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ORAL HISTORY TRANSCRIPT

JOHN E. DEFIFE
INTERVIEWED BY SUMMER CHICK BERGEN
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BERGEN: Today is May 16, 2000. This is an interview with John DeFife for the Johnson Space Center Oral History Project. The interviewer is Summer Chick Bergen.

Thank you for allowing us to do this interview today.

DEFIFE: You're welcome.

BERGEN: I'd like to start by talking about your early background, your childhood, and ask if there's anything in your child[hood] that led you into aeronautics or into space.

DEFIFE: I don't really think that there was anything in particular. I was always someone who was interested in tearing things apart and putting things back together again. I guess my curiosity had always wanted me to get into something adventuresome, although I'm not very adventurous as a physical athlete, that kind of stuff. It was just more of a mental kind of a thing.

I went to school at the University of Pittsburgh and studied aeronautical, aerospace-type engineering, so I did have an inclination that I wanted to get involved in something like that. I wasn't quite sure that it was going to be Houston, Texas, or anyplace associated with NASA, but the space program was all very new at that point, at that period of time, and it was very exciting to me. I still remember laying awake in bed, dreaming about travel to planets and that kind of

stuff. So it was almost a natural occurrence for me. It was something that I was very excited about doing.

BERGEN: I'm just curious, when you were in college, [President John F.] Kennedy made his announcement about sending a man to the Moon. Do you remember that? Did that have any affect on you?

DEFIFE: I do remember that. Of course, I've seen it so many times on television since then, and all of the movies and things that they make about space, but I do remember that. I'm sure that was part of the environment that excited me about going to work for NASA. I will tell you that when I interviewed, I interviewed at Wright-Patterson [Air Force Base, Ohio] and several other places that were in the aerospace area. I also interviewed at the Manned Spacecraft Center. I didn't receive an offer from them. Several other of my classmates had received offers, and I was a little depressed that I hadn't been given an offer, only to find out later that the paperwork had gotten confused somewhere, and I really did have an offer sitting there waiting for me to respond. So it was a no-brainer, basically. It was my first choice and only choice.

BERGEN: When you finally got there, your first day at work, after you did all your paperwork, of course, what was that environment like that you were introduced to, and what were your first impressions?

DEFIFE: Well, first off, I was overwhelmed and scared and frightened, and just excited. At the time, Manned Spacecraft Center was not in the facilities that they are now. We were scattered

all over the place, out and about the Gulf Freeway. I think my first job was in a set of apartments called the Franklin Apartments, off of the Gulf Freeway, near a bayou that I don't really remember the name of. I was sort of amazed that all of the stuff that you had seen and heard about on television, newspapers, articles, and everything, there we were in the middle of all of this, and we were in apartments and office buildings, and right around the corner from shopping centers and god-awful Houston, Texas, with its 95-degree summers. Of course, I was sold a car up in Pennsylvania, by a salesman who had spent some time in Texas and told me that we didn't need air-conditioning, so we were down there.

It was sort of overwhelming. I was very excited. I didn't know what was going to happen. I didn't know exactly which part of NASA I was going to get into. I was introduced to my boss, the division chief at the time, pretty much the first hour or day, I think, that I was on the job. We were given some choices about where we wanted to go, and I chose to get into the aerodynamic world. I was happy that I did that. I spent a lot of time in that group. Made some very close friends.

BERGEN: You said you went into the aerodynamic group. As your training in aeronautical engineering, you, I'm sure, designed aeronautics for planes. What kinds of changes did you have to make in your frame of mind of doing aeronautics when you went to work on a spacecraft?

DEFIFE: Well, it was kind of interesting, because the focus, the thing that excited me the most in school was really not so much the aeronautical design, the aerodynamic design, the wind tunnels. I mean, that was fun, but the thing that excited me the most was the computer simulations. I took a couple of computer simulation classes, and one of our aerodynamic classes was to design a

flight simulation or performance simulation of an airplane flying across the country. That was just very exciting to me. I have the ability to do a lot of mental visualization from things that I see and numbers and that kind of stuff. It was almost like I was flying the airplane myself.

When I went to work at NASA, one of the first things that they asked me to do was to get involved with the computer program that simulated trajectory flight, so it was almost heaven-sent, if you will. I was so excited that I was able to do the kind of stuff that I had really enjoyed doing in school, almost right out of the barrel.

Now, unfortunately for me, they did send me on some wind tunnel tests, because I was an aeronautical engineer, and they weren't quite certain what they were going to do with me. As my career progressed, I did wind tunnel tests in Tullahoma, Tennessee. I think I had been working at NASA for a month. My boss came in and said, "John, you have a couple of choices. Your choices are to go to Tullahoma for one week, two weeks, or three weeks." My furniture still hadn't arrived. My wife was in Houston. So I chose to go for one week.

But, you know, it was kind of exciting to go with some of the senior engineers, or people that were at least three years older than I was. I think that was the seniority at the time. We were all young and didn't know any better, basically. We just didn't have any apprehension at all about doing anything. Looking back at it from the vantage point that I have now of being through thirty-some years with NASA and five years in private industry, I'm absolutely amazed at what we did. We were a bunch of young people. There were some middle-aged managers who had very strong management skills, but if it weren't for them, I don't think we would have been able to do what we did. It's just absolutely amazing to me that we were able to pull off some of the things that we did with such a young workforce.

The similarities that I see with what I'm doing right now, there's a lot of young people in the group that I'm working with right now, and we're led by some middle managers who are also fairly young. There are some differences. I see the struggles that we're having here today versus what we were doing at NASA back in the early sixties, and it's nothing at all alike. The challenges are similar, in terms of the work that we have to do, but I think the structure of the management at that time was so good. I don't know how they happened upon it, but it was so good that it allowed us to do what we did, apparently as easily as we did.

BERGEN: Were there any people you worked with those first couple of years that you came to NASA that made a big impression on you?

DEFIFE: Well, of course my immediate boss is a guy that I worked with for a long time, Bass Redd, and a guy that he worked with and for, Bruce [G.] Jackson. In the early days, those were the people that I remember the most.

Chris Kraft [Christopher C. Kraft, Jr.], I think was the one that, although I didn't have a very close working relationship with him but there were several times when I was asked to give presentations to him. You stand in the front of the room, you're sort of trembling, because you know that Chris Kraft and Bob [Robert R.] Gilruth are going to be in the room. It turns out that you make your presentations and everything goes well, and you get some nods and some appreciation and some affirmation of what you've done by some of these people, and it sort of keeps your motor running. It was in that era, it was the Chris Krafts and the Gilruths.

Slightly later than the Apollo Program was Bob [Robert F.] Thompson in the Shuttle Program, and Owen [G.] Morris. Those people, Morris especially was one that I looked up to.

Of course, my boss' boss' boss' boss, Max [Maxime A.] Faget was a great engineer and very innovative, and Aaron Cohen, that set of management, although that's sort of bridging the difference between Apollo and Shuttle. But I grew up in that environment with those people, so those are the ones that I remember.

BERGEN: Great men there.

DEFIFE: Yes, they are.

BERGEN: When you first came to NASA, you worked in the Gemini Program?

DEFIFE: Gemini is when I started. Right. I think Mercury was well on its way, if not the last couple of flights. I really don't remember. It's sort of a blur. But I started the engineering work that I was doing in the Gemini Program. I teamed up with another engineer who was, oh, probably five years older than I was, and we worked on the Gemini ejection seat aerodynamics and the abort system. That's how I basically got into the abort world, both on Gemini, Apollo, and Shuttle. So that's sort of the path that I took.

BERGEN: Were you involved in any way in the decisions to use the ejection seats, or just the engineering aspect of them?

