came back. We wrote a report. We said yes, indeed it's sufficiently complicated that Bob Parker [another astronaut astronomer] and I could do it, but we'd have to basically spend full time for at least a year working at the universities that had built the instrumentation, and we still wouldn't have the depth of knowledge of the people who had actually designed it.

Sam [Samuel T.] Durrance and Ron [Ronald A.] Parise—Ron unfortunately died earlier last year—they had been involved in the development of the instrumentation. So they knew it inside out, and they did a superb job. That's just what payload specialists were meant to do.

There was some question, because we knew George Abbey didn't like the idea of payload specialists. Was writing this report going to be career-limiting, because I wasn't maybe giving him the answer that he wanted? But on the other hand, that was the answer. Obviously it didn't hurt me. I guess I probably was never one of George's close bosom buddies, but on the other hand I never got on his shit list. You can clean that up if you want to. So we got along fine, George and I.

ROSS-NAZZAL: Your next assignment, I think, was working as a support crew member for STS-5.

HOFFMAN: Yes, and that was very interesting, because you really get an inside view of how the crew trains and a lot of work. I did most of the support work for their orbital activities, because I didn't know a lot about ascent, that was more the pilot stuff. But they were doing a lot of test objectives, and I would go out and do the research in advance in order to find out what was the purpose of these tests. It was good. It gave me a lot of exposure to different parts of the Space Center, people doing different kinds of work. I think it was appreciated, and it was quite useful. I learned a lot and I think I helped a lot.

ROSS-NAZZAL: How closely were you working with the mission specialists?

HOFFMAN: Quite closely, because the deal was I was supposed to learn enough about what they were doing with their satellite deployments so that if questions came up I could help with it. What was also a very good thing, I actually got to meet the people who were building the

satellites and having them launched, particularly some of the people from Canada, the Telesat people, very pleasant. I learned a lot about what the Shuttle was like for the satellite users. At the time, Shuttle was supposed to replace all the expendables, and so all satellites were supposed to be launched on the Shuttle. There was this upstart Ariane who said they were going to do some launches, but nobody at NASA took them very seriously.

I saw lots of examples of NASA essentially just not understanding what it was like working out in the commercial world. They basically were running the Shuttle Program as though it was an Apollo mission. They treated the satellite manufacturers in terms of what they required them to do in filling out forms and all the safety certification and everything. They were treating them like the scientists on Apollo, "You guys are really lucky to be getting a ride here." They were paying customers.

I remember at one point the Canadian engineer said they really don't understand this customer business, but they were giving him a really low price, because it was a sort of a loss leader, and so they said, "For this price we'll put up with all this stuff. But if they really want to do this for a living, they better figure out how to work with the commercial world and make the Shuttle user-friendly rather than just continually giving us grief about how we have to meet all their specifications." In getting experiments on the Space Station, it's still very much the same. It's very difficult to get through a lot of the paperwork requirements. So that was an uphill battle.

Of course, after *Challenger* they stopped launching commercial satellites, so NASA never really had to make the accommodation. It did start to become apparent that we didn't seem to be flying 30 flights a year. How long was it going to take to build up the flight rate? The word was starting to come down that this is going to be a lot more complicated than we

really thought it was going to be. We might not ever make that flight rate. But maybe we'll make it up to 20, 25 flights a year. It took a while for it really to sink in. Then, of course, there were lots of problems, and flights started to get postponed and reconfigured, and crews started to get shifted around. But STS-5, it was a great experience. I got to be very friendly particularly with Joe Allen, who's still a friend.

They were going to do the first Shuttle spacewalk. I found it very surprising that JSC center management seemed to be, at the time, very much down on spacewalks. I guess they felt it was dangerous. I remember at one point Gene [Eugene F.] Kranz said, "Hey, we showed on Apollo we know how to do spacewalks. We don't have to do it on the Shuttle." It was only because some people came up with this door closing contingency that they insisted on testing out the spacesuit. It turned out that they had problems with their spacesuits, and they never got out the door. That really got people's attention. So then people got a lot more serious about spacewalking, and that's when Story and Don [Donald H.] Peterson did the first Shuttle spacewalk on STS-6.

Of course the lessons from Skylab [were] that astronauts can actually fix things when they go outside, it's just you have to learn it over and over and over again. It was frustrating. Like I say, I found it very strange the antagonism that management had at the beginning that they really didn't want—I think they were just being very conservative. They realized that the Shuttle was still a new vehicle and that we should be putting all of our attention just learning how to fly it safely, how to do the basic mission, launching the satellites. If you put a spacewalk on top of that, then people's attention is going to get diverted, and that could be dangerous.

It wasn't as I say until the STS-5 spacewalk failed that people really figured hey, we've got to get serious about this and do it right.

ROSS-NAZZAL: Tell us about your recollection of the first announcement of people in your class being assigned to flights: STS-7, 8, 9.

HOFFMAN: We all knew that it was going to be Rick Hauck just because he was the senior military officer in the thing. So that didn't come as any surprise. I guess the biggest question was who was going to be the first woman. It could have gone many ways. I'm sure there must have been a lot of things behind the scenes that went on there that I'll probably never know about, probably don't want to know about. I know there were a few antagonisms because of that that are left not discussed. But it was very exciting. Despite the fact all of us knew that somebody's got to be first, and it's probably not going to be me, and so we might as well go celebrate. The first TFNGers were going into space.

