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ORAL HISTORY PROJECT

Interview of: Dr. Clifford Jacobs
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Interviewer: Richard A. Anthes

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Anthes: Good morning. This is Rick Anthes. I'm sitting here with my long-time friend and colleague Dr. Clifford Jacobs, who worked for many years at the National Science Foundation. We are sitting in the National Science Foundation, a conference room. This is Monday, April 29th, 2013. Cliff, let me get you started here with a question How did you get interested in science?

Jacobs: Well, first of all, I want to thank you for providing me the opportunity for the interview, and for the AMS to provide that opportunity. But let me answer your question. I got involved in the late '50s, when I was growing up. I went to a good high school and it exposed me to a lot of interesting ideas that involved science, mechanical drawing. We even took typing at that time, so these things turned out to be useful afterwards.

But one of the things that I think was a strong influence on me was the invention of the aqualung by Jacques Cousteau, which happened in the late '40s. I got very involved in scuba diving and actually learned how to do it and taught classes, even when I was still in high school, at the YMCA of how you actually did scuba diving. And I did a lot of scuba diving. Since there were very few books written on it, I sent off to the Government Printing Office to get the Navy diving manual. Came back, it was just huge. But that's how we learned about some of the most fundamental things about the physiology of diving, what you had to do, the right circumstances.

So we taught those classes. There was an older gentleman who would pick me up and go. I didn't even have a license at that time. He would take me there and we would partner together. Over the years, even when I was in

high school, I did a lot of diving in quarries, ice diving even, where we would go and cut holes in the ice and dive in the quarry, sometimes as much as 200 feet, go between quarries that had tunnels in them. We did a lot of things that involved me in water and in understanding the physiology and the technology involved in scuba diving. That was useful.

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The other part was, my brother was very creative, and he did a lot of things. We wound up following his creative ideas. I was the younger brother, so I was always tagging along. He got very interested in cars, and he built a hot rod. We had 13 different makes of cars cobbled together in this one particular old Ford that we had. The name of the Ford was "Sleepy," because in the days we were growing up, muscle cars were a big thing in the '50s, really big thing, and if you ever wanted to know how I grew up, you go and watch *American Graffiti*. That movie totally described exactly the environment I grew up in in the '50s. Cars were a big thing.

We had this Sleepy car which didn't look like a hot rod at all, that's why it was a "sleeper." But underneath the hood there was a 550hp Pontiac engine and triple carburetors, bah, bah,bah. We built the car, we got it running, and it was unsafe at any speed. We didn't have adequate brakes in it, we didn't do anything correctly, but it went very, very fast. If you could control it.

Another thing we did, I remember once that he was looking in *Popular Science* and came across the design and how you make a crossbow to hunt elephants. Now, I grew up in New Jersey, and there were not a lot of elephants roaming around, but we built this crossbow to begin with. The bow itself was made out of the leaf spring of a car, so we went to the junkyard and got that. We had to figure out how to manufacture these things. When we finally built the whole crossbow and followed the design very carefully, we found out we couldn't cock it. [laughs] It had this huge cocking lever, but there was no way to cock it. All of us together, three of us, pushing hard on it, couldn't do it. So we went back and redesigned it and cut it down a little bit more and finally got it to be able to cock.

And then we found out other things, the experiment design, where you actually had an arrow, a bolt, for a crossbow. We had a short piece of wood with a steel tip and feathers, and the first time we shot it into a tree, the whole bolt disintegrated and we had to go back and try again. We found out we actually had to make the shaft out of steel and the feathers had be to aluminum fins. We figured all of this stuff out. All of those things I think influenced me about the creative ideas and about how you approach science. I think it was useful.

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Anthes: So that sounds like much of your later work was done with computers, or at least it was a very important part of your career, and we'll probably get to some of that. How did you get into computers from all of these mechanical devices?

Jacobs: Actually, you're jumping forward. You've got to remember that this was the '60s. I did do computer work for my master's work on one of the first early supercomputers at Texas A&M. We had to learn how to code. But this was really the early days. It wasn't till '84 that I was actually at NSF and the personal computer really started to take off. That's when I came to NSF, in 1984. I started a career that was really independent of the technologies that we have today. I knew in high school I wanted to be an oceanographer from this idea I got from Jacques Cousteau and the fascination I had with the ocean. The problem was at the time, and it's still pretty much true today, that there was no undergraduate course in oceanography at that time. You really had to get a degree in something else, and then you could get a master's and a Ph.D. in oceanography.

So I went to Texas A&M. There were only a handful of schools that taught oceanography back in the early '60s. They were the ones that emerged after the war. Texas A&M was one of them, San Diego was another one, Hawaii, Woods Hole were the major players. I went to Texas A&M and I almost went to Hawaii, but my mother said, "I'll never see you. You go to Texas A&M." So I went there, got an undergraduate degree in mathematics and then went on to do my master's in oceanography at A&M.

Anthes: You had a fairly good idea of at least the general area you wanted to get in. How did that change over time?

Jacobs: Well, about 1967, I had completed my master's program. Uncle Sam said that he had a position for me, perhaps in Southeast Asia, and at that time there was not a voluntary army, it was in the Selective Service. I was 1A, I was perfectly fit, I passed my physical and I said, "Well, you know, I just got married and I was thinking about the career, thinking about even a Ph.D.," but at this time I was going to be drafted. So I looked around for a job that would change my classification slightly, if I could. It turns out Travelers Research Center hired me, in Hartford, Connecticut, and I got my classification changed to 2A, and that was—I was working—Travelers was doing defense-related work. At the time they had a contract with the Air Force to look at clear-air turbulence.

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When I went there, I got involved with several people who were in atmospheric science, Joe Pandolfo, who was my mentor, was in

atmospheric sciences, graduated from NYU. Dick [Richard S.] Greenfield was there. He had also graduated from NYU and he was an atmospheric scientist as well. Over the course of a year or so, I starting helping Joe Pandolfo with air-sea interaction work and I got more involved in atmospheric sciences on the modeling side of the atmosphere. Again, we still had pretty limited computers, but we had a small IBM computer at Travelers Research Center. The whole story of Travelers Research Center of course is another one that's part of the history of that, and it's an important part, but we won't go into it now.

After about a year, Joe Pandolfo said, "You know, you really ought to go get your Ph.D." And I don't think I would have done it otherwise. I was in Hartford. There was no Ph.D.-granting institution in oceanography, so I commuted to NYU. It took me eight years to get my Ph.D., working full-time, I had two small children at the time. For four years I drove down one day a week and would take classes, and then for four more years I would work on my Ph.D. dissertation. It turns out that the Ph.D. dissertation was in air-sea interaction, and it was sponsored by NSF under Joe Pandolfo's grant. That's where I got involved in that. I finally did get my Ph.D. after what seemed to be a very long time, and I don't think I could do it today. [laughter] I just don't have the energy that I seemed to have back then. But that's true of all of us, what we did when we were younger.

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Anthes: That's very true. I think that you're like many people. You got your start in science at the university with an NSF grant. Later on, of course, you went to NSF and spent most of your career there. What did you do between graduation and NSF?

Jacobs: Well, I worked for Travelers, which became the Center for the Environment and Man and Travelers Research. They basically broke apart. Travelers sponsored their research center early on, and very famous people were involved in starting that institution, Bob White, Tom Malone, other significant names in atmospheric science's history. They were involved in that, but ultimately the real person who provided the support for that is a person in Travelers, Sterling Tooker, who actually believed in the value of learning more about the atmosphere. He finally withdrew his support. At that time we were getting about $600,000 or $700,000 a year base support. When that was withdrawn, we decided to break into a nonprofit group, the Center for the Environment and Man, which would be looking for support from the NSF, and a for-profit group, Travelers Research, and they would be doing more commercial work in terms of air quality and other things like that. That's the time when the EPA was starting to put in regulations.