DEFIFE: No, I was pretty much sort of a bystander, sort of an engineer-in-training, while people like Bass Redd and Bruce Jackson and Jim [James G.] Hondros, while those guys were making

the recommendations to project management. Of course, everything was done through project management, all the way back from the very beginning, as I recall. There was the parallel engineering structure to the contractor structure to the project structure. They were all sort of checks and balances for each other. My inputs were mostly computer simulations and working late at night, and that kind of stuff, just getting charts ready and information ready for the people to make the presentations.

BERGEN: What did you think about that decision, or did you know enough at the time to have an impression?

DEFIFE: I don't really recall on the Gemini much about the ins and outs of the decisions that were made. I just remember the wind tunnel tests, the little models spinning down. They were free tests where we actually ejected them into a wind tunnel and caught them in a net. I remember those quite well, and the testing that we did and the simulations that we did, and made data analyses of the aerodynamics.

BERGEN: Was there any significant event during that testing or in the simulations that stands out in your mind?

DEFIFE: Just my trip to Tullahoma, Tennessee. I can remember that. I can remember the hotel I stayed in. I can remember that they closed the sidewalks at about eight o'clock at night, and there was nothing to do. Yes, it was sort of an interesting first six weeks, six weeks to two months in the government.

Then they decided to send me to California, to Ames Research Facility at the wind tunnel test, and that didn't happen until the winter, right around Christmastime. So, no, nothing out of the ordinary that I can remember.

BERGEN: Did you work on any other systems in the Gemini spacecraft?

DEFIFE: Just the aerodynamic simulations. We did an awful lot of entry simulations as well as abort stuff. The ascent trajectory was really mostly done by some of the more senior people at the time. We did an awful lot of trajectory simulations of entry. That's about it. That's sort of the parallel throughout Apollo and Gemini, and the Shuttle, was mostly abort systems as well as ascent and entry trajectory simulations.

BERGEN: As you said, you didn't really work at NASA during Mercury, but did you see lessons learned from Mercury pulled into Gemini, in the areas you worked in?

DEFIFE: I don't really recall. I don't know that I would have been able to distinguish those kind of things. If I could remember some of the meetings and conversations that I had, maybe. Certainly we learned a lot from the testing that we did, in the types of wind tunnel tests that we did and the simulations that we did. We learned about the contractor-government relationship and how each organization paralleled themselves. I think those were some of the things that may have carried out into Gemini. It certainly carried over into Apollo and the Shuttle.

I don't really recall an awful lot. We had ground-test programs. I don't even remember—I guess we didn't really have much in the way of launch. Like in Apollo, we had the

Little Joe tests out in White Sands [New Mexico] area. I don't think we did any of that in Gemini. I can just simply remember sitting in front of the television, just watching and listening to the rendezvous and the docking and looking at the movies afterwards, and that kind of stuff. It was sort of was kid in the candy store almost.

BERGEN: What's your first mission that you remember, after you began work at NASA?

DEFIFE: The first flight?

BERGEN: Yes.

DEFIFE: Probably some of the early Little Joe tests. They were really unmanned tests where we had some of our engineers go to the flight facility. We designed the ascent system as well the abort system, but these were early Apollo tests. I think from the very beginning it was Apollo as the first sets of missions that I really actually participated in on a mission sense, or actually in Mission Control Center or some of the back rooms, or in preparation for flights, was the real focus point for what I had done, mission-wise at least.

All of the stuff leading up to that, if I remember correctly, it was sort of being done in parallel. Apollo, of course, was being designed at the same time we were flying Gemini, so we were sort of jumping between flight tests, wind tunnel tests for Gemini, and flights for Gemini, and all the design and engineering work and wind tunnel tests for Apollo. So it was sort of all a big blur at that time. We were working a lot of hours. I didn't spend much time at home, sort of missed the early years of my kids growing up, but it was, like I said, basically a blur.

BERGEN: In Gemini, you used ejection seats, and then in Apollo, they went back to the launch escape tower. Do you know the reason behind that decision, or did you see, as an engineer, a reason for that decision?

DEFIFE: Well, I think that one is fairly easy for me to remember. The ejection seats were very limited in altitude and capabilities. Apollo was a much bigger vehicle. The ascent vehicle was much larger. Ejection seats would have had to have been extremely powerful and large to get away from a Saturn-V explosion. They had to have a better abort system, one that lasted, went much higher in the ascent trajectory. Ejection seats probably really were never much of a consideration, I don't think, in Apollo, because of all the things—well, in this particular case, I guess on all of the performance limitations that we learned about in Gemini.

Same with Shuttle. There were days in the early part of the Shuttle where ejection seats may even have been part of the design. I honestly don't remember, but it was really never really seriously considered, because the explosion potential of the booster was so large that you just really couldn't get away fast enough. You would kill the astronauts in the ejection because of the power, the force that you needed to get them away from an explosion. So they basically pulled the command module away from the booster, allowing the command module for the protection. So I'm pretty sure it was pretty much, almost without a doubt, the fact that we had such a large booster that kept them from using the ejection seats.

BERGEN: That makes sense. As far as parachutes and things of that nature for reentry, were you involved in those, too?

DEFIFE: Yes. We didn't really design the parachutes, although we were working in the division that had an awful lot to do with the design and the attachment of the parachutes, and whether there were three or two or one, and how these parachutes performed during aborts.

Pretty much exclusively, my work on the parachutes started, I think, with Apollo. I know there were parachutes on Gemini, but I don't really recall that I had any involvement with the parachutes on Gemini. But Apollo, I was intimately involved with the performance of the parachutes. Not so much the design, but what the vehicle would do when the parachutes were deployed, after they were deployed, what kind of trajectory, where would the thing drift.

We were also involved in the apex cover, the ejection of the cover over top of the parachute deck on Apollo Command Module. That was one of my early wind tunnel tests where I was sort of the lead engineer from Houston going out on some of the tests where we were trying to figure out the aerodynamics of the apex cover coming off, to see if whether it would come back and recontact the parachutes on top.

By and large, I think that the largest amount of work that I did on Apollo was with the parachutes. Again, the descent, the impact forces into the water, could they impact on land, the drift, the large abort problems that we had with a launch pad abort, with the escape tower pulling the command module off over towards the water, ejecting, having the parachutes open and have the wind push it back over land. That was one of the things that I had to do, me and several others that worked in this area, to figure out if the winds coming from the water, if that was the direction they were coming from, they were strong enough with abort conditions and weight of the command module and that kind of stuff, to blow the command module back over land. We were responsible for giving information into the flight director's realm of whether the winds

were too strong or not for an abort, go, or no-go decision. That's pretty much the extent of the parachute.

I remember riding up and down the runways at Ellington [Air Force Base, Texas] with the tow truck that we had found somewhere, in one of the hangars where we had different parachute designs. This was really experimenting with the people who were designing different parachutes, to see whether those parachutes would be better for the spacecraft for entering. So we would be driving this tow truck up and down the runways with this parachute flying off the back of it, measuring the angles and the drag, and the aerodynamics associated with it, just to see what we could do.

Parasail, I think, was an early possibility for one of the things that we were looking at it. One of the guys, I believe [John W.] Kiker, was the gentleman who was fundamentally involved with the design of that system. We were all in the same aerodynamic aerospace group of divisions. We were all sort of loaned out to work for each other.

BERGEN: You talked about working on abort criteria. Did you do that in Gemini, too, or just once you got to Apollo?