I guess that was '83 was STS-7. Then STS-8, that was about the time that the space motion sickness was starting to get a lot of attention. I guess Bill [William B.] Lenoir was very publicly ill on STS-5, and other people were starting to report space sickness. So that's when they decided to fly extra crew, Norm [Norman E.] Thagard and Bill [William E.] Thornton because they were MDs, on STS-7 and 8. So we got yet another TFNGer on STS-7. That was quite exciting.

Yes, to actually get crews right away up to a six-person crew sooner than people had anticipated, I think that was very exciting. Then let's see. STS-8 was the first night landing with Dick [Richard H.] Truly. I know that when we were the chase crew for STS-2, which was Truly and Engle, and those guys were really a comic—they were always having fun, playing jokes and everything. Also, as I said, Dick had been in the next office just right off mine. He had to come

through our office to get to his office. I had spent a lot of time talking with him and that was nice to see. Of course Guy [Guion S.] Bluford was on that flight and Bill Thornton. So then STS-9, I knew Bob Parker pretty well because he had gone to Amherst College [Amherst, Massachusetts] where I had gone. He was eight years ahead of me. His career was probably the most similar to mine in that he had been an astronomer and he was just starting out on the academic track when he got picked up, but then of course he didn't fly for a long time.

I actually remember, when I was a first year graduate student, seeing the call from NASA where they were asking for applications for scientist astronauts and thinking to myself, "Boy, that would be fun to do." But you needed a PhD, and I was just a first year graduate student. Also you had to be under six feet, and I'm six-feet-two. So for various reasons that wasn't going to work. But when I saw that Bob had been selected, and that here's somebody from Amherst College, an astronomer, and he's selected to be an astronaut, maybe it's not impossible. But as I said, it was never a realistic career goal. I didn't really pay much attention after that, because we never heard any more about it, because none of them ever did anything until the Shuttle came around.

ROSS-NAZZAL: You mentioned STS-8. You were CapCom [Capsule Communicator] for that mission.

HOFFMAN: I'm trying to remember why I was. Most people were CapComs for a few missions, but I was only CapCom for the one mission. That was in '83. Maybe it's because after that I got assigned to our first flight and we had to start training, and so I had to leave off being CapCom. That probably is it. But I remember how much fun it was sitting in mission control and actually

talking up. Being a CapCom, if you have to do it over many months at a time it can get pretty old, particularly when you have to work the midnight shift and everything. But for me it was all new and exciting.

Quite a few of the early CapComs from our group then went to get—then they would be a CapCom, then they would get a flight assignment. So I don't know if that was part of George's plan, but it was generally considered that to be a CapCom was a good deal. So I was pleased to be a CapCom. I'm trying to remember STS-8. That was also '83 I guess.

ROSS-NAZZAL: Yes, I think that's when it was.

HOFFMAN: So yes, it would have been right after that shortly, because when I first got called to George's office and he told me that I was going to be on STS—oh, boy, the numbers are—

ROSS-NAZZAL: I think it was 41-E.

HOFFMAN: Forty-one-E, which was going to be the flight in June with that big solar array that was going to be extended. Of course then that's an incredible exciting time for any astronaut is when you get your first flight assignment. I got assigned with Dave Griggs, which was nice because we were friends and our families all knew each other. Very fortunate. I've actually been fortunate pretty much in all my crews that we've all gotten along well together. Our first crew, we've had reunions every ten years as well. Bo [Karol J.] Bobko was just a wonderful guy. He was a great commander, never raised his voice once the entire time we worked together. Just very good example of the way leaders are supposed to lead.

I wasn't supposed to tell anybody about it. They said, "You got to wait till it's publicly announced." That's the hardest part of it. You sit around, and you really want to tell people.

ROSS-NAZZAL: You did tell your wife, right?

HOFFMAN: Yes, yes, yes, but I couldn't call my family, couldn't tell my friends. I remember riding in the car with one of my friends, and he was asking me about NASA. I must have been very bubbly about something. He said, "There's something you're not telling me, Jeff." So I said, "I'll tell you soon." So he sort of guessed, but I wasn't allowed to say.

Yes, we started [training]. That's when this crazy odyssey started of the playing musical chairs with all the missions, because at that point they were starting to have problems not just with getting the Shuttles ready for flight, but—let's see, the crew that went before us, which was Hank [Henry W.] Hartsfield's crew, they were supposed to launch the second TDRS [Tracking and Data Relay] satellite on the IUS [Inertial Upper Stage], which STS-6 had launched. But then the IUS, if you remember, had a problem, and they put it in the wrong orbit. They were able to get it successfully in place using its own propellant so that it could support the Spacelab 1 mission, but then they canceled or at least indefinitely postponed the next TDRS IUS flight until they had sorted out the IUS problems, which meant that their 41-D I guess is what it would have been canceled.