So I went with the Center for the Environment and Man, had a number of NSF grants, worked with internal collaborators on various activities, and I learned a lot more about the modeling activities, air-sea interaction, and atmospheric modeling. But the Center for the Environment and Man was having some troubles. I assumed a number of roles there. I was the chief scientist, but I was also the business manager, and I think those things helped me a lot when I came to NSF. After a time, Dick Greenfield had come to NSF, and he was very instrumental in saying, "I know you're looking for a position to fill in the section that provides oversight to NCAR, and I know somebody at the Center for the Environment and Man who I think would be perfect for this." He got me an interview, and I got the job. I came as a temporary in July of 1984, and I stayed, worked full-time at NSF, till the end of 2010, and then I worked two part-years all the way to 2012.

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Anthes: So you were actually recruited by Dick Greenfield to consider this NSF position?

Jacobs: Right. And there was some debate on what the right kind of person would be for that particular oversight job. The section head at that time believed that a lawyer was the best person, and Dick would vigorously argue, "No, you need a scientist to oversee this person." Somehow that logic won out, and I came here.

When I walked in the door the second day I was here, and this gets to the question you asked me before, Walter McIntyre and several other people came in from NCAR and said, "We want to tell you about the next upgrade in supercomputers we want. We want to buy an XMP." So that was my early involvement with NSF and supercomputers. And when I look back at the competencies in the section, there were a lot of competencies, but there was kind of a void in this whole area of numerical modeling, and I had some experience, my research experience in that modeling. So I assumed this oversight role, as well as other parts, the XMP and acquisitions over the years as well as a number of other activities that NCAR was involved in.

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Anthes: Along these same lines, but much later, you recently co-authored an article with Steve [Steven J.] Worley, who was in the data support group at the Computational Information Systems Laboratory at NCAR. You both wrote a very notable paragraph. I'll just quote that.

"Many of the characteristics outlined in the cited reports about, data preservation, curation, infrastructure, partnerships, and sustainability, were addressed decades ago by the Division of Atmospheric Sciences at NSF

by the establishment and long-term support of NCAR. At NCAR there is a well-established computational and data infrastructure which is available to the science community. This infrastructure and set of services was developed over the years in response to community needs."

Give me some background on that statement.

Jacobs: When I first came to NSF, the more I understood about it, I have to say that I stood on the shoulders of giants, the people who created NCAR and UCAR back in the late '50s and early '60s. The first award to UCAR was for $500,000 in 1960, I believe it was, and of course they've got more facilities and people and they've helped the community more since that time, but that was the first award. And I began to understand how important it was for that kind of infrastructure to be created. I was going and computing at NCAR in the mid-'70s with the early Cray-1 and the CDC 6600 when I was doing my research. One of the things I learned to appreciate was, whether it was the specific intent back in the late'50s and early '60s or whether it was a general intent, what this facility provided, and the intellectual capacity associated with the facility, increased the productivity and the capabilities of the science community.

I couldn't have done some of the things that were needed to get my codes to run on these complex pieces of hardware. So I fully appreciated the value of this kind of investment as a huge payoff in the outcomes of science, because it enabled scientists to do science and not worry about all the technology issues. I thought that was important.

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Another thing that was important was, I was at NSF, and I got a very different perspective than I'd had when I was in the outside community. If you're part of the atmospheric sciences community, you don't really fully appreciate how unique NCAR is with respect to all the activities that NSF funds. It's very unique. It is the single largest assistance award that NSF provides funding to, and it's grown over the years. But the whole paradigm, the concept for setting it up is very, very different than NSF, which is primarily a research-granting organization. What I appreciated was, I saw the creation of the Internet, I watched it, I was an observer to these activities, not really a major participant. I saw the creation of the PACI centers XSEDE, I saw the creation of the Track 2 and Track 1 things. All of those were attempts by the National Science Foundation to provide infrastructure to the entire community. And they did. They provided needed, valuable infrastructure.

The particular model NCAR chose to use, which was this close coupling of facilities in scientific computing and intellectual capacity, was, I think, the best model. Over time, they tried a lot of things at NSF, and there is today a better recognition of the fact that discipline-oriented

computational centers do have a place in the overall portfolio of NSF. And for a number of years, I tried to make that point internally at NSF. I'm not sure I was heard as well as I'd like to be, but it always did seem like the right thing. And the outcomes from what was accomplished from that particular paradigm were very, very significant in atmospheric sciences. It advanced the science way beyond what it might have been without something like NCAR.

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Anthes: I think it's probably fair to say that most of your oversight of NCAR had to do with the computational infrastructure, rather than, say, the observational side of NCAR, although you had responsibility for the whole laboratory. How in other ways did you contribute to establishing the computational infrastructure as NCAR evolved over the years and as computer science evolved and the science evolved and computers got faster and faster and the architecture changed?

Jacobs: I will say that I did get involved in the observational sciences, but I did not take the primary lead. We were fortunate to have other people here to be able to do that, but I was closely involved in that. We'll come back to some of the things we were able to do. But I think I learned a great deal from my colleagues at NCAR. They were extremely technically competent. They were willing to share facts with me. I appreciated the balancing of various aspects when you'd go for a procurement or when the science is being done, how codes have to be designed with respect to the architecture and how the architectures were constantly changing. I also appreciated it from working with my colleagues at NSF, where they were going through the same problem of trying to procure supercomputers and other kinds of infrastructures. I had the benefit of all of this great knowledge, and I tried to learn from it.

I was an advocate for NCAR and its computational capabilities, and I also at the same time wanted to not be overbearing about it, but be respectful with my colleagues about how there are these alternative paradigms for doing the computations. One of the things that people would like to do is get as much computation as you could for the dollar. That particular notion lasted in NSF for a long time. You'd have these competitive environments that would do that. There's some other questions you might ask me that would illuminate that a bit more. But I did learned a lot from the community that I worked with.

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Anthes: That brings me back to a general question. You said you were an advocate of the computational facilities. In fact, you were an advocate of NCAR overall, as you just mentioned. Did you ever feel you were in some kind of

conflict of interest, being the program officer and responsible for the review and oversight as well as being an advocate?

Jacobs: No. I never felt I had a conflict. I always knew who I worked for, and I always knew that collectively, UCAR, NCAR, and NSF had the same general values in mind. They wanted to support the community. They wanted to do the best science. There's a lot of ways to get there, but I think those shared values were the most important thing for us that got us to the place where we are now and got us through some tough times, when the funding wasn't there or we had to confront issues.

For example, in the review process, I always felt that it was something that was very onerous for NSF, certainly for NCAR and UCAR, certainly for the community who had to be involved in that, but it was a process to improve. We got a number of recommendations, and after those recommendations, most all of them were discussed and a plan of action on how to address them was put into place. There were times where we would talk to UCAR and agree that a recommendation was not practical, that we would let that one pass. And there were other times where I wasn't sure the recommendation was a good idea, but UCAR might have taken it up anyway. [laughter] So there was that.

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And I know that they know me out at NCAR. I can be a critic, and constructive critic, I wanted to be. So I never felt that I had any conflict of interest. We shared the idea of, how do we get to the best things we want to get to, better communities, better science, more infrastructure to support that, more intellectual capacities that is connected to the universities? I think we did OK on that.

