Stuart Leslie: We seem to be on it. Making sure we are here this morning with Dr. Akira Kasahara. She is a longtime climate modeler at NCAR. We are on tape. It's September 16th, 2005. I am here in Dr. Akira Kasahara's office at NCAR. I am from Johns Hopkins University. Today, we will be talking mostly about architecture interaction whether the laboratory worked out quite as what Roberts and Phil Thompson thought. So, I guess, what I am trying to discover is whether the building work like Pei thought it would work or whether it worked a little differently. I found this quotation in Roberts' papers. It is very short, but I am going to read it to you because I was intrigued. He said, "That modern laboratories look more like Hollywood versions of a corporate palace. They look more like Hollywood than places for science and engineering. They are slick, swank, and precision made." This is the part that I am interested in your reaction to. He said, "Laboratories should look like laboratories. The scientists who will live in them must wage war to make them so. They have to make sure they are like laboratories if the imprint of the scientist is to prevail." So, what the quotation was basically that scientists have to make the laboratory their own if they want it to work well. That the architect cannot decide how things should work but the scientist must.

Akira Kasahara: Most of those are interesting because I hadn't seen the quotation. I heard about the speech quotation, but not the full text. Certainly, it agrees with my vision of what robots think. So, I'm not surprised, but certainly, he is correct that scientists themselves have a great deal of autonomies and thinking and doing research.

SL: Sure.

AK: Now, I wonder, sometimes when I see the movies how the movie people makes the movie. Because if the director direct every movement, to me, it's almost impossible. So, clearly, the director must leave a great deal of gratitude for the people who work for.

SL: Sure.

AK: And that otherwise, I don't see how the wrong person can see the entire details.

SL: Would you say that is true like in science?

AK: But in science, I think, in some sense, are the organization. Obviously, if the director has to do every detail, it's just impossible. So, I think the organization should be in such that the people themselves has a great deal of gratitude to work on. Yet in exactly the way the director acts, I think that's an idea of [inaudible].

SL: I think Roberts like to talk about invisible administrations.

AK: That's right. I think in that aspect both Roberts and Phil Thompson totally agrees. In fact, when Warren Washington and myself started working on the general circulation modeling here at NCAR around 1963, Warren Washington was just a graduate from Penn State. So, he's a fresh PhD, but he had a great interest. It's amazing to me that he had interest in working on the general circulation model. But anyway, one day, he came to see me that he wants to work on the numerical modeling of the atmosphere. So, when he mentioned about that, obviously, I was

quite excited. I already spent nearly 10 years of research experience. So, I was somewhat kind of in charge of reading people. So, Warren Washington happened to be just a fresh PhD. So, I need a young person to work with me and what I felt is great. So, we talked about what to do and so on. But obviously, we should mention to Phil Thompson to get approval of doing things because the work involves a great deal of resources and manpower. So, obviously, it has to be approved by the organization.

SL: Sure.

AK: So, Phil Thompson and Warren Washington and myself had lunch together and talk about that. We talked about how we like to proceed setting up group to work on the modeling of atmosphere.

SL: About what date was that? Do you remember what year that might have been?

AK: I think that's 1963 or [19]64.

SL: Before you were even in this building?

AK: Yes. Well, we are not here. We are in university, in a dormitory.

SL: In a dormitory?

AK: That's where we started. Although, very early, NCAR 1960 and [19]61 and even to 1962, I believe. The NCAR started at University of Colorado, Armory.

SL: At the Armory?

AK: Armory Building.

SL: Yes.

AK: But then Robert and his group started growing. In fact, I came to Florida and got interviewed in the Armory Building.

SL: I see.

AK: So, it's really in 1962.

SL: And where were you coming from?

AK: I was coming from University of Chicago. I was a research associate working under Professor (Blattsman?). I was there about six years or so. So, I started thinking maybe I better go someplace. Turns out, I received the offer from Philip Thompson.

SL: Did you know him before? Had you known Thompson or knew of his work?

AK: I know his work. But [19]63 or [19]62, I think, or actually [19]61 is the first time I met Phil Thompson here in Boulder. But it's not in this building, no. It's in the University of Colorado, Armory. But then the staff was increasing. So, when I joined in 1963, the reason I came to 1962, no, [19]61, is to talk the employment things and I was very much interested in coming to NCAR. But the time when I came, this is in Armory, is just about ten or fifteen people.