At the time, the protocol was that the crew stays together, you just move to the next flight. So they took our flight, and we went to the August flight, which actually was in some ways even a more interesting flight, because we were going to deploy the first Spartan, a little mini satellite, with the arm, so we got a lot of arm training, and we got rendezvous training and

there were a lot of EVA [Extravehicular Activity] contingencies. So Dave and I, in addition to just the regular Shuttle stuff, we had to learn to do a lot of arm and Spartan underwater stuff. Normally you only get—I don't know—20 hours or so, if you just have contingency EVA training, but then we got payload training on top of that. Every time we went to a new flight, we got different payload training. So we ended up with about 50 hours under water, which is a lot more than most crews got, which as it turned out turned to be very very good.

So anyway, we're going along with our training for the August flight. In fact, I'm unhappy when 41-D has a pad abort in June. That's Steve Hawley's famous comment about, "Gee, somehow I thought we were going to be a little higher at MECO [Main Engine Cutoff]." But then they had to launch the satellites, and now NASA was getting under pressure because the satellite launches were starting to pile up. So they got rid of Spartan. They combined the satellite from August with the satellite from June. Hartsfield's crew took that flight. We lost our flight altogether. Then the next couple of flights were very strange, because let's see. One of them was Crippen's flight, STS-11 I think. Crippen was sort of inviolable. There was no way that he was going to get bumped, so we went over him. Then I know there was a couple other—there was a military flight in there. Anyway we ended up getting bumped all the way till December. I remember that was one of the lowest points for our crew. I remember Bo had us all over for dinner because he recognized that he had to do something for morale, just another example of good leadership.

We survived. We got assigned the next TDRS IUS launch. Any first flight is a great flight, but that was certainly a lot less intrinsically interesting than the Spartan. There was no arm on the flight. But there were a lot of other EVA things that you have to do for the IUS. So again, we had a lot more time in the pool training. That got pushed to January because the IUS

wasn't quite ready. Also that summer we picked up Patrick Baudry as a payload specialist and Jean-Loup [J.M.] Chrétien came along as his backup. I've actually been friendly with both of them over the years. Spent a lot of time with them when I was living in France, particularly with Jean-Loup.

Then in November, Dave and I were just leaving the Orbiter Processing Facility where we had been doing some tests when we heard on the radio a rumor that NASA was thinking of flying a US senator. We just cracked up. We thought this is never going to happen, this is crazy. Then we got home to Houston, and sure enough, not only was it going to happen, but he was going to be on our flight. I have to say—jumping ahead a little bit—because [Edwin Jacob] Jake [Garn] has been a good friend ever since—he was a good crew member. I won't comment on the politics of flying politicians, but he had been on a World War II airplane crew, so he knew what it meant to be a member of a crew, and he didn't try to play the senator with us. So we really did get along very well. He told me afterwards, he said, "Jeff, don't ever play poker." He said, "It took you a while to disguise your initial skepticism about this whole thing," but he said, "Don't worry about it." We got along fine.

But anyway, we had now picked up two payload specialists. Every time our flight got shifted, our Shuttle got shifted as well. We went from *Discovery* to *Challenger* to *Discovery* to *Challenger* and eventually back to *Discovery*. No, to *Columbia*. No, I think *Discovery*. Back then you put your Shuttle name on your patch. So we went through four different patches. Every time you get a new patch, NASA has to print 100,000 patches or something. So we broke the system basically. Oh, and also the same with the payload specialists, because we kept changing payload specialists. So after our experience, NASA changed the rules, and they said no names of Shuttles on patches, and the payload specialists have to go on those little chevrons

which could be sewn on underneath so that if you change them, we don't have to print all these patches.

It's an incredible story, when you think of all the changes that went into our mission and what we actually ended up with, because finally in January we were trained, we were ready to go, they said, "All right, time to go into quarantine in Houston." Packed my suitcase. My wife dropped me off. We went in, we had lunch, got a call. "No, there's some problem. There's still a delay. Go home." A couple days later, "All right, time to come back into quarantine." [Packed] my suitcase, went into quarantine, had lunch, call came. "Time to go home," another delay. Then the third time Barbara said, "Look, you're not going to go. This is ridiculous. Leave your suitcase at home. Go into quarantine. If they really want you to stay overnight, I'll bring your suitcase in." Of course at that point they called us. It turned out that during all this time when the IUS was being repaired, the people who were responsible for the TDRS itself had found a problem with their communication security. I think that was the way they explained it to us. They were working like crazy under the umbrella of the IUS problem. So they hadn't publicized the fact that they had a problem too.

Well, now IUS is ready to go, and uh-oh, TDRS still hadn't solved their problem. Flight gets canceled. Now there's another flight on the books in March. There was a question, would we get that flight, or would we have to jump over it again? Finally they decided they'll give us that flight. That flight had a Canadian telecommunications satellite. So I got to renew my friendship with the Canadians that I had gotten to know on STS-5, which was very nice. It had the famous SYNCOM or LEASAT, and it also had the McDonnell Douglas electrophoresis experiment with Charlie [Charles D.] Walker as payload specialist.