Anthes: You started out as the overall program officer, program director, manager of NCAR. But then fairly early on in your career at NSF, this new program called Unidata came up. It was not put into NCAR, it was put into what was called the UCAR Office of Programs at that time, I believe. You got very involved in also being the project manager, officer, oversight of Unidata and were you also an advocate of Unidata. Can you tell me your perspective of how Unidata got started?

Jacobs: I was not involved in the very early stages. Oftentimes people point to the 1983 workshop at Wisconsin as the starting point. It was certainly precipitated by things that NOAA did about pulling away the feeds for data to the university, and the community came together and said, "We need to react to that." But fairly early on, after it got started but it really wasn't formed, I did get involved, and I watched them go through different ideas. But we had three challenges to address. One was this idea that was not really native, shall we say, to NSF that the provision of data,

software, and community facilitation was something that NSF ought to sponsor. I believed in that. I thought it was the right thing to do. So we provided that infrastructure, that guidance for starting that. But how do you actually implement that paradigm? We don't really know. At the time we didn't know, and we had to develop it as we went along.

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What was the right governance to do that? What was the kind of community involvement that you needed to have in that activity? The second point was the technology one. What was the right technology to have? How do you make choices? You had to recognize that technology was constantly changing. How did they adopt or create the new technologies? What are the risks involved in not doing anything? What is the payoff in actually doing something?

The third important part was, how do you gain some sense of community involvement? How do you gain the trust of the community that the decisions by, for example, the policy committee and Unidata are in the best interests of Unidata? How do you sustain that trust and communication with the university? I think those were important factors we all had to figure out over time.

My involvement in Unidata was one in which I attended almost every policy committee. I would sit there in a role that I felt I played at NSF in general, and this is, I wanted to be a neutral but constructive third party to try to help them have creative thinking in understanding the full perspective of how Unidata fit within the National Science Foundation and the larger picture of Washington DC. The university people do great things, but they don't have that perspective. So when they were moving toward a certain decision process, I would encourage it or be quiet, or if they were moving in another way that would cause problems, I would say, "Let's think about it in this different way and help them to move that." I always made myself available to the management of Unidata to discuss any kind of issues that they wanted to in a very informal way. If they decided they would take my advice, fine. If they didn't, that was fine, too, both ways. I tried to guide them as best it could, but never tell them what to do.

Anthes: In my experience with you over the years, I saw that in all respects, that you were always available to bounce ideas off of and occasionally you had stronger ideas than others, but you were always careful to keep the oversight role of NSF and the sponsorship role separate from the management role of UCAR and the management that went on within NCAR. Back to Unidata, perhaps you could say what Unidata is, what it does, what it set out to do, and why it wasn't put into NCAR.

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Jacobs: This was pretty early on. The community felt very strongly at the time that if I put it into NCAR, it becomes a subcategory in something bigger, and the community would lose the ability to control it and govern it and guide it in the way that they would like to. If you put it in NCAR, you might be putting it in at that time the computational computing division, and they have also some other demands, so whether the needs of Unidata would be met was a concern to the community. By putting it under UCAR, which is a university-based consortium, they felt there was a clear vision for how the universities would be involved in that, and indeed it truly turned out to be that way, that the universities felt a true sense of ownership, even though the universities involved in Unidata are larger than the consortium universities of UCAR. They've been very, very important in guiding that.

One thing that's important as well to recognize that Unidata was always for the haves and the have-nots. The smaller colleges could make major contributions to and have major influence on Unidata. They felt that under the NCAR banner they might not be able to have that, and I think that feeling exists today. I've had discussions with people at NCAR who point out that NCAR is totally capable of doing everything Unidata is doing, and I agree. But they would lose that important connection to the community, building trust. "This is our organization." We all have a sense of ownership in Unidata, and it would be diminished by putting it in NCAR.

But today, Unidata has transformed the way research and education are done in the atmospheric sciences community. Several years ago we had an independent study done to see if that was really the case, and it did come back as, that was the answer in a nutshell. Yes, it's been transformational in the way things are done. The important thing about Unidata is that even though it was done in a way that provided one award to 20 or so people who ran an office, who communicated and did a lot of software development and data things, many of the most interesting ideas that were developing by the Unidata program center came from university communities, whether it be something like distributing the cloud radar that NOAA actually eventually adopted, that came out of the universities, that idea of how to do that. The other ideas that might have come up over time was lightning distributions that came out of Albany and other places like that. That was the beautiful mix about Unidata providing the technical competence to implement some of these ideas and getting community involvement.

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I still believe that Unidata is an interesting model. It was one that AGS, or ATM at that time, had to take a chance on. We didn't know, but at some point we indirectly wrote something to the community by our actions that

said, “If you have an idea—” this was once Unidata was well started—“to develop software to bring data in, distribute it, analyze it, don’t bother to apply.” Which is very unusual for NSF. This was the way we were going to go, and we felt that this was the way to provide the need. We saw many other places within the NSF that took the approach of, “Let the very best ideas bloom.” But you don’t build true community infrastructure and true ownership that way. And even one of the major institutions that did not adopt Unidata early on probably went 15 years before they finally threw in the towel and said, “We cannot afford to develop our software, keep it up, and constantly get new equipment. We want to become part of Unidata.”

So universities had this way of bringing in infrastructure connecting to intellectual capacity that wouldn’t have existed if Unidata wasn’t around.

Anthes: That raises a question. If Unidata was so successful, and I agree with you completely that it was successful, why not break NCAR into a dozen or so Unidata-sized programs, each with its own policy committee and its own constituency, and operate them as a collection of programs rather than a national center?

Jacobs: Because I think we would diminish some of the basic ideas NCAR was created for. NCAR was created to address problems that are very, very large that universities couldn’t do. So if you break it into a meteorology section, universities have a meteorology section. It’s the fact that all of these parts of NCAR work very well together to address these big problems that are really, really complicated. The meteorologists who are working with the chemists in an environmental that allows them to work very, very well, they live in an infrastructure that works really well, and they are able to engage the university constituents in that. I felt that breaking it apart would not achieve the overall objectives that were set back in the late ’50s and early ’60s that was the right idea. These had to be global problems, really, really big problems that could not effectively be addressed at the university.

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Anthes: Shifting gears a little bit, you worked through several different White House administrations with different priorities. How did the different administrations affect your work at the NSF? Related to that, as the budget levels went up and down, priorities of different administrations and different Congresses, how did you adjust to the changing funding levels.

Jacobs: On the whole, up until very recently we had fairly steady budget increases. That’s not to say that we have the same buying power that we used to have. Inflation has eaten away at that. Priorities have changed. The amount that the nation invests with respect to the gross national product in science and engineering has certainly diminished over the years. But we

haven't hit a point in which we've felt we were losing ground. It takes a long time to build institutions like NCAR, or even departments in universities, and a huge budget cut, a slice like that, can wipe out years of work in a very short time, and it's very, very hard to rebuild that. I don't think we ever had that at NCAR or the UCAR community. We always maintained at least some level of subsistence that allowed us to move forward, perhaps not as fast as we'd like.

The problem, of course, is that the U.S. budget over the years has changed dramatically. If you look at the budget now, probably 67% of the entire budget of $1 trillion-something is devoted to payments to individuals. That's Social Security, Medicare. That's consumed so much of the budget. You add the defense on top of that, the payment of the national debt, there's so little left for discretionary spending, and even among the discretionary spending, there's quite a difference in agencies. Probably the most stark example is the difference between NSF and NIH funding, very big. They're a $30-plus billion organization and NSF is a $7.5 billion type of organization. I don't think those things will change over time, but it has developed, for various reasons, at least at this point, up until the current time.