SL: Ten or fifteen in your group?

AK: No, in NCAR. By the way, I came from Japan and I was thinking about going back to Japan.

SL: You had done your PhD in Japan?

AK: PhD in Japan. So, I came to this country to do the post-PhD research work. So, I was thinking at that time to eventually go back to Japan. I was interested in the vision of NCAR. So, I thought that that would be a good idea to come to NCAR to work. But when I came, it turns out we're only fifteen people.

SL: [laughter] Was that disappointing?

AK: If I spent a year or so or two, it's just a practical environment, facilities, and so on. But it turns out, also, I received an offer from New York University, Courant Institute of Mathematical Sciences.

SL: At NYU?

AK: NYU in downtown New York. So, I mentioned to Thompson that I had come to NCAR but let me first go to Courant Institute. In fact, that was a good experience because I wanted to learn more about the numerical computation. So, Phil Thompson said, "Well, it's fine. So, you can come back after you finish your stay there." So, I stayed on a year and a half.

SL: In New York?

AK: New York. Then I joined 1960s here. So, let's say, at the time I joined, it's already a hundred people.

SL: Now, how many were in…

AK: Well, a hundred maybe. I did it in exaggeration. Perhaps somewhere around fifty. So, the office is in the [inaudible] Hall.

SL: How do you spell that? Begin with a C?

AK: C, I think so.

SL: It was a university building?

AK: That's right. Then we moved to the university research building. Then we moved to downtown Boulder. So, we moved several times before coming to this building, 1968.

SL: Well, it was finished in 1966, but I do not know when you moved in.

AK: I think it's either [19]67 or something.

SL: When you moved in, you were the first people in whatever office you were in?

AK: It must have been somewhere around 1967. So, somehow, I remembered [19]68, but it could be [19]67.

SL: What was the name of your group? And how large was it?

AK: It's called the dynamical aspects of atmospheric circulation, about ten people.

SL: And what were their different backgrounds in terms of discipline or training?

AK: Well, it's supposed to be atmospheric dynamics. Whereas the other sections, it's called the program interface dealing with smaller scale atmospheric phenomenon. So, the program I was asked to manage is large scale.

SL: Large scale.

AK: So, that's why it's general circulation in the atmosphere and we feel that NCAR should have at least one such numerical model. So, back to the lunch conversation with Phil Thompson?

SL: Yes.

AK: Well, after we finished talking, we said that he's all right to work on. The only thing he did that is he just closed eyebrows a couple of times and he never said anything.

SL: He just raised his eyebrows and did not say a word.

AK: And then we finished lunch and that's the agreement. [laughter] Well, I wanted to tell how Phil Thompson's…

SL: His style?

AK: He rarely talked. He's not (rutilant?).

SL: He is not?

AK: (Rutilant?). He don't speak. But when he speaks, he is remarkable. For example, as though he's reading some case, this whole sentence, throws a complete sentence.

SL: Without any notes. He did that without any notes.

AK: I participate in the interview with Thompson and with other scientists and I was really amazed how complete he speaks. Even during lunch, he doesn't talk pretty much. Mostly, we are the one that's talking.

SL: You did the talking and he did not even say yes, but you knew that he meant, "Do you want to go ahead?"

AK: Right. I think one of Thompson's sayings is that he had a very nice human relation. In fact, he often gave a party for the scientists at his home.

SL: His home.

AK: At his home. When visitors come, I was invited to join. So, I think he enjoyed it as well. I think that's his style of doing what he wants to accomplish. Now, he was not using the party as any political. I think it is purely social.

SL: Sure.

AK: But I am sure that he has a tremendous influence on people's research. Because obviously, during that conversation, he speaks after drinking and people listened. So, I think that is his kind of style of management.

SL: Yes. Now, when the group finally got up to this building, to the Mesa lab, where were you assigned? Where was your space?

AK: What is the office?

SL: Yes.

AK: Perhaps the north tower, I mean, the south tower where the chemist…

SL: What Pei called the south tower was the one that was never built.

AK: Then middle tower.