So we had yet another payload specialist switch, and Patrick Baudry got bumped to the June flight. Jake stayed with us. So yet another patch. Then in March, someone ran one of the little cranes through the Shuttle's wing. So we got delayed by another month until April. We sent out—I think we counted them, because of course we're all trying to keep our launch guests apprised of the situation—we sent out 22 different letters to our launch guests with all of the different delays that we were undertaking, just keeping them apprised. Putting on a launch is a lot of work, because you give a party for people. [Margaret] Rhea Seddon and I—or I should say Hoot Gibson and my wife—gave the party. It was nice, because I got the idea of calling in on the phone so I could talk to all the launch guests while they were enjoying the party.

Finally April came and we actually did go into quarantine. We actually went down to Florida. Let's see. The one other aspect of that flight which ought to get recorded is that NASA management for a long time had been trying to get the astronauts to demonstrate autoland. That was always resisted by the pilots. For some reason, there was another big push that our flight was supposed to be the autoland demonstration. Bo was going to be the first pilot not to land the Shuttle. We made a special patch with all of us sitting in the Shuttle with our hands up in the air saying, "[*Vide, mater, sine manibus!*]" Look, Ma, no hands! But once again the pilots prevailed, and we never did it. So that autoland went away. So with all those changes there, finally we were down in Florida.

We go through the final preparations. We had maybe a little more attention than some crews because of Jake Garn being with us and the Senate, certainly lots of photographers. Also people coming to quarantine who normally would not be allowed in quarantine, but that's another story.

In any case, I remember riding out to the launch pad. Some people were talking about are they nervous going out; I remember saying to myself, "This is not the time to be asking yourself do you really want to do this." I had made that decision a long time ago. I figured this is something I've dreamed of doing ever since I was six years old, riding in a rocket, so if it's going to blow up, there's nothing I can do about it. So I just don't think about it. That's just my personality. Things I can do something about, I pay attention to. If I really can't do anything about it, I'm able just to put it aside, which is probably a good thing. I know not everybody can do that. I've spoken to plenty of astronauts who don't like launches because they're dangerous.

I thought to myself, "I'm just going to sit back and enjoy the ride." It's a pretty spectacular ride. I really enjoy the launches. But it wasn't clear whether we were going to go, because it was overcast and a little bit drizzly that day. I think nowadays they probably wouldn't have gone, but they didn't have all of the rules quite so well developed at that time. I remember we were listening to the conversation with the Shuttle Training Aircraft that they were flying up, and there were questions. "Is there rain up there?" They said, "Well, there's moisture on our windshield." "Well, is it drops?" They said, "Well, how big does it have to be in order to be a drop? Is it mist or is it a drop?" They just went on and on again.

In the meantime, we had run out to the end of our launch window, which was cut off because of some sort of a satellite lighting constraint. So I unstrapped, and Dave Griggs unstrapped, because we figured we weren't going that day. In those days we didn't have a launch and entry suit. You were just wearing a flight suit, so you could strap yourself in and out pretty easily. It was no big deal. I was riding downstairs next to the window. Back in those days, that was before they put the pole in, and we had a seat right next to the hatch. So I had a good view out the window during launch. But I went up to the flight deck, and I was just

chatting with Dave. The next thing we heard, the launch director spoke to the satellite people and they said, "Can you give us an extension?" They said, "Yes, if you can go for it, go." They said, "Manual countdown start nine minutes now." All of us, Dave and I, we're sitting, we're not strapped in or anything. What do we do now?

So I helped him get strapped in, and then I ran down and strapped myself in. It was probably T minus two before I really knew that I was finally going to go, and then I was all psychologically set to go. That's a very exciting time. Lots of things are happening. Of course the Shuttle is really alive and it's moving. There's noises in it. I'm sure you've heard about that from lots of people. But the experience of a launch, particularly the first time—a lot of people had told me about it. But nevertheless, when everything starts to move and you feel the bumps as the engine bells move around, and then the roar as the engines finally start coming on, and the real kick in the pants when the solids light.

Then the ground falls away, and it's almost like, "Can this really be happening?" A lot of vibration. I think the thing that surprised me the most was when we went through max Q, when you break the sound barrier, that the level of vibration went up so much that I thought the wings were going to fall off, it was just vibrating so much. Nobody had quite described it to me in quite such graphic terms. But I remember thinking to myself, "Fifteen Shuttles have flown before this, and the wings never fell off. So probably we're going to be okay." Sure enough we were okay.

Then just looking out the window and watch the blue sky turn black and the ground fall away. Then the boosters fall off and that's pretty spectacular. Then it gets very quiet, and then the Gs gradually come on to about three G. I remember propping my head up just so I could

keep looking out the window. You can't do that anymore, because nobody sits over there. But it was nice for my first flight that I could actually watch out the window.

Then when we got to orbit, the first thing that happened, we had a special test. We were supposed to open—usually they have a little valve to drain the hydrogen out of the fuel lines inside the Shuttle, because they don't want it to gasify and expand because it might blow one of the pipes. They decided to try a different way of dumping it through the fill and drain valve. That caused a torque on the Shuttle, which tried to spin it over about 45 degrees. Then the reaction control jets were firing against that, and they're really loud. We get into orbit, and the first thing that's happening is boom, boom, boom; it wasn't supposed to happen. The people who had planned the test had not anticipated that. I remember Don [Donald E.] Williams in the copilot seat saying to Bo, "Should we terminate the test?" Bo said, "No, let it go. It should quiet down." Sure enough it did.