Now, my understanding, with the sequester and other things like that, that it is far more challenging now to maintain that. However, there are things that offset that, the decrease in buying power, shall we say. Part of that was increased efficiencies in the community and productivity in being able to accomplish science, and part of that was from the investments we made. Increase in the management and administration efficiency and capability in places like NCAR and UCAR that were able to do the same things for less money, partly due to technology, partly due to better things. And then there were some other things that were important, and I felt when opportunities came along, and there were a few that were bump-ups, you didn't want to invest in things that were like bringing on five new staff members that you knew you might not have a budget for the next year. But you could invest in certain infrastructure activities that would have a long-term effect. And we did that.

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There were times like in 2009 when we had a big bump, when the Obama administration came in and we were doing the recovery, and that led us to do things like the avionics for the C130. That was a $7 million upgrade. And we also were able to refurbish some of the Eldora stuff, we were able to bring on and sustain support for some computer modeling within NCAR, and we laid out a long-term plan, when the money went away, how we would start that. Those were opportunities you'd look for.

There were also other opportunities where we had other funds to tap into, like the major research and infrastructure funds, and we got the G-V funded for that. That was an $82.5 million project that went very, very well. But there was no way we could have afforded that under the regular budget. So we do these things that we look for, and occasionally, when we got a good budget year, there were times in the past where I would go to NCAR and say, "Look, you have a structural budget problem and we need to works with you to fix it." One of those particular activities was how they funded the aircraft. They were funding some of the basic expenses for the aircraft by how many hours you flew and how they would charge for that. That didn't work. If you didn't fly the aircraft because the science wasn't there, you were in trouble, because the fixed costs were still there.

So we tried to fix those structural budget problems that were important at the time and make sure that they put money aside for inspections and aircraft and other kinds of fixed expenses they knew were coming so we could use budget activities in a positive sense to try to mitigate those out-costs.

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Anthes: Did NSF ever get any pressure from any administration to do something or not do something?

Jacobs: I think we always did. I remember writing a lot of responses to Congressmen, climate change was one of them. We'd get Freedom of Information Acts searching for things. Climate was a political issue. NSF has maintained its neutrality in that, and I think that's turned out very, very well. We support science, and this is an area that we invested in. We found out a lot, we learned a lot on all of that. We were able to address those things. We never really felt pressure, but we always said to ourselves that whatever we do, we need to be completely transparent about it. There was nothing that we did that couldn't be shown except for a few internal reviews and that kind of thing that are protected material, but everything else we did had to be aboveboard and open and we could share with anybody. We're only supporting the best science and following the course wherever that leads us.

Anthes: Look back on your long career, what do you consider the two or three most important contributions or achievements during your long service at NSF? What are you proudest of?

Jacobs: Part of it was that I was able to somehow sustain a level of support at NCAR that allowed them to accomplish so much. There weren't wild variations. And I can't take a lot of credit for that. I would fight as much as I could internally for doing that. I must say that I never fought to the point internally that I would ever diminish the value of the university

contributions or the grants program. We always had to have that balance. But whatever I was able to do, we were able to sustain it, and NCAR really functioned for the university and for the science community in general in a way that they were able to accomplish a lot. If you can go from their recognition in the IPCC Nobel Award, the many authors, the papers that they authored that were outstanding, the editorships they did, the awards that people got—I always felt that at least they had a solid institution that wasn't going through wild times to allow them to accomplish that. I felt that in the oversight I provided, I tried very hard to do that, and to let them follow the course that they want, never try to tell them what to do. Discuss the options, try to communicate with them as best as I can. That was certainly one of the things I felt was an accomplishment.

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Another accomplishment was somehow managing the competition for the management of NCAR. That had the potential of being extremely divisive. It was a very, very hard process. It took NSF three years. It was hard on the community. It was certainly hard on UCAR and NCAR. It was a long process. I worried a lot about the fact that whatever was created years ago could actually unravel to some degree when you did this competition, or that we could be faced with choices that we were not happy with. But somehow we managed all of that. We got through that competition, I managed to get in front of the Science Board, a five-year award and with a reasonable review another five years, so we wouldn't have to do that. The whole competition issue, I probably went 10 years stalling, but it became apparent at some point in the early 2000s that we needed to get this over with. And we all dug our heels in and went to our respective corners.

One of the values for us going through this was the fact that you and I and other people had a long discussion about UCAR's role as managers and how it was separate from NCAR's role. So we had this vision and we talked it through, and I think it helped UCAR in the end to understand its role, and even in the latest proposal, they have a much clearer idea of what their role as managers are as opposed to what role NCAR has in FFRDC. That was another accomplishment.

Other things like pulling off the G-V Gulfstream aircraft. That was an interesting story. That story was that the physicists at NSF had created this new account, MREFC, [Major Research Equipment and Facilities Construction] and they needed it because they knew that they had big infrastructure things to fund and they couldn't fund them within their budget. They were many millions of dollars, and it would have decimated the grants program. That was recognized, and they worked with Congress and got this special funding through. They went to that trough and they drank for a while, and then they were through drinking. The idea of the

way that was set up was, you come, you get your thing funded, and another project comes and drinks from the trough and goes away and gets funded.

0:49:03.8

So one day our budget officer walked into my office and said, "Do you have anything in mind for major a research equipment project that would qualify for the MREFC account?" And I said, "Well, yes. UCAR and NCAR and the community have been thinking about a mid-sized jet for a very long time. We've got at least 10 years' worth of documentation thinking about it." He said, "That's good. You have 10 days to prepare all the paperwork.

Anthes: [laughs]

Jacobs: So I called up NCAR and the paperwork was many, many inches thick that you had to do. We worked together at the very beginning. We actually benefited from some of the interesting ideas. NOAA had recently procured a G-IV aircraft, and one of the things they learned was, "We got the platform, but we had no money left for the instrumentation." So from the very beginning, we asked for, "Make sure you put in money to build state-of-the-art instrumentation that would go with the state-of-the-art aircraft." Needless to say, in the 10 days we got the paperwork in and we actually were able to get that thing funded. It took a long time to get it funded, and as a process, every time there was a delay in Congress and say, "There's inflationary costs. We've got to bump it up a little higher." So it started as a $60 million project and ended up as an $82 million project. And we got it funded, came in slightly under budget and certainly on time, and that was to the real credit of the management of UCAR of that project.

Anthes: Those are exciting achievements, that's for sure. The long-term sustained support that I haven't seen from any other agency. Agencies and programs come and go, but the sustained support of NSF has been one of the unique parts of NCAR's success. So thank you for playing that role. On the other side, what are a couple of your disappointments during your service at NSF?

0:51:43.2

Jacobs: I must say that there were times when I could have convinced UCAR and NCAR to be a little bit more productive and efficient in the way they do things.

Anthes: [laughs]

Jacobs: And part of that is that, like any institution, you're going to have certain turf wars that were not in the best interest of advancing science but might

be more parochial in their way. Part of that was the fact that over time, some of the divisions weren't working together as well, or the administrative system wasn't as efficient as it should be, or the communications within the organization could be improved. I always tried to help them, but I never wanted to be directive to that. What you can do as a program officer if two divisions aren't working as best as they could, there's a few things that I can do. I can say, "Work better together." You try to find various ways to affect that. And over time, many of those things were corrected. They just took a lot longer than I would have hoped for.