DEFIFE: I definitely remember it on Apollo. I don't really recall doing much in the Gemini world. Again, I was probably in towards the middle of Gemini. Pretty much most of the design work, I guess, had already been done, and I was really working with one of the senior engineers, a guy by the name of Jim Hondros, on the ejection seats and the abort system at that time. So I don't really recall much of Gemini. Again, it may very well be because I was just sort of awestruck when I walked in the door, but that's the best I can remember.

BERGEN: In Apollo, do you know if they took much of the information gained in Gemini and applied that to Apollo, or if you were still just doing things from starting point zero on Apollo?

DEFIFE: Certainly the ascent trajectory and the entry trajectory, both Mercury and Gemini, those technologies moved forward into Apollo. All the wind tunnel testing and the schemes for doing testing, the best wind tunnel facilities to test them in, what you could expect from the data, how accurate it was, all that kind of stuff we learned from Mercury as well as Gemini, and that applied to Apollo. It was really utilized when we went to Shuttle.

The abort system was different, so the design of the abort trajectory was different. The abort modes were different, so there wasn't an awful lot of carryover from Gemini into Apollo. I'm sure range safety was part of the stuff that we had learned. We had learned to work with range safety officers. All of the people at [Redstone Arsenal, later George C. Marshall Space Flight Center] Huntsville [Alabama] in the interaction between the command module and the launch vehicle, I believe—I don't have a strong memory there as to whether we had that relationship with Marshall for Gemini or not. But the flights and the vehicles were so different, the trajectories were so different, the boosters were so different, the abort systems were so different, the aerodynamics were so different. Gemini had, I believe, a floating heat shield. Maybe it was Mercury that had that. Apollo was all solid and ceramic, and it was designed to come in at the lunar return speed, so there wasn't an awful lot.

I mean, all the tools that we had developed, the trajectory tools and the aerodynamic analysis tools, those all applied, but those were textbook type of things you develop when you

build them. You build a hammer, and you use it no matter what you're pounding. It's that kind of thing.

So we spent a lot of time retooling the computer programs and gathering the data, so that we could input the data into the models, and setting up the models so that they would be different. The number of engines are different. The thrust-vector control was different on Apollo and Gemini, but the basic physics were similar enough that you could at least learn those kind of things.

The abilities that we had or the things that we learned to be the government relationship with the contractors for the government to be sort of a check and balance to the contractor in a lot of the stuff that they did, to be the advocate for the government, I guess, in challenging ideas that the contractors might come forward with that might not be in the best money interest for the government and vice versa. We would take different roles. We worked together as a team. I think that was learned from Gemini as well, but it really expanded in Apollo and Shuttle. Shuttle was a prime example of how to make it work. We did it well. But other than that, I don't really remember that the technology of abort system was a carryover from Gemini to Apollo. The launch and the models were very tied together.

BERGEN: For an engineer coming out of college today, they would look back at the tools that you had, as far as computers and computational equipment, and just be amazed that you were able to get done what you got done. What's your perspective on that now, seeing how technology has advanced?

DEFIFE: Well, it's kind of interesting, because I work in information technology here in Richmond, with a company in Richmond, and I'm referred to as the token rocket scientist that they have. "This is not rocket science, but oh, by the way, we have a rocket scientist sitting here." Knowing the difference between rocket scientists and engineering—of course, I'm not really one to challenge them calling me a rocket scientist—in any event, it's kind of interesting because we are in the middle of all the computers and information technology that my company uses.

The stuff that we were doing with slide rules and punch cards and trays and old IBM 7090 computers, I mean, you can do with some of these fancy hand calculators that the engineering students have these days than we could have ever done with the computers that we had. It's absolutely amazing that we did what we did with slide rules and calculators. I remember the group that we had in the aerodynamic world, I'll use the modern term, they were called math aids, I guess. I'm not really sure exactly whether it was math aides or math assistants, or something to that effect. In any event, we had this roomful of people that had these old mechanical—they were new at that time—these large mechanical push-button calculators that added and subtracted and multiplied and divide through the moving of gears. We would bring the aerodynamic data back on tablet form, almost on handwritten data sheets, that we would take as we went and read the gauges, and give it to these people and they would calculate and normalize it and plot it and re-plot it and change the ratios and the areas and that kind of stuff. These people did nothing but plot, calculate, punch keys on the calculators, and re-plot. That's all they did. Measure, take areas.

I could do more in an hour with [Microsoft] Excel and the desktop computer that I have today than we did in months in the early days. But then the requirements for the analysis didn't

seem to be as complicated as they are. I do more complicated analysis today, I think, than I ever did in the space program. I don't know that it's because the space program was simple, because it certainly wasn't simple. It's a fact of, you used what you had, you got what you needed, and you didn't get any more than that. Today, you just keep going and going and going and going, and that's why people make so much money these days, that they can take advantage of the technology.

We did what we had to do. We had a lot of people to do it. We spent a lot of hours doing it. We could have stayed home with our kids had we had an IBM [International Business Machines] PC [personal computer] sitting on our desk, that's for sure. So there's a vast difference between the technology today and the technology then. I just can't imagine how we did it. I still have my slide rules. I took them in as a show and tell to show some of the people that I work with, "Yes, this is a slide rule, and this is how it works." It's kind of funny.

BERGEN: Yet at the time, you felt confident in your calculations and what data you did have to send people up in the spacecraft.

DEFIFE: Certainly. That was one of the benefits of the contractor-government relationship at the time. We had different tools. We tried to keep our computer models different, so that if there was some sort of a generic flaw or a mistake in one, it might be picked up in the other one, so we developed different tools. We did parallel analyses. The contractors may have done ten iterations on an analysis and the government may have done five, but we backed each other up to the point where we were fairly certain that through enough repetition and enough running of data, we were fairly accurate.

The math and the physics are the same. It makes no difference what the machinery is that you use to calculate it, it just took longer. So you didn't run as many iterations as you would run today. I am sure if we had the computing power back in the early sixties that we have today, the management and the project group would have been asking an awful lot of "what if" questions. What if this, what if this, what if this, what if this? We would have spent a lot of time being much better prepared than we were if something were to happen, but we would have ended up at the same place, I'm sure.

BERGEN: Speaking about problems happening, in January of [19]'67, the Apollo 1 fire occurred. How did that incident impact what you did as an engineer at that time?

DEFIFE: It pretty much brought everything to a stop. I think the impression and the memory that I have at that point in time, although I wasn't directly involved in any of the analysis of the accident or any of that since it was really an on-the-ground kind of a problem, it just seemed to slow everything down. Of course, everybody was sad and everybody was angry, all the emotions that you go through when a failure like that occurs, but my memory is that it stopped. We just shut down.

Everybody became a lot more conservative in what we were doing. Even though we weren't directly related with the flight problems that they had or the design problems that they had, everybody went back in and redid everything. You looked at it from different angles. You worked twice as hard trying to make sure that you had the right information put in the right way. You relied on cross-checks even more.

It seemed like things started to slow down within NASA. The enthusiasm sort of waned for a year or two. There were a lot of difficult times, I think, at that time. Everybody was really uncertain about what we were doing in the future and whether we were going to come out of the Apollo 1 tragedy and be better for it. That's pretty much what I recall. It sort of was a blur. We were really off working ascent trajectories and simulations and lunar trajectories and simulations, and when it happened, I think everybody who wasn't involved just sort of stepped back and let the other guys get into the middle of it and do the energy stuff that they needed, the investigative stuff that they needed at the time, so. That's as I remember it.

BERGEN: You said everything kind of slowed down for a while. Is there any certain event that kind of changed the attitude of people, or was it just gradually changed over time?

DEFIFE: You mean back to normal?

BERGEN: Yes.