So that was pretty exciting. They were really loud, the jets when they go off. But then I felt myself floating up in the seat, and I loosened the harness. I had had a lot of rides in the Vomit Comet in addition to the initial training rides we got. I had done quite a few experiments. In fact, one of the people that I did a fair number of experiments with was Jean-Jacques Dordain, who's now the Director General of the European Space Agency. So we first got to know each other on the KC-135. It was nice because I knew him while I was working over there in Paris.

But anyway, I was pretty used to floating around in the KC-135. But of course after 20, 25 seconds you have to get back in your seat and ready for the pullout. So I was floating up above my seat. Then I realized after about a minute or so I was sitting there bracing for pullout just by force of habit, and then I said to myself, "No, wait a minute, you're in space." That's when it really hit me. I floated over, and I looked out the window, and there was the Earth going

by. I think we were just coming [to]—you could see Africa off in the distance. Then I looked in the mirror, and there was me in space. I just got this big ear-to-ear grin, [and] I couldn't stop smiling for several hours. It was just such an elation. From such an extraordinary experience to go through a launch the first time. Then to realize that finally we're really in orbit. It was just incredible. Can I take a quick break, get some more water?

[Break in audio]

HOFFMAN: The first day of the mission went fine. We're all wondering whether or not we're going to get space motion syndrome. I knew that I didn't have a particularly strong stomach in T-38 acrobatics. You start doing aileron rolls, and I'll get sick in a hurry. But I felt fine in space. I was quite pleased with that, and I started eating pretty early on. I have a pretty good appetite.

The first day was perfectly nominal. We launched our Canadian satellite, and everybody was happy. Then the second day we launched the SYNCOM. It did not activate. So we sort of looked. After two minutes, there was a little antenna that was supposed to pop up. Of course it always did in the simulators, and this was the second SYNCOM that was launched. The first one had worked fine. Of course once we launch it, once it's left the Shuttle our responsibility is finished. That's all that we were responsible for was put it out into space, and it will get itself up in a geostationary orbit. We moved away just in case the engines fired 45 minutes later, but of course they didn't. Then already on the ground they were starting to think about contingencies. They told us to do another burn, because otherwise we would have kept moving further and

further away from it. They said, “Just come to a stop so that you’re following it. We’ll figure out what to do.”

We went to bed. We were kind of bummed out, because although obviously it wasn’t our fault—we had launched it perfectly fine, but nevertheless you kind of like the feeling that everything about your mission has been successful. Then the next day they started talking about what they might do. We did actually have a manipulator arm on board, even though we weren’t planning to use it. That was a function of [turning] the Shuttles around. It was easier to leave it on than to remove it, even though we didn’t have a use for it.

They came up with this idea that well, first of all you’re always looking for a single point failure when something goes wrong. The only single point failure was this little switch on the outside of the satellite, which is closed when it’s sitting in the cargo bay as a safety measure. As soon as it leaves the bay, the switch comes out. During transit, the switch is held in position by a little piece of foam rubber. I was told afterwards that they weren’t able to locate the paperwork that showed that the foam had ever been removed, although the person who had removed it swore up and down that he had done it, but that was the only single point failure that anybody could think of. It was something potentially that we could do something about because it was on the outside.

So at first they had the idea that we should actually rendezvous with it, and I would be on the end of the arm and I could flip the switch with my finger. But there were two problems with that. First, you got to worry about a rendezvous and an EVA at the same time. We hadn’t trained to do a real EVA even though we were well-trained, and we hadn’t practiced a rendezvous since June. It was April, so we hadn’t practiced a rendezvous for ten months. During the rendezvous, although Bo and Don were flying the Shuttle, I was always doing the

navigation part of it. So the people who had been in the training said that it would really be better if we could separate the EVA and the rendezvous and switch activation. Then somebody came up with the idea that well, if we could attach some sort of a device to the manipulator arm and then we could use the arm to wiggle the switch, maybe that would work.

That device they actually built looked a lot like a flyswatter, so that's how they started describing it. So we started to be called the "Swat Team." The thing was that in those days we didn't have a fax machine on the Shuttle, which they have now, so you can now send pictures up. But all we had was an old-fashioned teleprinter with the yellow paper and all capital letters. So they sent up this long description of how to build the flyswatter, and then they tried to do a picture of it with Xs just to show what it was supposed to look like.

We went through all the instructions, always wondering if what we're building [is] anything like what they think it's supposed to look like. We built two different instruments. In the meantime, of course, before they had finalized that—there's a few plans. The first is to do nothing, which we thought was most likely. The second would be to fly over to it and just take a close look. The third would be actually to do an EVA and fix it. When we heard the word EVA, it [was] just electric. Because who would have believed it? It was a unique situation for Dave particularly, because he was a pilot but he had been assigned to fly as mission specialist. So I think he was a little bit bummed out, because of that he was the flight engineer. But as a mission specialist, he did the spacewalk training with me.

In fact, after the spacewalk was over and we came inside, I said, "Dave, please admit to me that life as a mission specialist is not all bad, okay." He said, "Yes, it has certain advantages, I have to admit." Anyway the excitement just built. By that time, everybody in the crew was feeling well. It was just enormous activity, because we didn't have a rendezvous checklist.