And some are still going on. There's some software they've been developing for the administrative systems where I don't know if I'll live long enough. I'm asking people to put a note on my grave when the system's finally done. [laughs] It takes a long time. So that was a disappointment in the sense that I wish I could have found better ways to move them forward to get over some of their institutional things. At the same time, I had to keep an arm's length with doing my oversight.

0:51:43.2

Another disappointment, I always wish I could have provided more funding, but there were some times when I had to call that panel, which I know is one of the questions you might ask. There was a time when NCAR had been criticized publicly about the way its climate code was developed and how appropriate that code was for the current architecture. The story behind that is, the criticism didn't come from the atmospheric science community, it came from the advisory panel for the computer science groups, who knew the atmospheric science community, and they actually said, "NCAR's codes are dinosaurs."

Well, NCAR and UCAR didn't like this at all, and they felt that that was not true and that they were proactively saying, "That's not true. We'll go even to the OSTP and tell them this is not true, this is a terrible rumor and we can squash it just through our sheer presence and bringing a lot of people in to tell us from NCAR and UCAR that it's not true." The NSF had to deal with the situation, so what did they do? They would call a review panel to do what I think became known as the "code police," the code assessment panel, whatever it was. We did bring a very distinguished panel in. They listened to NCAR and UCAR about their process and what it was, and I remember after the first day, the chairman of that group said to me in the lobby of the hotel as we were waiting to go back to the second day of the review, "I'm depressed. I thought we would come in here with NCAR being in such a high-quality place that we would have nothing but a glowing report to write. But there are really problems here, and I'm going to have to write, and I think the panel's agreeing, we're going to make some recommendations." And they did. They were constructive recommendations. I'm not sure the folks at NCAR ever agreed with it or

forgave them for doing that, but actually it got worse even after that report came out.

0:56:03.9

It was widely known as the panel report. I remember going to a session at NCAR in which we were lucky enough to have the assistant director from CISE [Computer & Science Information & Engineering] visit out there. It was still a pretty sore point. At one point during the conversation, when NCAR was saying things and I wouldn't cut them off, I would let them say it, I did think I had my hands in my face—

Anthes: [laughs]

Jacobs: [laughs] —shaking my head slowly, "I can't believe what they're saying!" But we finally worked through all of that, and as a result, the codes did get improved. They were much more modern. And part of the reason that developed initially, this is my speculation, don't know for sure, was part of the thing that I alluded to before. The divisions weren't working well together. They became very parochial about, "I'm not going to realize my code and get any computer scientists working on my code. This is all about science. They'll screw it all up." Until you get that full collaboration that they needed to have, and they have it now, I don't think you would have developed a code for the best architectures that were constantly changing and the science was constantly changing, and if you have something like a community climate model, you can't be just changing it ad hoc. You have to be very disciplined about how you change it so that you can build your science case as you move forward in what you've made the changes to.

0:57:36.5

We've worked through all of that, but it was a disappointment that I had to call that. I think it was the right thing to do, and I did certainly consult with all of my superiors before I did that. One of the fundamental things I had was, my role at NSF was to make UCAR and NCAR look good. And that is to give them a perspective inside the foundation about how you can best present your case. They were going downhill fast. They were losing ground, and I had to step in to do something to make sure that they got back on track, that they didn't take—"I'm going to dig in my heels and we're going to resist this." That was not the most productive thing. They needed to get over this and move on to what it was. So I made that decision, that it was time to step in to do that.

Anthes: I think that intent of trying to improve NCAR's codes and improve their image perhaps was not understood for a long time by many people, myself included, and that's where the "code police," affectionately, the term came from. I remember, in our long relationship together, that was probably our

most violent disagreement that you and I ever had. Do you remember how our arguments were finally squashed? Do you remember who did that?

0:59:20.7

Jacobs: No, I don't remember. Maybe you can remind me of that.

Anthes: I think Jarvis's Moyers finally told us both to stop arguing. [laughs]

Jacobs: [laughs] Oh, yeah!

Anthes: That was probably the only time in our many years together that we really had a misunderstanding, and I will be happy to call it a misunderstanding at this stage.

Jacobs: But we did get beyond it.

Anthes: We did.

Jacobs: And I agree with you that as a result of that process, it might not have been the most efficient and effective way, we did get results.

Anthes: Right. Were you involved in the situation where NCAR was trying to acquire a Japanese computer?

Jacobs: Yeah. That was another place I would add to my big disappointments. The disappointment perhaps is not fair on me, saying it summary, I couldn't have done anything about it. Even if I knew it was a disappointment, the disappointment comes from the fact that as a part of that process, the community lost about a year and a half of having access to a really high-quality machine, by the time we actually were able to go about that. It was a very interesting story.

1:00:38.9

NCAR goes through this process about every three years to have an open competition for a supercomputer. They put out a request for proposal. That request did not have any restrictions on it in the sense that it didn't say Japanese could not apply, because the thought was at that time that the Japanese really didn't have a contender, a computer, and that there were some ideas by the present director of the scientific computing division, the director at that time of supercomputing, Bill Busbee, who said, "Look, Cray really had this thing locked up, but IBM might be interested in partnering with other groups, and maybe we'll have a real competition rather than Cray having the supercomputer industry all locked up."

So they put out an RFP, and two Japanese companies were real contenders, Fujitsu and NEC. NEC made a very good offer. I got a note

from Bill Busby that said, “I want you to let know that we’ve done a preliminary look at the data so far, and it does look like there’s two Japanese contenders here that might be in the running. I want you—we’re sensitive to this. I want you to give us some feedback from NSF.” I wrote a memo to the director of NSF, Neal [F.] Lane, at the time saying, “I want you to be aware that this could be a problem.”

As part of the process, they went through evaluating and then it became clear that one of the Japanese supercomputer makers was really a contender. They were head and shoulders above what anybody else was providing to us. So they came in, NCAR, with their technical staff, and I pulled together some folks from our administrative, Larry Rudolph was one of them, he was the Office of General Counsel, and we sat in that meeting and I remember to this day, after they made all this explanation, Larry said, “Have you—I don’t have a warm and cozy feeling about this at all. Have you considered dumping?” I hadn’t even known about dumping to that point! [laughs] They went through, “Oh, yeah, we had this independent person look at that,” and Larry’ just was very skeptical.

1:03:21.0

Well, it went downhill from there, because first of all, people in the government got wind of this, that the Japanese actually had a real contender, and there was an unwritten law that says that supercomputers cannot be provided by the Japanese. I don’t know where this came from. There was nothing explicit about it in the law, in the code, but some of the agencies, like the CIA and NSA, wound up swarming around NCAR, not believing their code. CIA I think sent several people out there for five days. NSA sent a few people out there, saying, and I’m interpreting this, “How could we have missed this? How could we have missed that kind of technology development in Japan?” They were a second-rate player, and now they’re right up there at the top of the field. Everything they were doing in terms of memory bandwidth and things like that was way ahead of everybody else.

As a result, we tried to write to Commerce, saying, “Are you going to launch a dumping suit?” Because Commerce can do it or the industry can do it. We kept writing, Larry Rudolph kept trying to get them to respond, and they would say nothing until the last—it was almost at the final hour Cray came in and filed a dumping suit. After that it went to court, and we couldn’t do anything about it. We knew we were in over our heads, and we couldn’t do anything about it. We could have told UCAR, “Forget it. Cease and desist.” But there was no real reason to cease and desist, and they had already spent a lot of money, and I always felt UCAR would be liable for a lawsuit, because they went about their due diligence to do something, and NEC and Fujitsu and others had spent a lot of money trying to win this procurement, and suddenly UCAR turns around, it

wasn't the government counseling it, UCAR would turn around and say, "We're canceling." What would be the cause of canceling? Because the winners were Japanese?