DEFIFE: I guess this is really more speculation. I remember the *Challenger* [51-L] problems a lot more vividly than I remember Apollo, but I suspect what it is, is after we re-engineered the command module, changed the gas mixture, the people who were working in the peripheral engineering design, the trajectory people, the aerodynamic people, we didn't have an awful lot of new things to do. So we were able to refine everything that we had done in the past. It seems to me it was almost a matter of, "Well, okay. We understand what the problem was. We understand what the design flaws were. We understand where the breakdowns in

communications were. Now we've got a job to do, and we're set about to go to the Moon by the end of this decade," and all this stuff that Kennedy had commanded that we do. Time was just running out. It was a case of, "Boy, we can't wait too much longer before we get going. We've done all the redesign, so now let's get back on track." That's as I remember it.

It was definitely a different feeling than it was in the *Challenger*. *Challenger* was more of a very slow, methodical, over and over and over and over again kind of a recovery. And then we flew, and then it was all just like it was nothing, it was like normal in terms of the pace. But I think Apollo was more geared towards there was a deadline. We were struggling to meet that deadline. We knew we could do it, if we could move beyond the tragedy. *Challenger*, we didn't have that mandate for a deadline, so they were able to stretch things out a little bit longer before we got back to what I would think would be normal, if you believe that we ever got back to normal.

BERGEN: So you said that the problems that they identified for the cause of the fire didn't really impact your group directly?

DEFIFE: No, not at all.

BERGEN: Basically, how did it feel? I'm sure you were glad that most of your systems never had to be tested out.

DEFIFE: Absolutely.

BERGEN: But you got through Gemini and Apollo, and there was really never an abort.

DEFIFE: Right. That was the prayer that we had all the time. It was sort of a mixed bag, so to speak. You know, you felt that you never, ever wanted to test the work that you've done, but then you never tested the work that you had done. So you never knew whether you were really going to be successful or not. But, nevertheless, you never, ever wanted to do it, because you knew it was going to be pretty traumatic when it happened. If it was successful at all, it would have been a lot of work and a lot of luck all combined, I think. I think we would have had people who survived, but you just don't know what quality they would have survived with.

Like you said, the Apollo 1 disaster had absolutely nothing to do with our systems, our subsystems. It was on the ground. It was electronic, and inert gas, or gas-breathing mixtures and that kind of stuff, so it was really more of a kick in the head relative to communications, and "Yes, we can make mistakes." And the realization that we were dealing with human lives. I think it sort of brought that to us, especially working with abort systems, it made it more difficult to even think that you might need to use the systems. You hoped that they never did, because you never, ever wanted to fail again like that, but that was the extent, I think, of what impact it had on us.

BERGEN: You mentioned that you worked on trajectories, and those obviously were abort ones. Did you have any involvement in the lunar trajectories and Apollo 13 or any of that?

DEFIFE: No. Well, Apollo 13 a little bit. The lunar trajectories a little bit, but once we got out of the Earth's atmosphere, my job was pretty much done. So the environment that we designed

and developed in was earth atmosphere, on the way up and on the way back. So Apollo 13 and any of the lunar missions, we were always sensitive to aerodynamic entry, the heating, the trajectory, the recovery, the parachute loads, the position in the water, or wherever. But that was the extent of it. We did not do any of the lifeboat—any of the work associated with getting Apollo 13 people back, other than, again, the entry angle calculations, but those were pretty mathematical. At the time, there wasn't an awful lot of aerodynamics associated with it before you got into the atmosphere. So all the burn trajectories and all the angles and all that kind of stuff were pretty much done by another group, but once we got into the atmosphere, the simulation and the heating and all that kind of stuff was part of what we did.

BERGEN: The only mission that I was able to identify that might have some impact on what you did was Apollo 15, where there was a failure of one of the parachutes. Were you involved in that at all, or the investigation?

DEFIFE: I don't think so. I don't recall Apollo 15 at all. A lot of the studies that we did, I guess, were preliminary to what happened on Apollo 15. We always tested parachute failures, so all the technology and all the studying had been done prior to the flying of 15, so it was just a matter of post-flight analysis as to what happened and what went wrong. That, again, was done by the people who were on the mechanical engineering side or on the parachute side or on the pyrotechnic side, whatever the failure was. I honestly don't even remember that there was a parachute failure on 15. I obviously believe what you say, but it just obviously didn't have any impact on what I was doing at all.

BERGEN: Looking back over Apollo, are there any missions that you have personal recollection of, that maybe meant a lot to you at that time?

DEFIFE: Well, Apollo 13 was fairly important to us. I worked with Fred [W.] Haise [Jr.] after Apollo. I didn't know any of the people, any of the astronauts, while they were flying or prior to them flying, but that sort of again brought NASA together. It was sort of a rejuvenation, I think, of who we were, or a renewal of who we were, that we did have people that worked as teams.

One of the things in the group that I work in right now, they have a thing called "Movies to manage by." The *Apollo 13* movie is one of the movies that they use as examples in showing and teaching to the company people how to manage. What they're talking about with the Apollo 13 is crisis management and teamwork and all that kind of stuff. I've sat in on several of the showings of this movie, and sort of have acted as "I was there" kind of a person.

In my recollection in Apollo 13, it was nothing at all as dramatic as the movie made it out to be. I'm sure it was dramatic in the people who were in the control center and all the people who worked very hard to simulate and all that kind of stuff, but the people who were on the outside looking in, we didn't have any—I mean, we were totally confident that they were going to be able to do what they needed to do. That's how well we worked together.

I do remember Apollo 13 and what it did to us, but the first Apollo mission, the lunar landing, I remember sitting in the living room watching the television just like everybody else did. My job was at liftoff, my job in the command center was basically to calculate drift-back in the event of a pad abort. Once we got out of that flight range, two, three thousand feet, then I left and I just went and enjoyed it like everybody else. So the first few missions of Apollo where I was actually part of the back-room engineering, I remember those, and Apollo 11 and Apollo 13.

I think that's probably the last one, just because it was the end of the program. But we watched every one of them on television, just like the rest of the world did, just as excited as we could be.

BERGEN: When you mentioned the last Apollo, Apollo 17, when that was over, what were your feelings at that time?

DEFIFE: Well, I think at that time we were probably into Skylab. Shuttle was probably being thought about or early designs. My memory is that there wasn't any sadness or any kind of a bad feeling about the end of Apollo. We had done what we were supposed to do. We had done it several times. It was time to get on and do something different.

I think the biggest memory that I have was about halfway through, after Apollo 13, 14, 15, in that area, 16, people stopped looking. Thirteen, if you look at the movie, they weren't really interested that much in what we were doing. At the end of Apollo, it became obvious that we really were going to have to do something special in order to regain the old Apollo, go-to-the-Moon kind of fervor in the country. I don't know that that every happened again. I think Shuttle did a little bit of it, but we never really regained that public interest, I don't think.

So at that point in time, I guess we realized that there was this lagging interest from the public. The government wasn't giving us as much money. There were a lot more fights associated with money, fights, "Well, Congress cut your budget again," those kind of fights. It became to be a little bit more of a business, a little bit more of a, "Let's go do it and do it better and do it cheaper," and that kind of stuff.

Apollo was kind of different. It was almost a "money is no object" kind of a program. At least that's the feeling that I had. In western Pennsylvania, my mother and father both

worked blue-collar work all of their lives. Spending the amount of money that we spent on Apollo was sort of something I had never really ever imagined before, so maybe it really wasn't free spending, but it sure felt like it to me. And in hindsight, it still feels like it. You could go in, you could convince somebody who could make the decision that you needed to spend this money, and, yes, you went and spent the money. You didn't have to go ask permission fifteen times to get the money, and convince fifteen different sets of people before you got the money. You just basically knew what you had to do, convince someone that you were right, and you just went off and did it. That ended, I think, with Apollo. We never did that. We never had that kind of an atmosphere ever again, so in a way, Apollo shut that down, but that had gone away towards the end of Apollo anyhow. We weren't really getting an awful lot of money. Certainly the development money for Apollo was done by then.