They had to send us up an entire checklist on teleprinter paper. It was about 30 feet long. We had to cut it up into individual pages. We got our postinsertion checklist, which we didn't need anymore, and we Scotch-taped each of the teleprinter pages into the postinsertion checklist, so we built our own rendezvous checklist.

We were sort of reviewing among ourselves do we remember how to do this rendezvous? We haven't done it for ten months. It's kind of amazing that they went ahead and did all this. It was real. On the ground, I knew that these are the moments [in which] NASA really shines, when they have a problem and it's like Apollo 13, although nobody's life was at stake. But they were sending people out to California to the satellite [manufacturer] to get a good close look at the switch. They had people going in the water tank. They had people in Building 9 using the manipulator arm. Just all of NASA was working on this.

Of course we were at the focal point. You've heard the story of all the different launches that we were assigned to and missed. What was the probability that we were going to be at that time, at that place when the satellite went bad? Luck and fortune play a big role in people's lives. Obviously we were able to take advantage of it. To a certain extent, good luck you have to take advantage of. We were prepared and we actually brought it off. I remember at that point when we started getting the spacesuits ready for the first time and we took the cabin down to 10.2 psi [pounds per square inch] for the bends prevention. Dave and I kept looking at each other. Are we really going to do this?

I was the first one out. Bo and Rhea helped us get in our spacesuits. We had the flyswatters with us, and the little wrapping tool that we were going to use to hold them on. Dave and I figured out who was going to do what. Then the next thing I knew, [I opened] the hatch,

and it was just when the Sun was setting. So the whole Shuttle was lit up red, and it was just so spectacular.

I turned over on my stomach to float over to the tool chest, and I was amazed at how much it felt like when I was under water all those times. I just felt really comfortable. It's remarkable how good the training was, despite the fact that nobody expected us to do an EVA. At that point I remembered that [at] our last EVA training, as Dave and I were getting out of the pool, sort of as a joke I said to all the people around the pool who were training us, [I] said, "Hey, if we actually do an EVA, beer party on us." I thought to myself, "We're going to have to pay up." It was well worth it. It was well worth it. Dave and I, we did, we gave a good party when we got back. It was definitely worth it.

So when I was looking down into the Shuttle into the toolbox getting all my tools ready to go, it really felt very much like being in the water. But as soon as I turned around and there's the Earth and the sky and the stars and the Sun, it was really just kind of overwhelming. It was a fairly simple task. We just had to hold the two tools in place and wrap the strapping tool around it and then attach it.

The problem was that since we weren't planning an EVA, we didn't have any foot restraints, we didn't have any special tools, and so each of us had to use one hand to restrain ourselves. You could only work with one hand. We were trying to coordinate me using one hand, Dave using one hand. Your body is flapping all over the place, but we were pretty well-trained. We did it. Then it occurred to the people on the ground—was there going to be enough clearance for the arm to be put away before entry, because they didn't want us to have to come out again to remove the tools. One EVA was enough, at least for the people on the ground. We would have been happy to do it.

So they got Rhea to cradle the arm. But just about that time the Sun set, and so they didn't have good enough lighting that they could really see what they needed to see. I always remember the call that went up, "Would you guys mind staying out another 40 minutes until the Sun rises so that we can get a good view of this?" No problem. I had a great time. I was just crawling all over the Shuttle. I crawled halfway up the tail, tried to stay out of the view of the TV cameras wherever possible.

I basically had nothing to do except watch the world go by and look at the stars. Just what an extraordinary opportunity, because usually you're very busy when you're doing EVAs, because there's lots of work to do. I had 40 minutes of basically nothing to do except wait for the Sun to rise. So I'll never forget that.

My hands got very cold, that was something I remembered when we were training much later for Hubble. That's another story we can get into another time. But in fact, they got so cold that I had to actually ball my fingers up inside the gloves, like when you're skiing sometimes. Your fingers get cold, and you have to make fists. Of course you can't whirl your arms around like you can when you're skiing. So you just sort of have to tough it out.

But what an experience. It went fine. We came inside. I remember Jake and Don in particular said that they had just gotten almost teary-eyed looking at us out through the window, because they just couldn't believe that it was happening. There's Dave and Jeff, and they're out in spacesuits doing this stuff. What had started out originally it was going to be a four-day mission, and then I think it got extended to a fifth day because of the electrophoresis experiment. But we ended up with a seven-day flight.

Well, the next day of course was rendezvous day. The training was good. We hadn't done it for ten months, but we remembered how to do it, and we did it. We flew right up to the

SYNCOM, and I could see through the binoculars as we were approaching that the switch in fact was fully extended. So I was a little bit skeptical that this was going to work. But we had come this far, and we were certainly going to try it.

Anyway, maybe the little microswitches underneath would get shaken. We never knew. We flew right up to it. Quite an extraordinary sight, flying right up to this big satellite in a very different configuration than it was when we had let it go. Rhea reached out with the arm and snagged it a couple of times. Then something which in retrospect we should have anticipated just from the basic physics, but because we were pulling on the switch the satellite started moving forward with respect to the Shuttle, and it got hard to reach. Rhea basically was running out of room. So she turned the controls over. I had one swipe at it, and then it was out of reach. We reported to the ground that the switch was already out, but we flew away from it and waited a couple of minutes, and sure enough nothing happened.