1:05:47.6

So there was some sense of exposure to UCAR, and we didn't want to do that, so we let this completely ride out. There was a dumping suit. There was 450% dumping tariff put on there. Finally NEC withdrew its offer, but in the meantime, we went through this whole process where we were stuck with an old computer that was outdated. We tried to get the one from Pittsburg, and we couldn't get that. It was about a year and a half that we lost ground in climate modeling. I'm not sure—I think we would have made progress if we had had access to that computer. Whether the acquisition of NEC in the beginning was the right computer, it certainly would have been a lot of great science. It was still a vector machine. The codes were written for it. It was a great computer at the time, and perhaps they did underbid. I don't know. I wasn't fully aware of that. If you want to get a foothold in the U.S., NCAR's a great place to do it. So that was a disappointment, and we learned a lot from that. I still reminisce with people like Larry Rudolph and Neal Lane about how difficult that was for all of us.

Anthes: That was one case where politics really did get into the NCAR-NSF relationship. The Congressman from Wisconsin—

Jacobs: As a matter of fact, it got so bad that one of the Representatives from a state that manufactures supercomputers got a resolution passed in the House of Representatives that said, "If I approve this, I should not be paid."

Anthes: [laughs] And it named you!

Jacobs: There were two people involved.

Anthes: Except for Jacobs.

Jacobs: Grants, the administrative officers who had to sign off on it, and the program officer, me. So if we signed off on it, the resolution said that we should not be paid. We should never do this.

Anthes: That did not pass as a law.

Jacobs: It was a resolution. But I often note that that was my greatest distinction in government, being recognized by the House of Representatives that I shouldn't be paid.

Anthes: [laughs]

1:08:08.0 End file 1.

File 2
0:00:00.0
Anthes: Did you have any other either memories of achievements, the positives or the negatives in your tenure at NSF?

Jacobs: I think I covered some of them. We could go for a long time talking about a lot of the accomplishments that NCAR and UCAR managed with the community. I was not involved with all of those in the sense that I helped facilitate them. One of the things I think was important, and I would consider it an accomplish in this particular balance that I had come up with is that there are really three parties involved in this. There's the NSF, there's UCAR, the manager, and NCAR, the federally funded research and development center. It was always an objective to keep the balance for all of those in the right tension mode. Too much tension and things aren't productive. Too little tension and people go their own way and they're not paying attention. The main point here is, in this triad, they all speak to the university community, and they speak differently to the university community. Certainly the university community speaks to NSF in one way, speaks to NCAR as a provider of facilities and an intellectual center, and UCAR as a consortium in another way.

All of those inputs and perspectives are important, and they all pull that triad in different ways. We needed to make sure we kept the balance. One of the ways we would do that was showing up to the board of trustees when they had open sessions. I would oftentimes be there and provide that NSF perspective. As you know, we had often shared our remarks before they ever were made, and we thought that was helpful. I never wanted to pull any surprises on you, and you always kept me informed about major issues that would be discussed in open session.

0:02:54.4
There were times when you had called me and said, "This is an issue we're dealing with," and you'd give some advice. There were times even that I told you, "Don't ask that question."

Anthes: [laughs]

Jacobs: "Because I can tell you what the answer is, so let's find out a way where you don't have to ask that question." And that was helpful. I would always make my decisions in consultation with the division director or at the appropriate times with the assistant director, so I wouldn't be on my own. I would want to make sure they shared my opinions about things. I felt

that was an accomplishment, that we had a constructive relationship. We would basically figure out what the best path forward would be. Occasionally, as you pointed out, we didn't agree on everything, but surprisingly, we agreed on a number of things after discussion.

Anthes: Well, looking back, it's pretty remarkable that we had more than 25 years of running a very complex organization, and with these three tensions that you mentioned, there were I would say quite relatively infrequent serious issues that caused problems. That's a pretty good record for that long a time. There's a lot of money there, a lot of different complexities, a lot of constituencies that had to be satisfied, and all the legal issues. I think you can be proud of the part you played in that.

0:04:30.2

Jacobs: Of course a key element was to be completely respectful to the issues you were dealing with and the issues NCAR was dealing with. We tried to inform you about the issues that NSF was dealing with, and what was going on inside the Beltway. The main thing was that we were listening to you and understood your issues and tried very hard to understand the issues.

Anthes: Another big development at NCAR and UCAR toward the end of your tenure was the NCAR Wyoming Supercomputing Center [NWSC]. That was quite a departure in many ways. What were the big issues from your point of view, from the NSF point of view, when you first heard of the need that we had for a new facility, that the Mesa lab had run out of space and power?

Jacobs: That was back I think about 2003, when NCAR recognized that they would not have the ability to upgrade to the next generation supercomputer. That ability focused a lot on the size of the computer but an awful lot on the amount of electricity needed, which was not available on the Mesa lab. We started discussing that idea. UCAR did their due diligence to try to find a solution to this. They worked with NSF on this. I tried to present some of the ideas within NSF, and it went for several years of discussions, evaluations, possible sites, possible solutions. My discussions at NSF were not falling on friendly ears because there was a big dollar tag involved with it. We knew it would be a $50 million-plus project, and that was independent of the actual supercomputer itself. That was just building the structure.

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NCAR in its budget had the facilities to replace the computer, because that was the way it structured its budget, where they would reserve funds for every three to four years and they were able to actually purchase that without a one-time funding, but it was part of carry-over money that they

could actually use to purchase that. So that wasn't the issue. The issue was how you provide the next upgrade to supercomputing. And it really did raise a much larger issue, because at the same time, NSF got involved in this track 1 and track 2 thing. We were under a lot of pressure about how you were going to provide supercomputer facilities to the nation. That was an obligation that NSF had. And we started down a particular course that suggested that the best way to do this would be to have open competitions, that it would be independent of a discipline. You would just buy a computer, fund it for four years, you'd go out for another competition, and you'd fund another supercomputer and there's no telling where it could be and what you would try to maximize is the amount of cycles you'd get for the dollar.

This did not fit the paradigm that we had founded many, many years ago with NCAR and UCAR, which was, essentially you tried to provide the most scientific productivity that you could for the dollars you spent. The emphasis was not on necessarily the highest number of cycles, but how much science could get done with the cycles you bought. Which means that you wouldn't buy a completely experimental machine that was down 50% of the time while you were trying to figure out how to make it work, or that it required rewriting codes in ways people hadn't even figured out how to write them yet. It was one that was more conservative but focused really on getting the science done.

0:08:31.4

So with these basic ideas within NSF, there was also a change of leadership within AGS [Atmospheric and Geospace Sciences] at the time, and I was not getting the buy-in that I was hoping from the division director, the AD, and whatnot. NSF decided it would have a panel. OCI [Office of CyberInfrastructure] and AGS convened a panel. They did a very nice job. But there basically was an elephant of the room. OCI was running track 2 and track 1. AGS had a very nice panel, did some very thoughtful things, they gave some nice recommendations.

Anthes: This was the Kinter panel?

Jacobs: Yes. James Kinder and Ed Seidel were the two chairs of that panel. The main issue was the value of a discipline-oriented setup, and whether that would be the right way for the community to go. That issue really wasn't put in their charge, so they came out and did the best job they could. I saw this situation as being derailed. There was not enough support for this. I felt it was really important for the atmospheric sciences to have this upgrade, and I saw too much risk in adopting a new paradigm now compared to the successful paradigm that we had had for many, many years and with which we could point to a number of accomplishments.