Other than those flights, I don't think there was anything in particular that I missed about Apollo. It was just time to do something different.

BERGEN: And after Apollo, Skylab was the next order of business for you. My research shows that you did some work in Skylab.

DEFIFE: I did a little bit. Skylab was sort of a bitter time in my NASA career. I learned at that time that if you became a specialist in something, you didn't get to play with the new toys like the other guys got to play with the new toys. That's sort of a very much oversimplification and it wasn't anywhere near as dramatic as I'm making it out to be.

I was the abort subsystem manager. I knew how to do Apollo aborts. They were flying Apollo-type vehicles. The rest of the guys that I had worked with, guys and gals that I had

worked with, were off working Shuttle. They were off in the skunkworks, off in the remote parts of the Johnson Space Center, working and having a lot of fun.

I was back going to the meetings that I had been going to for years, and talking and making presentations that I had made a dozen times before. When I asked to get involved with some of the newer projects, "Well, John, you're an expert in this field. We need you back here, so you have to sacrifice for NASA." It was a case of almost a little bit of envy for the guys that weren't quite as fortunate as I was and weren't put in positions and worked their way through positions that I did to get in, so they were able to go off into something new.

I was pretty much left alone at that time. The people that had sort of raised me at NASA, always watched out after me, the Bass Redds and the Bruce Jacksons and the Max [Lovick O.] Haymans and all those guys, made sure that I didn't really screw anything up, but they were busy doing their other things. I was sort of on my own. It was a good time and it was a bad time. It was good because I was almost autonomous in the group. I represented the aerodynamic group in those times.

Everything was sort of routine for the part that I was involved with. I just had to make sure that we were represented in the board meetings and the Change Control Board meetings and that kind of stuff, when they did something that might affect one of our subsystems, so it was almost, "Okay, I'm here. Tell me something." So it was a little boring after a while.

BERGEN: So there weren't any challenges or changes that you had to incorporate for your systems.

DEFIFE: No. Well, there may have been small ones, but there certainly wasn't anything traumatic that I remember.

BERGEN: Eventually, you did get to work on the Shuttle Program.

DEFIFE: Right.

BERGEN: What was your first avenue into the area of Shuttle?

DEFIFE: I left the aerodynamic group, I believe is the way it worked, I left the aerodynamic group and went to work in the program office, or in the Shuttle Engineering Office under Milt [Milton A.] Silveira. There's another gentleman that had an awful lot to do with who I was. He was in the same group, Milt Silveira, Bruce Jackson, Bass Redd, Bill [William C.] Moseley [Jr.] all those people in that time were in the aerodynamic group when I first came to work there. I went to work for Milt Silveira in the program office. He was in the Shuttle Engineering Office, as I remember the name, and I went to work as an engineer.

It was sort of a strange, something relatively new, I think, for the way it was organized. It was a program office-like group, pulled out from within the line organizations in the engineering directorate. We still reported to the engineering director, Max Faget, but we also had a dotted line or a soft line in to Aaron Cohen in the Shuttle world. So we were really serving two masters. We were serving the engineering directorate and we were serving the program office at the time. Bob Thompson, I think, was the program manager back then.

So we had a sort of a unique role where we had to be the advocate for the engineering group, the NASA Engineering Group, be the devil's advocate for the program office in regards to their relationship with the contractors, and be able to get the resources from the engineering directorate to do the work. That's how I got involved in Shuttle.

It just so happened that I became our Shuttle abort subsystem manager in the early days of Shuttle. I guess prior to that, before we really designed the Shuttle as it exists today, I think it was McDonnell [Douglas Corporation] and [North American] Rockwell [Corporation] were the two winning contractors. I don't remember why they didn't settle into one contractor, but those two had left what we called a Phase B study and were going into the Phase C, which was more of a detailed design. Their designs were still competing with each other.

Milt Silveira pulled me aside and said, "John, we think we want to have Grumman [Aerospace Corporation] and Boeing [Airplane Company], as well as Lockheed [Aircraft Corporation]." Grumman and Boeing paired up, and Lockheed was on their own, Lockheed-Martin I guess, on their own, to do what they called alternate designs. That was interesting. That was a time when Milt called me in to the office and said, "John, you want to grow up? You want to grow up in a hurry? Here's a job for you to do."

So he gave me this program manager's job for this 4-million-dollar Grumman-Boeing alternate Shuttle design, and then Milt and all the senior engineers that he had working for him left to go to California to be with Rockwell and to McDonnell-Douglas, and there I was. I had to negotiate a contract for 4 million dollars. I had never, ever done that before. I had one senior contract specialist that was left behind to help me.

Fortunately, the guys from Grumman who came in sort of took pity on me. I didn't know anything at all about contract negotiations. We were supposed to set the details, technical

specifications of the contract and everything else. Milt was right, I grew up in a hurry. It was very fortunate that people like the guys from Grumman and Boeing sort of went easy on me. They really were losers in the Phase B competition. They lost out to McDonnell and to Rockwell, so they had a vested interest in seeing that we all succeeded, so I guess we all just sort of jumped in there together.

In the Shuttle design, Lockheed went off and went on a project of their own, sponsored and coordinated by the Marshall folks, and the Grumman-Boeing team was coordinated out of Houston, Max Faget being the prime engineer, chief engineer, so to speak, of that. That study ended up very close to what Shuttle is today, the external tanks, the solid rocket motors, the non-fly-back booster. The Rockwell and the McDonnell-Douglas designs had fully reusable boosters as well as fully reusable Orbiters, so it was a plane flying on top of an airplane. They found that that was so very expensive. The Grumman-Boeing-Lockheed combination of all of the things, the ideas that were being designed at that time ended up with the delta wing Orbiter, the external tank, the strap-on solid rocket motors. There were all kinds of different designs. Did the motors gimbal, did they not gimbal, that kind of stuff. How many engines on the Orbiter?

As I recall, the Grumman and Boeing design, which we did in a year, fourteen, fifteen months, for 4 million dollars really changed the direction of Shuttle. That was because of Faget's input and some real good engineers in the Grumman-Boeing world, and the fact that at that time, we were looking for a cheaper way to do the Shuttle. And that's what we're still flying today. I mean, I can show you a model that I got from that contract. You won't be able to tell much difference between the way it looks and the way the current Shuttle looks. You'll see some distinct differences that were engineered out when it become the selected system, but it's amazingly similar to what we're flying today. I had a lot to do with that.

By the time we got doing things very well in the Grumman-Boeing contract, all these managers, including Mil Silveira, that had been off working with the Rockwell-McDonnell-Douglas folks started to gain interest in what Grumman and Boeing were doing. Then they started coming back. I've actually had project meetings called by contract, where the Grumman and Boeing managers had come back into Houston to give a presentation to NASA where nobody from NASA showed up, because they were all in Rockwell and McDonnell-Douglas, doing those reviews there. That didn't last very long, when we started to get some good designs.

BERGEN: So your work on that Shuttle design with Boeing and Grumman was a little bit of a change from your Skylab days.

DEFIFE: Oh, yes. Big time. Yes. I went from not being very excited about what I was doing, to being in the middle of something that I felt like I was in 100 feet of water, treading fast and furious to keep my head up. It got to be very good after a while, after I got settled in to the routine of working with the guys at Grumman and Boeing. There was a lot of traveling to Bethpage [New York] and to Seattle [Washington]. It got to be a lot of fun. We really started having a lot of fun, and I think that was my first taste of real project management life.