It turned out, though, that it was still worth doing, because had we not done that—they did finally do another flight which went I think the following August, Joe Engle's flight [STS 51-I]. They actually went up, and Jim [James D.A.] van Hoften and Bill [William F.] Fisher went out in spacesuits. They now had specialized equipment. They had foot restraints. What they would have done, had we not done our experiment, they would have gone after that switch. But since they knew that the switch wasn't the problem, even though it was the only single point failure, they realized that there must have been really multiple failures inside, which in fact was the case. So they were able to go up, and they captured the satellite and actually essentially hotwired it. So LEASAT did finally make it to geosynchronous orbit.

The whole story of the satellite was successful, even though—I often told people when I would show our flight film, I said, "Now if this film had been made in Hollywood, this all would

have worked and we would have lived happily ever after.” In fact we did live happily ever after, but it took a little time.

When we finished that, we had been working really hard. The official plan was that we were going to come home that evening. We had to clean up the Shuttle in just a few hours. Somebody in the crew activity planning unit pointed out that maybe it would be better if they gave us a little bit of rest and let us come home the next day. So they called up and asked Bo if we would like another day. Again, duh. But he gave a very gracious answer pointing out how hard we had been working, in fact, and what a mess the Shuttle was, and we still had to clean up from the previous day’s spacewalk. Yes, sure enough they gave us another.

Apparently the reason why they had wanted us to come home was because they had done the calculation that we were running out of food. Particularly people knew that I ate a lot, but there were a lot of people on the flight who were not eating very much the first couple of days. In fact, we had plenty of food. We had enough food left for another day in orbit plus the couple of contingency days. We took the extra day, which really was very nice, because we really did have a chance to relax. That was the time when I first experienced what I will call a zero-G sensory deprivation.

I found myself floating in front of the window, and I realized that if I didn’t work at actively relaxing every muscle, I could still find muscles which were a little bit tense. So I gradually relaxed my entire body, and I was just floating watching the world go by, very peaceful. All of a sudden I felt like my body was just being encased in a cocoon, and then I could no longer feel my arms and legs and the trunk of my body. It was a very pleasant experience. I realized what was happening. It was sort of like the experience that people talked about. They had these flotation tanks back in the ’70s and ’80s where you try to cut off sensory

experience. It induces a strange physical or mental trance almost. It was very pleasant. I learned on subsequent flights that I could get into that state fairly quickly.

I remember having a chance once to talk with Oliver Sacks, who wrote the book *The Man Who Mistook His Woman for a Hat* and did a lot of stuff about various psychopathologies. I was describing this to him, and he said it's a common thing that you can get with sensory deprivation that your body—your mind can essentially—if it's getting no nervous stimulation, it can lose track of the body. People have actually reported these phantom limbs. They're sleeping at night, and they see a hand floating in front of their face, and they don't know whose hand it is because they have no connection between their arm. The whole feeling of zero-G, of floating, is so different from anything you've ever done before. It's easy to share what it looks like, because we take pictures and IMAX movies. But the actual internal experience of what your body feels like when you have no weight, it's remarkable. Everybody who's there loves it. Charles Simonyi is paying another \$30 million to go up for his second trip now. He liked it so much.

We had the one final day in orbit. At that point, although the SYNCOM hadn't activated, we were still totally pumped up and just really happy. We got the Shuttle put away and cleaned up and ready to come home the next day. I was sitting upstairs for the entry. One of the things I do remember. My brother had given me a—I have two brothers actually. One of them was a composer at the time. He's now a psychiatrist, but he had composed some music for me. I played it over the air-to-ground radio, which was nice, so he got his music played from space. My other brother had given me a poem to take up about mountain climbing, which I remember reading to the whole crew, because it was very nice. It's about what happens after you have to come down and the fact that you can't stay on the summit forever. I love mountains, and so I see a lot of analogies between certain aspects of being in the high mountains and being in space.

You can't stay on the summit, but on the other hand the things that you've seen while you were up there, which you were unaware of beforehand, you can never forget. So even though you still can't see it, you still know that they're there.

It was interesting. Just about two or three weeks ago I had an email from Rhea Seddon, and she asked me, "Jeff, I remember that you read us a really nice poem before reentry, and I was thinking about that, and could you send me a copy of it?" Of course I know it by heart, so I sent it to her. So that was very nice.

Reentry was quite an extraordinary experience, because we were actually landing in Florida. So as you are coming in, you sort of get used to the speed at which the Earth is moving by underneath you. It's about the same angular velocity as when you're flying in an airplane. You're a lot farther away, you're going a lot faster, so the two balance out. But after you fire your engines, and now you're falling closer to the Earth, and when you get down to about 80 miles, you're still going at the same speed, but you're five times as close to the Earth. So it looks like you're just tearing across the coast of California, and that's when the heating starts up.