I did something at that point that I had never done before when I was at NSF. I didn't think the right information was being given to the very upper levels of NSF management. The issue, of course, was the competitiveness of the process. As a matter of fact, UCAR and NCAR had been going through for several years quite a competitive process. They'd even decided, and you might remember this, that they were going to settle in Boulder for the supercomputer center. I called you up and basically asked you to reconsider that. [laughs]

Anthes: Mm-hmm.

Jacobs: The board of trustees already had approved that and I asked you to reconsider it. Jarvis and I talked it over, and I said, "I don't think you've explored these options fully." We'll come back to that in a minute. But internally at NSF, I went to people I knew in the Office of the Director and presented them with all the correct information, presented the full picture, and asked them to evaluate the situation and make a presentation to the Director of the Foundation. They did. They made a recommendation, which was basically to allow the UCAR-NCAR process, as it has in many years past, to proceed. They would do the procurement, they would have a competitive process, but it would be completely run by them, not by the National Science Foundation. It would not be a supercomputer center open to all disciplines, and AGS would pay for it and AGS might get some of the time on it.

0:11:54.7

We got that accomplished, and that was a big breakthrough. It was an important meeting. Actually, I was never invited to the meeting, but the stage was set for that, and it was a setback for the folks who advocated the other paradigm. But we captured that opportunity to move forward with that project, and at the same time, Wyoming captured the opportunity of not making a decision to put it in Boulder and doubled their offer, if I remember, and did some other things that made it extremely attractive for a partnership between the state of Wyoming, the University of Wyoming, UCAR and NCAR, and the university community. Others actually completed the project after I had stepped aside from NCAR. But I felt my most important contribution there was to make sure this wasn't derailed before it ever got started.

Anthes: What were your concerns about restricting the competition to Boulder, where the rest of NCAR was?

Jacobs: The site wasn't ideal. The power wasn't ideal. The contributions were not as good as I thought you could get. I was guessing that I think it was, as I felt at the time, correctly or not, that you were suffering a little bit too much from Boulderitis, that you had to be a little bit more open about that.

And we also had this pressure of competition that we wanted to be able to satisfy within NSF. And the idea that you had opened it to a much more competitive environment, that you engaged a state in that, was a very positive thing. They were major contributors. I think they were great partners. They remain to be great partners, and I believe this is going to be one of many transformational investments that NSF has made in working with the university community to transform not only the way the science is done, what NCAR can do, what UCAR can manage, but also the way these EPSCoR states are going to be engaged in the high-performance computing and the intellectual capacity that goes with that. I think we've seen those transformations now. It's an obligation for NSF to consider those other states, and this was a great opportunity that I didn't want to let pass.

Anthes: That's very interesting. That was certainly a very important period in the whole decision to move off the Mesa and find some place. It really did change the paradigm of how we did computing at NCAR.

Jacobs: Right.

Anthes: Fortunately, from my point of view, the paradigm of discipline-specific computing won the day, at least for now.

0:14:49.4
Jacobs: I needed to push you, but I didn't want to give up that principle that you just articulated. We had been too successful in this, and we've seen other examples where I don't think the disciplines have benefited as much or even in the centers we have invested in, there has been a tendency to move toward maybe not one disciplines, but several disciplines that the communities have benefited from. And certainly having a timeline of three to four years for a center and then you move on I don't think maximizes in my opinion the real focus of what these centers are about, which is getting science done for a community.

Anthes: What are yours and Beverly's plans for the future?

Jacobs: The first thing is, we're being very proactive about making sure our health is good. We're doing lots of things to do that. We think that's number one. Do whatever you can to make sure you stay healthy and well, because the warranty is kind of up on all our bodies. [laughter] We're hoping to do that. Beverly's still working for the NSF, and the folks who have ever submitted a proposal through FastLane have in small part to thank her, because she worries and deals with the maintenance of the FastLane activity in there, and that's a whole part of NSF that I don't think people really appreciate how hard they work for many of the systems that have to be up like a banking system, 24/7, never fail, lots of backup. It's all behind

the scenes. The university community just sees that interface of NSF, but it better be there. The more complex the proposals get, the more difficult it is to submit electronically because of all the different formats and finding little things that people want to change in FastLane, so she's still busy. But I think she might retire within this year. At that point we will certainly do more traveling, have more time to do our pastime fun activities. We have a grandson in the area, so we'll spend perhaps more time with him. Those are the things we have planned, nothing spectacular.

0:17:17.1

The other thing is, I'm always still devoted to the community and I'm always willing to help them in the times that I am not having fun.

Anthes: You said maintaining your health is a key part of your strategy. You're a runner, I believe. How far do you run a week?

Jacobs: I run three times a week. I manage, I don't know how at 70 years old I'm still able to do that. There's a couple things. I run three times a week and I get 28 miles a week, so I'm usually doing nine to 10 miles.

Anthes: And your knees are holding up?

Jacobs: My knees are holding up. Part of the thing that I tried a couple years ago was, I was doing the Big Sur marathon. I went prior to the marathon, which is a wonderful marathon, if you do one marathon in your life, the Big Sur is the one. It's the most spectacular course, right along highway 1, south of Monterey.

Anthes: Across the bridges.

Jacobs: Yeah, it's just beautiful. But when I went to that marathon, Jeff Galloway gave a talk before the marathon. He developed this method that he's had for a number of years called the run-walk method. Even though I never trained that way, I did it that marathon without any training, I just said, "I'm going to do this." I would run several minutes and walk for a minute. I think at that particular time I ran three minutes, walked one minute, or something like that. It might have been four and one. It made a huge difference in my ability to get through the 26 miles. He always points out that at the beginning you see all these people getting ahead of you, but at miles 20, they're walking because they don't have a choice, [laughter] and you're passing them!

So I've maintained that walk-run strategy and I'm able to keep my knees and do that 25 to 30 miles a week. The other thing Beverly and I do. We have a personal trainer. We work on strength training, so we're busy five, six, seven days a week trying to maintain that. And I think there's enough

evidence to suggest that your body will go into decline, but if you keep pushing it, it responds in a positive way to try to ward off whatever is going to come down the pike. [laughs]

Anthes: That's certainly a good strategy, a good attitude. Are there any questions you wish I'd ask but didn't?

Jacobs: I think I've given you a lot of insight into how I provided oversight to NCAR. There's a couple things that I could say that are interesting. Perhaps I could have added an interesting sidelight to one of my accomplishments at NSF.

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One of the things I promoted when I was at NSF was the concept of a federally funded research and development center, which few people actually appreciated. NSF had five at the time, I think they're down to four now, and what was the meaning of a federally funded research and development center? It was a strategic partner with the agency funding it, and there are certainly of the order of 35 or 40 of these within the entire government. I tried to emphasize that fact and how important NCAR was as a strategic partner to the NSF.

I must say that there are some in the NSF that couldn't accept that idea, that an awardee was a strategic partner with the agency. But I maintained that they were a strategic partner, they represented the community and what we wanted to accomplish. UCAR was the manager and was well connected to the community we cared about, and NCAR provided the kinds of facilities and the intellectual capacity for the communities, exactly what an FFRDC should do. And I did promote that. I even developed some talks on the history of federally funded research and development centers. I think that's an important plus. Astronomy has a few, but none of the FFRCDs that NSF sponsors really had the mix of science and facilities the way NCAR does. The astronomy is mostly facilities, and even some of the bigger facilities stepped aside from the FFRDC because they didn't think it was a plus. I always felt it was a plus. That was one thing that I didn't mention before.