Prior to that, I was doing design and engineering and running trajectory programs. This was a major change in my career, when I became more project oriented. It made an awful lot of difference, I think, in the next several years. It carries on today. It's something that I like to do. I enjoy managing, so that was my first taste at it, I think. But I'm excited, because I did contribute in some way to the current Shuttle design through that contract. Very exciting, actually.

BERGEN: It was a good design. And then after that, did you become the abort subsystems manager for Shuttle?

DEFIFE: Right. Once the design concept and the configuration was adopted, and I guess they went through their final competition, and it was given to Rockwell, then I got back more to the routine engineering where I was doing abort subsystem managing, subsystem management for Shuttle. I was doing trajectory simulations, I was working with contractors, and I was working with the engineering directorate to get the simulations and everything taken care of. We basically—"we," that group of people, the people in Rockwell, the people in the engineering directorate and myself, and a couple of others in our office—really were fundamentally responsible for the mission, the abort profiles that we fly today, the early return. Thankfully we've never used that one. The one engine out; the two engines out.

Now, they made it an awful lot more complicated than we ever imagined, with the different landing sites and the Spain landing site, and the various stages in the trajectory, but we knew all along, from the early days, that first-stage abort was going to be almost impossible. If not impossible, it was going to be very difficult to do. So everybody hoped that we weren't going to have one. That's one of the reasons we went to solid rocket motors, because once you started them, they didn't stop. Except in the case of burn-through, which is what we had.

BERGEN: I have information that indicates that you worked on solid rocket project review.

DEFIFE: Right.

BERGEN: What did that entail?

DEFIFE: I don't really remember how I moved from abort subsystem manager into that job. Since we worked for Max Faget in the engineering directorate, the concept, I think, behind that project review team was pretty simple. At least it felt simple at the time.

We had this government-contractor relationship where one guy was checking the other guy. The contractor was doing the primary design and we were checking, "we," as the Johnson Space Center or the Manned Spacecraft Center people were doing. Marshall became the prime designer for the solid rocket motors. They were the prime contractor. They subcontracted to Thiokol [Chemical Corporation] for the components of the motor, but the NASA engineers at Marshall were equivalent to Rockwell when it came to the design. There was nobody who had any independent oversight into what they were doing.

So Bob Thompson, the Program Director for Shuttle, and Max Faget, and I guess several other people got together and decided to put this small group of people together. There were thirteen or fourteen of us, mostly engineering directorate specialists, people from parachutes, rocket motor people, trajectory people, aerodynamics people, structural engineering people, and there was one gentleman, Jim Shaus, from the program office. The twelve or thirteen of us would fly to Huntsville, Alabama, a lot, and we became the oversight, the technical oversight. We had no control over their project decisions or program decisions, but what we did is, we were the devil's advocate. We looked at the calculations that they did and made recommendations and acted as consultants to Bob Thompson for when he did his program reviews of their work. We were the NASA people overseeing and giving alternate points of view to what they were doing.

We must have done that for a year, year and a half, two years, and it just became much more difficult to do.

It wasn't an easy relationship to sustain, because it was NASA-to-NASA. There was no money involved. The NASA-to-contractor relationship is pretty much held there because NASA controlled the money, and the contractors had the technical resources to do the job. When it was Huntsville, NASA, to Johnson Space Center NASA, it was very difficult to maintain that relationship. We did what we were supposed to do, and then we went on and did something else.

BERGEN: Did you have any involvement in the *Challenger* investigation?

DEFIFE: Yes. I knew from the studies and the involvement that we had had with the Marshall people that one of the prime failure modes for solid rocket motor, especially a segmented solid rocket motor, was a burn-through, hot gases burning through the case. When the *Challenger* exploded, there were several other things that it could have been, but predominantly we sort of knew at the time that that's what it was.

I was back in the engineering directorate at the time. I was back in the aerodynamic flight dynamics group at the time. We were working Shuttle return White Sands [Missile Range, New Mexico] test—I don't even remember the name of it—where the Shuttle flew on top of the [Boeing] 747, approach and landing test [ALT]. We were getting prepared for all of that. After the analysis, we had finished all of that analysis of the approach and landing test. In any event, we knew at the time what was going on.

As the result of our involvement, the fact that I was then getting into the computer side of work at NASA, I had several people working for me who were doing graphics, three-

dimensional analysis, getting ready to tool up for Space Station and that kind of stuff. We had the tools, the graphics tools, that they needed to help analyze, so several of the guys that worked for me were pulled off and put on the *Challenger* post-accident investigation, applying a lot of the techniques and the technology that we had been working on up until that point.

Personally, I didn't do any analysis on it other than to act as an advisor in some of the meetings that they had, but they were pretty smart people. They got the best people at JSC and at Marshall to work on it. So it was pretty much known what was going on, it was just a matter of figuring out why it happened, what the conditions were that it happened in. Those tests and stuff were done pretty much at Marshall.

BERGEN: You mentioned the approach and landing test.

DEFIFE: I guess that came well before *Challenger*, but I was involved in that, as well.

BERGEN: Were you involved in any way in the discussions about putting engines on the Shuttle or letting it land unassisted?

DEFIFE: During the approach and landing test, or totally?

BERGEN: Or prior to that, whichever was later.

DEFIFE: If I remember correctly, that was part of the discussions and the designs that we went through with Grumman and Boeing, whether it was a powered fly-back or whether it was a

glider fly-back. I don't remember anything about the approach and landing test itself, whether we were going to do engines on that or not, but I think it all fundamentally boiled down to it was an external tank on the Orbiter. There was no propellant left. I think that's what finally made the decision is that it was going to be a powerless fly-back. So, yes, we were involved in that, but only through the Grumman and the Phase D design after they chose Rockwell.

BERGEN: Is there anything significant, other than what you've already told us, about your work during the Shuttle development and design that stands out to you, or something unique that you had to deal with, that was different from your work that you had done on Gemini and Apollo?

DEFIFE: Well, it was a lot more political at the time. There were a lot of discussions at the time about money. Space Station was competing for money. There was a lot of discussion, I wasn't directly involved in much of it, but I know there was a competition for, "Do we do the Space Station before we do the Space Shuttle?" and all that kind of stuff. So we had an awful lot of, "Let's go put a presentation together and give it to management," to prove this point or prove that point or show this analysis or show that analysis.

We almost went to the point where we didn't have direction, technical direction. We had good managers; it's just that they didn't know what their job was. They didn't know what mission we were trying to accomplish, so we sort of scattered into different directions. So the atmosphere was completely different, from my point of view. I was working on one piece of this and one piece of that and one piece of this, and another piece of something else, and I never really did seem to have the continuity of taking a project from beginning to end and working on the design and that kind of stuff, until they made the decisions that they made for Shuttle.

So it was very much a different atmosphere. It started to slow way down. It started to become much more bureaucratic, much more money-driven, much more "Let's fight between the Johnson Space Center and the Marshall Space Center for project management." Is it in Washington [DC], or is it independent, or is it Washington employees working at the Johnson Space Center. It just became something that was much more political.

I've thought about this in the past, and I've tried to figure out what it was. Was it the fact that I grew older and a little bit more understanding of what was going on, or was it actually that the program and the environment at NASA changed? I don't know that I have a real good answer to that, but I honestly still think that it was the fact that we changed, the program changed, that it was not that I understood more and was more sensitive to that kind of stuff.