You've probably seen pictures of the wake, this plasma wake trail that the Shuttle leaves. When you look at it out the window—which I could do, because we weren't having any problems; I was ready to help with procedures if we had had any problems, but luckily it was a nominal entry and so I could really enjoy the spectacle. You're surrounded by this red, then orange, then yellow, then white-hot plasma around the front windows, but behind you there's this flickering wake just like the wake behind a motorboat, but it's fiery and it's just—I found it awe-inspiring. It was like some monolith sitting back there glowing as bright as the Sun. That lasts for about ten minutes.

At that point you gradually start feeling your weight coming back. I would hold a pencil and watch it gradually start to fall down, and then a little bit faster, and a little bit faster. I'd pick up the camera, and the camera would be a little bit heavier. Finally when I figured we were back up to about one-G, I called up to Bo, because he had the G meter, I couldn't see it. I said, "Bo, what's our G level now?" and he said, "Mm, 0.2." I felt like I was at one-G, because after a week at zero-G you feel a lot heavier. I also started to feel the very strange vestibular confusion when you come back. Just small movements of my head produced the feeling that my head was bouncing back and forth from one wall to the other. I know in some people it actually produces a very serious vertigo and they're not even able to stand up. I found it kind of interesting and amusing. I was sort of playing with it on the way down. So I actually felt pretty good when we landed. I got up right away.

But before that it was an incredible feeling, when we go into the final bank coming around the heading alignment circle. You can actually look down and see the Space Center. By that time we're pulling about 1.5-Gs, and you're feeling very heavy, but Bo was flying the plane. I was just sitting back and enjoying the whole thing. Come right up on the runway. We land. That was before we had the new brakes. They didn't have a drag chute. We couldn't use the nosewheel steering because there was a single point failure in it. The only way you could steer the plane was differential brakes, and we had a significant crosswind. So Bo had put a lot more braking into the right tire. As a result, it overheated and eventually blew out.

That was really a shock, because I remember the feeling. We felt the main gear come down to the runway, then the nose gear comes down, and then you feel the deceleration as you're slowing down on the runway. We were almost at a stop, luckily, because if the wheel had blown at high speed it could have been a lot more serious. But I was just having the feeling the mission

is over, nothing can possibly go wrong now. Pow, this big explosion. I didn't think of the tire at first. I thought gee, maybe one of the RCS tanks has exploded and there's going to be hazardous gas all over the place, but Bo realized what had happened. But by that time the Shuttle had come to a stop. It was the only time, I guess, a wheel had ever blown. I think that again got management's attention. They put a lot more work into getting the new brakes and getting the nosewheel steering fixed.

But for us, it had been just such an unbelievable odyssey because of all the postponements and the disappointments and the getting switched from one Shuttle to another and different payload specialists and different missions. Yet we had done something that was so unique and extraordinary and unexpected. I don't want to call it poetic justice, but it was like someone up there was looking out for us. As it turned out—this is jumping ahead in my career a little bit, but—seven years later when NASA was looking for a crew to go up and do the first rescue mission for the Hubble Space Telescope, which was an absolutely critical must-succeed mission, they decided that in order to reduce the risk, the people who would do the spacewalks on the Hubble mission had to have already done a spacewalk before. Well, hey, I had my union card. Totally by chance. Of course the Hubble mission really changed my life in many ways.

So when I think back on what was the probability that all of that should have happened, I've just been very very fortunate. That was just one example. Then of course we had almost nonstop visits with family and a little bit of medical examination, but it's an incredible time, particularly because it had been such an extraordinary mission. I'll always remember we gave a big party for our friends, and each of us had to get up and make a little speech. I was wondering what Dave was going to do, because he was very taciturn, Navy pilot, great behind the stick but not a man of many words. I thought, "What's he going to say?" I gave my big flowery speech.

Then Dave got up and he said, “Ladies and gentlemen, I’ve learned something on this spaceflight. Gravity sucks.” That was it. Everybody cheered. But he’s right.

It’s a different world up there. We had only experienced it once at that point. But after having waited for so long, I guess I had the same reaction of everybody. No matter how long people have waited for their spaceflight, and I guess Don [L.] Lind was the longest, he went on the very next flight [STS 51-B] after us, and I think he got selected back in the mid ’60s and he didn’t fly until ’85, so that’s 19 years, but he said, “When those solid boosters went off and I realized that nobody in Washington could stop my flight now,” again they all said, “Hey, it’s worth it, even after the wait.”

It certainly was for me. We had a particularly nice set of postflight visits, partly thanks to Jake Garn, because we did go to Utah where we were royally received. We sat right up on stage with the Mormon Tabernacle Choir performing specially for us. Went to the White House, to a special dinner in the Senate Dining Room with John [H.] and Annie Glenn. I sat next to John Glenn, and I remember [what] he told me back in 1985. He said, “I really envy you guys. Everybody knows what I did, but I only had three orbits around the Earth. I don’t even know what space is really like.” He said, “Someday I’d like to get back into space.” Sure enough. We had a nice meeting with President [Ronald] Reagan. So it just turned out wonderful.

ROSS-NAZZAL: I think this might be a good stopping point for us.

HOFFMAN: I think so.

ROSS-NAZZAL: We can pick up next time, with the rest of your flights.

HOFFMAN: Okay.

[End of interview]