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Another thing we had chatted a little bit about is, one of the things I noticed at NSF is that there is a lot of good training for program officers who come in here, and even for some management in terms of, how do you do the grants? How do you make those decisions? What are the proper conflict of interest rules? Etc., etc. But one of the things I don't think that is well—and maybe it's too hard to do. How do you provide proper oversight to complex activities within the NSF? There is a tendency to try to over manage them or ignore them, and it's got to be something in

between those two. I don't see that there is a particular way of doing that necessarily. It might be more personal style, but NSF is now developing more and more of these activities. I always felt that that was something that we should be able to help train our program officers and the people who provide those oversight facilities. I think it's gradually getting to the point where that knowledge is starting to go through the agency. But it's a new form of knowledge that people haven't had at NSF, because how many places were funded for 50-plus years where you could develop that experience base, except places like NCAR and some of the astronomy centers, but they're managed differently than we manage it.

Anthes: You have studied, I've seen your presentations, FFRDCs, you know the philosophy behind them, the history. They're some very good presentations that I've used myself. Do you think the NSF over 50 years has effectively used NCAR as an FFRDC? Has it just happened that NCAR serves some of the functions of an FFRDC?

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Jacobs: I think it's more the latter, that they've served some of the functions of an FFRDC without them realizing that they were serving this larger picture. Over the years, there were several times where people tried to declassify all FFRDCs because there were some obligations administratively that came with that FFRDC. I fought those very hard, trying to make that point. But accepting that an awardee could be a strategic partner and could be an integral part at a high intellectual level and to advance the community was something that never really took within NSF. It's a grants organization. NCAR is a very unusual part of a grants organization. And when you look at the money spent, 95% is spent on doing exactly what we do well. We support individual researchers. But there's a growing tendency to realize that there's this service aspect and an intellectual capacity aspect, an intellectual commons, if you'll have it, that does benefit the other parts of NSF. I think that's becoming more appreciated now. We're even starting things like EarthCube, which I was a little involved with before I left, which is again trying to get at that same idea, to provide services for all the geosciences community, intellectual capacity.

It's something that I wish was more appreciated, but it wasn't the right organization necessarily to do that. DOD understood it. Even the IRS has an FFRDC. I gave a talk a year or so ago at the AMS. Part of my research looked at how many FFRDCs were involved in atmospheric sciences directly or indirectly. Surprisingly, at least half of them had some stuff to do with atmospheric or related sciences. So when you think about some of these, Argonne, they had something to do with it, Pacific Northwest Labs, these are all people who are part of FFRDCs. And the fact that they have

such stable funding and they're part of the strategic mission for these has immense positive impacts on atmospheric scientists.

I've chatted with you before about, if you think about the size of the AGS budget, and you use as a metric the corresponding size of the university community in atmospheric sciences, you would think that the AGS budget would be fairly small, because atmospheric sciences, when you look at all of the universities across the U.S., is a relatively small discipline. There's not a lot of people involved in it, and they certainly don't produce a lot of Ph.D.'s.. But the size of AGS's budget is one of the largest in all of NSF. I've always attributed that because we started NCAR and we sustained NCAR and it really has advanced the entire discipline because of the things we've done with NCAR. It's increased the budget for the entire division in a very substantial way.

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Some would argue, I think without thinking it through too much, that if we just did away with NCAR, we would have all that money to spend on the grants program. That's absolutely not true. If you did away with NCAR, that money would disappear. It would never wind up back in atmospheric sciences, necessarily, because NSF does an awful lot of good things. To make a decision that it should all stay within atmospheric sciences if you do away with NCAR would be a huge mistake.

Anthes: That's an excellent point that you've made many times in the past, and it's important to have that point of view coming from somebody as close to NSF. As we get toward the end here, how many days, what fraction of days in your career did you look forward to going to work?

Jacobs: Every day. One of the interesting parts of the job of providing oversight was, it was something different every day. I really respect my fellow program officers. Some of them have been here for 30 years, getting in grants, going through the review process, making the awards. And it's different material that comes in in those grants and there's new things that happen. With NCAR and UCAR, it was a whole variety of things that happened. It was administrative. It was science. It was sometimes internal politics that we dealt with. Every day would be different, and I enjoyed that part. The variety was never-ending. Sometimes it was conflicts you were having with other agencies, because NCAR and UCAR do get substantial funds from other agencies, which comes with a lot of problems. Sometimes they were dealing with NCAR in which I tried to make them more effective, because I know, for example, with the supercomputers, when they got through this long process that might take 18 or 24 months, when they finally get to the point of submitting a contract to NSF, they would say, "Can't you just approve it in two days?" And of course we have a much more complex process than that.

What I would do is work with all the people internally at NSF, tell them, "Something is coming. I'll give you a little heads-up. I'll try to get some advice from the people who have to approve it and get that advice back to NCAR. Here are the issues you need to address so we don't go back and forth." Those things really did help. But thing got me involved in much more administrative activities than a program officer would do. I'd have to deal with these issues. When we did the competition, that was a major thing. I enjoyed that part. It was different.

I always felt the oversight of NCAR was a 24/7 job. I never—even on the weekends I could always—I was thinking about it and getting ready to do the next thing, because there were so many things in the wings that had to be dealt with. As you pointed out, it's a pretty complex organization. There are actually more people in the UCAR organization than in NSF. There's about 1,450 people in the UCAR organization and NSF has maybe 1,350. So there's complexities that go with that large staff and a lot of things that UCAR and NCAR do.

Anthes: Did you ever regret taking the path of science management and science leadership compared to actually doing the science yourself or with students?

Jacobs: Not at all. I felt this was the role I was best suited for. I did the science. I liked being on the other side. I found that whatever I did in NCAR or UCAR, it was working. It came more naturally to me. It was far more interesting, and I think part of the reason for that is because it had so much human interaction that was important to me, and I had a sense of how to understand reactions and dialogue with people. I always felt that was important. As you know, I would show up at NCAR often and walk the halls. I always said jokingly, "If I really wanted to find out what was up at NCAR," and I did. "I would walk the halls. Then I'd listen to management." [laughter] But you took that same approach when you were president of UCAR. You would have lunch, breakfast, you talked to a lot of people and got real insight into how they were thinking and how they pursued things. That was very important to me.

Anthes: As you know, a few years ago I wrote an essay on the value of scientific program managers. I picked NSF because I knew NSF the best. I picked you and Jay Fein and Jarvis Moyers as exemplary. I think the public and much of the community doesn't appreciate this aspect of science. It's behind the scenes. You rarely get awards and recognition, and I want to take this opportunity to thank you personally on behalf of certain UCAR and NCAR, but much broader than that, the whole community which you have worked so hard and successful to serve all these years. Thank you very much, Cliff.

Jacobs: Thank you. I'm glad I have done it and I don't regret doing it. It came so naturally to me because of the great intellects out there, the great people who are devoted to advancing atmospheric science. If I could help them somehow, I was really happy to do that. And that's what I tried to do. I tried to help everybody do the best they could. And they truly did wonderful things for atmospheric sciences. We're at an age now where we're really making a lot of progress and we're going to find out even more things. We joke a little bit about how once you actually have made all of this progress, about better weather forecasting, better understanding of the climate, that might have been the easiest problem. What do you do about it once you understand it? To me, that's always been the next big question. What do we do about it once we're convinced that there is a situation, whether it be weather forecasting, severe storms, or climate change? How the hard problem comes. What do you do?

Anthes: On that upbeat and challenging note to your successor and my successors and the next generation, thank you, Cliff, for this interview.

Jacobs: Thank you, Rick. I enjoyed this very much.

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