There were a lot of times in the Shuttle Program where it wasn't a lot of fun to be there, because you were always worried about a decision coming from somebody at Headquarters or in Congress making you do something technically, politically, organizationally, that you didn't really think was the thing that needed to be done now. These guys were being paid a lot of money. They were a lot smarter than I was. They had a lot more information than I did. I'm not being critical of anything that they did. It just seemed from my point of view that NASA changed significantly at that point, in the early days of Shuttle.

After *Challenger*, it was another change, complete change. I mean, it went from something where we were trying to save money, to very extreme pressure, very extreme tenseness to get it done right and to not screw it up, and to change the way we communicated, and all the problems that they found. A lot of all kinds of investigations, people flying to Washington for investigative testimonial. You just wondered what was going to happen to your job when some of those reports were finished.

So it became—I don't want to say—it was sort of adversarial. It really just didn't feel very good. It certainly didn't feel like it did in the early days of Apollo and Gemini, when we were actually having a lot of fun. It just became more of a job at that time.

That's about all I can remember for Shuttle. The *Challenger*, of course, changed everybody's life. There was some discussion and some thinking, as I remember talking about it, or hearing about it, that the way we managed Apollo, Gemini, Mercury, we had different managers at different phases. One manager would be good at the initial design and development. Then when that phase was done, they'd bring in a new high-level manager, and he or she—never she—he would be good at doing something else and going for that phase. They always seemed to be able to choose the right manager for the job.

Shuttle came along, and Bob Thompson came in and he stayed through all phases of Shuttle. Bob was a good manager, I believe, he was a good project manager, but he took a lot of flak because maybe he wasn't as good at design and engineering as he might have been at operations. There were a lot of personalities that were starting to become very strong and very vocal at the Johnson Space Center. At the time there were a lot of politics that were starting. The Chris Krafts had gone and the Bob Thompsons had pretty much gone. Other people were taking over.

BERGEN: Your job seemed to change a lot. You spent some time with the Aerodynamic Data Analysis Program. Tell us a little bit about that. I think you mentioned it earlier, briefly.

DEFIFE: ADAP, Aerodynamic Data Analysis Program, was kind of a strange project. We had a lot of aerodynamic data that we had to analyze and accumulate. They were putting together

aerodynamic data books. For this particular flight, this is the set of aerodynamics that you would use, because it had this configuration and it had this pedigree, and it had this heat protected system, and it was done at this wind tunnel and it was done for this flight range. Then we would do more tests, and we would refine the data, and we would change pieces of that data block.

There were people from all over the country, I guess, the contractors as well as NASA, who were looking for baseline reference data. "Which data set do we use?" It was a matter of, if you used a different set of data from a wind tunnel test that perhaps wasn't calibrated as well as another wind tunnel test, and the data was slightly different, you would get completely different performance from the vehicle. So they decided that they had to have a set of baseline aerodynamics, and we had a lot of aerodynamic engineers, aeronautical engineers, working on what was the best data.

What we needed at the time was a program, a computer program, a software program, that would allow the engineers to analyze the data, look at it from different views, combine it with other data, show differences between one test to another test, refer to the data, come up with a baseline print and document, and put a set of data charts out there that had the official data. So the Aerodynamic Data Analysis Program was a piece of software that was developed by Lockheed as the support contract to the engineering directorate.

I became the program manager for that. It was struggling in the beginning. There were some personalities involved, conflicts I guess, more precisely. It wasn't doing well. We were having delays and missed deadlines and that kind of stuff. So I don't know, for some reason or other, they chose me. I was interested in software at the time. That was the beginning of when I was really starting to get into computer stuff. Since I had spent a lot of time in the program office, especially on this Grumman-Boeing project, I had the ability and I had the skills, I guess,

that they needed to get in there. Plus I had the aerodynamic background that they needed from the NASA side. So I got in and we worked that program. They probably are still using that program, as far as I know. I don't really know that they're not, but it was a fairly sophisticated set of software coding that we did, that Lockheed basically did.

BERGEN: What did you do after your work with ADAP?

DEFIFE: I really became more specialized in computers. The super mini-computers were starting to come along. The tools, the slide rules were gone, and the big 7094 computers or 7090 computers were gone, and we were running off of UNISYS and larger computers. It was at that point in time when small companies like Digital Equipment Corporation and Harris Corporation and several of these companies started to develop competitors for the large mainframes. They were cheap compared to the IBMs of the world and to UNISYS, UNIVACs I guess at the time. We needed, we as an aerodynamic group, needed some computational power of our own. So we spent a couple hundred thousand dollars, went off and bought one or two of these things.

They needed someone to manage the operation of those computers, and that's basically how I got into computers as a career, managing the operation of the Harris computers and the Digital Equipment computers. Plus, at that time, the small desktops were starting to come out. Underwood-Olivetti was one of the early PCs, I guess, if you can call it a PC. My god, it was so, I guarantee you I can do a hundred times more with a computer I can go buy at Circuit City, just a little hand-held thing, than I could have ever done with that Olivetti. But the technology grew rapidly, to the point where we had terminals on our desktop, and networks, all kinds of stuff that was going on. So at that point in time, after ADAP, my career moved off in a different direction.

The other thing that was going on, I guess, in my life, a little bit more selfishly, I guess, is I had been there twenty-five years, something like that. I knew what it was going to be like to retire. I imagined what it was going to be like to retire from the government and go to work for Grumman or Rockwell or McDonnell-Douglas, and come back and do the same work that I had been managing, and I didn't know that that was what I wanted to do. I saw that computers were starting to come alive in the country and in the technology, and how much difference they made in the way we did our job, and I was excited about it. That was the other part of the classes that I liked in college. I got to work with computers, as well. In addition to doing the numerical simulations, I got to work with the computers that did them. So that's the direction I went.

BERGEN: It was like the early space program, because you were doing something new that had never been done before.

DEFIFE: Right. Exactly.

BERGEN: Did it give you that kind of excitement for your work again?

DEFIFE: It did. I was basically alone. There were two or three of us, plus a couple of contractors, that got to do all the fun work. We could get up at two o'clock in the morning and go to work, and nobody would ask us why. We were becoming geeks, I guess, if you want to use today's terminology. Nothing at all like what they do today. Yes, it was something that we felt that we were in control. "Give us some money. Let us go buy the toys." We got to play. We

got to do the kind of stuff. People depended on us to do the job. We were contributing, and it was sort of different. No politics associated with it at all; you just go back and work.

I had been told by one of my managers in the aerodynamic group before I went to the Shuttle Program Office that I would not like the program office work, and he was right. I went back to work in that group, to do engineering work. So it's sort of a parallel with what I'm doing today, actually.

BERGEN: So was there anything in those last few years that you were at NASA, any major projects that you would like to discuss?

DEFIFE: Well, when I changed and left the engineering directorate, that was fairly traumatic in my life. Dan [Daniel S.] Goldin [NASA Administrator] came in and did some turning over the ground and getting rid of the cobwebs, and trying to convince people to do things differently, I guess the terms "faster, better, cheaper." No, there really wasn't much.

I went to work with a whole completely different set of people, doing a completely different job. I moved into central computing information technology. We supported office automation. It was a whole new line of work for me. The thing that I carried with me from the engineering and Shuttle and Apollo days was the management stuff that I liked, the project management. I did a lot of project management when I was in that group. Even though I managed people at the same time, it was pretty much project management, as well as people management. I lost a lot of technical skills during that period, and that wasn't the best thing that ever happened to me. I was maturing, and I was about ready to figure out how I was going to spend the rest of my life. Along came early retirement, and I left.

BERGEN: Looking back over your career, are there any moments or events that stand out in your mind?

DEFIFE: Good or bad?

BERGEN: Good or bad.

DEFIFE: Yes. There's a couple. I debated with myself if I was going to get into this or not.

BERGEN: Could we pause for one moment?

DEFIFE: Sure. [Tape recorder turned off.]

I guess the thing that I remember the most, one of the major changes in my life, is the time probably in the last five years of my career at NASA, when I realized that I was going to have to leave. Prior to that, certainly in the early days, I could not see myself doing anything else. I was so excited about what I was doing and enjoyed what I was doing, and it was challenging enough that I thought I was going to do it until I was ninety years old. They'd take me, bury me, and I'd have my slide rule with me or whatever it was.

But that all changed. All the political stuff that went on in the Shuttle days never really went away. When they started looking for money for Space Station and they started reorganizing over and over and over again, and Headquarters was running it, and Houston was running it, and this guy was running it and that guy was running it, Dan Goldin came in and, like

I said earlier, started to get rid of the cobwebs and that kind of stuff. It became obvious to me that NASA had become very bureaucratic.

When I went to work, I had a choice of going to work in Cleveland [Ohio]—I guess it's Lewis Research Center. I had applied, I believe, to Langley [Research Center, Hampton, Virginia], and I applied to Houston. There was another one up in the Cleveland area. What I knew about NASA at the time was it was bureaucratic. The old NACA [National Advisory Committee for Aeronautics] was bureaucratic. They may have had some good engineers and did a lot of stuff, but there were a lot of meetings, a lot of management, a lot of this, a lot of that.

I went to work for the Manned Spacecraft Center, they didn't have any of that. It was a lot of fun. We had a lot of work to do. We did a good job, but there weren't a lot of controls that were put in, that were there.

The controls started to come in. The tighter the money got, the more the control. It just got to a point where I realized that I was going to have to leave. I don't know whether it was truly something that changed at NASA, but it felt to me like it was no longer a family. It was a business, it was a job. It was, "Okay, you guys have been here thirty years. Thank you. Did a good job. Here's your retirement book. Here's your pictures, here's your plaque, here's your retirement party. Now, see you later." That's the feeling that I had about NASA in the last four or five years, in the early nineties, [19]'90 to '93, '94, something like that.

When I left the engineering directorate, it was fairly significant. Well, I had spent twenty-some years in the engineering directorate, doing everything that they asked me to do, only to find out that I had become so specialized. I had made the same mistake again that I had made in the early days when I worked on Skylab: I became specialized. I became so specialized that they reorganized and I no longer belonged to the engineering group, the people that I had—

we spent a lot of time together. Some of those guys are still there, as a matter of fact. I communicate with them. But it sort of was a big letdown for me, something that I had never, ever expected to feel at NASA.

It led me into private life and private industry, only to find out how bad it can really be, how political it can be, how cutthroat it can be, how different it is than the government ever was. The government may be that way today, but the private industry is so much different than what I was prepared for. At least the company that I work for now, they're very young. I am probably one of the oldest people in the information technology, probably within the top 2 or 3 percent of age in this group. I don't consider myself old, but compared to these people, I have a couple of guys that work for me, when you add their ages together, it still doesn't add up to my age.

So it's this whole feeling of, they're there to make a career. "Get out of my way. Money is no object." It's very much like NASA was in the early days, but it's not anywhere near as controlled as it was on Apollo and NASA in the early days. So it's a lot more—I don't want to say cutthroat, because it's really not that extreme, but NASA, to me, sort of stuck that up for me. They basically dropped the "I'm your family." It's no longer a family operation anymore. This is a business. It was the beginning of that feeling that I found in the last five years of NASA that bothered me. Still bothers me.

I follow NASA as much as I possibly can. You don't get an awful lot of it in the Richmond newspapers, but you do get enough. There's a lot of things that are bad about NASA, a lot of things that are good about NASA. I sort of miss being there, but I don't miss being there at all. It's one of these kind of things. I'm glad that I'm not there anymore, because I can imagine how difficult it must be, with all the politics associated with the way it was going at the time, but yet all of the bureaucracy that had come in, and all the power, and all the control, it

must be a difficult place to work. I don't sense a lot of joy coming from the people that are still back there.

BERGEN: What do you feel led to that change, looking back?

DEFIFE: Money; Congress; the country not spending a awful lot, not paying a lot of attention. Shuttle, they weren't even watching Shuttle anymore. We were watching it in the conference rooms and stuff, but you didn't see much. You saw it on the evening news. It's just like it is here. I barely know that there was a Shuttle flight. If I don't pay very close attention, I could miss the flight completely. I believe that that's the way it was back in the early nineties across the country. That's the way it was getting.

So Congress and the government wasn't too interested in giving us money, and they brought in a new bunch of management. They were charged with making it better, spending less money, all the "faster, better cheaper" stuff that NASA is doing today. But I think the management is missing. I don't think they have this layer of managers that can make you feel like you're part of an organization. Yes, you had less money to do it on, and, yes, you had to do a better job of what you were doing. Yes, you had to be more efficient. No, you couldn't waste a lot of money. No, you couldn't do a lot of false starts, because you had to be more intelligent. It seemed to me, right before I left, that there wasn't an awful lot of direction coming from the middle levels of management at NASA. I don't know whether that went all the way up to the top, or whether it just was the middle management, or whether it was an age thing, or whether it was me. Kind of hard to tell. Looking back from where I am now, I don't think it was me.

BERGEN: If you were to give advice to a young engineer that wanted to go into some new field, whether it be space or computers, what would that be?

DEFIFE: You mean someone who is in school, that would be perhaps looking for a job? Actually, I had an opportunity to do that not too long ago. A friend of mine from high school had a relative that was thinking about going into aerospace. At the time I advised him no. I didn't think it was going to be an easy place to get a job, for one. Things have changed a little bit. My son's stepdaughter is graduating from high school next week. She's interested in engineering. She's working as a once-a-week intern from high school at Goddard [Space Flight Center, Greenbelt, Maryland], and I can see the excitement that she has about the things that they're doing, the Hubble Telescope stuff, all the things. But it seems to me that what they're doing, at least at Goddard in the area that she's working in, is they're trying to take the technology that they're developing and they're trying to apply it to the country. That's beginning. I think she's excited about that.

I don't think I would have the same advice. I would think I would advise them pretty much to do what my granddaughter is doing. She's basically going to look into going to work at NASA if there's not a better offer that comes along. If she can find a job that excites her, I don't think it's a bad place to work. Publicly it's kind of different now than it used to be, but you know, we miss that excitement of "The Right Stuff" kind of astronauts. We don't have that publicity anymore, but probably it's much more worthwhile and beneficial, I think, the work much more rewarding if you can get into an area like that.

BERGEN: Looking back at your career at NASA, what do you think was your most significant accomplishment?

DEFIFE: Oh, I don't know. I guess the Grumman-Boeing contract and the design impact that we had. I got to a point where I enjoyed managing people a lot, so the mentoring and the managing and the leading and the career counseling of people that I did, I think was important. I still feel that way. It's one of the parts of the job that I have today that I enjoy a lot.

ADAP was something that I'm proud of. The fact that I got some awards along the way and I made good money, and I was well respected, and had a great retirement party, that's something that makes me believe that I did contribute. I don't think it was any one specific thing, other than the things that I just mentioned, but it was mostly a lot of little things as I went along, all the people that I met and the people that I worked with, and the small contributions that we made. I feel more proud of those than I do of any one specific thing.

BERGEN: Is there anything you would like to say in closing, maybe that I didn't ask you about specifically?

DEFIFE: No, I don't think so. I think I was able to get into the things that I see today in the job that I have. I was interested in talking about that a little bit, and I think we did get into that enough. No, I'm pretty comfortable.

BERGEN: I appreciate you sharing your history with me. I enjoyed it.

DEFIFE: Thank you.

[End of interview]