SL: The east tower or the…

AK: East tower.

SL: East tower.

AK: But at the time, we moved to north tower, too. So, I don't quite remember how…

SL: I was interested in where they located, your group, and whether they thought about the relationship of your group to other kinds of groups or whether you were fairly independent, whether they expected you to simply work on your own.

AK: Obviously, because it's such a bigger tower. So, as you see it, it's extremely convenient to interact in the same floor. But when the floor changes, then obviously, groups are separated by floor. Any building without a floor is impossible to talk. Having your floor is not bad things, but you can think of making a very flat building with only a few floors or, say, having a tower. So, there's a choice. So, a choice must be made to make each group more coherent and work together. After all, it's not possible to work fifty people together. It's not easy.

SL: How big was your group when you got here?

AK: There's only about ten.

SL: Ten people?

AK: So, I think just for tower setup, it's just fine.

SL: You could all be on the same floor in the tower?

AK: Yes. So, I don't know. My only understanding is that when I.M. Pei designed this building, he designed the so called conventional. I don't know what conventional means building, but –

SL: Then his first one was a ten-story tower. It was pretty conventional, nice storey.

AK: I see. Well, because one could setup [inaudible] building.

SL: Well, Roberts did not like long corridors.

AK: I see. So, that's…

SL: So, Phil Thompson was the one who said that you needed to have small clusters of people. He did not like the idea of a big tower. He wrote a rather strong message to Pei about how other people interact that way. I'll read you a little bit of it because you may have seen it. But he said that "Intellectual coherence does not depend on formal mechanisms of cohesion. A building that is most symbolic of this feature and designed to nourish it is one that is clearly designed for sustained intellectual, spiritual, and aesthetic life. It is not a temple, but a place where a variety of people can meet privately or semi-privately, can be alone or it can be distracted by a different kind of beauty."

AK: Well, I think that sounds exactly what Thompson has to say.

SL: How much of your time during a particular day would you spend, say, by yourself working

in your office or how much time would you spend with other people in the group working together?

AK: Of course, we had a meeting and so on. But when you work on the development of some – like a moderator, the moderator answers the questions that come up. So, I'm sure that I had a lot of interactions, watching hours. I think the building is very convenient for that as you see it.

SL: So, you could walk out into the areas and that is somebody else's office. Where was Warren Washington's office?

AK: Well, I don't know exactly where his office was located because there are so many people there.

SL: I just meant whether it was close or far.

AK: On the same floor, but not obviously here. It's in New York.

SL: But similar to office size like this one?

AK: Yes. There's a senior unit, too. There's four of them and over there four. But then there is a laboratory, so the middle tower, the south side, mostly. So, chemists go over there and see if they are there.

SL: So, in east tower, that is where the chemists would be?

AK: Yes, that's right.

SL: But people like yourself would work more on paper over the computer?

AK: The north part of the east tower. That's more or less the office side.

SL: And were there particular groups either above you or below you that you had much interaction with?

AK: Well, actually, I remember that when our group was located in the north side of east tower, we are in the first floor. In those days, post offices are above us. There is a crow's nest.

SL: So, you were right below the crow's nest?

AK: That's right. So, in fact, we have very good connections. It's crow's nest, too.

SL: Did you ever use them yourself?

AK: I didn't say. But obviously, it's not only entrance. These are from the fifth floor you can get in. But there is like [inaudible].

SL: A little cylinder, a circular stairway –

AK: You can even call and return .

SL: Yell at the stairway?

AK: Yes.

SL: Who use the crow's nest offices above you? I do not mean the people, but were they postdocs or they were…

AK: Well, I don't know whether you heard about ideas of crow's nest.

SL: I would like to hear. You tell it.

AK: In fact, when it's first viewed, there's no telephones.

SL: No telephones in crow's nest.

AK: No telephones. The idea is that the postdoc scientist need time to deliberate.

SL: To just think.

AK: So that they should not be disrupted. So, that's why the telephone wasn't traditionally –

SL: That is funny. No telephones. That is very funny.

AK: So, deliberately designed as an isolated place.

SL: Do they imagine one person would be up there at a time?

AK: Actually, there are two persons. Whether you have seen it or not, I think you should see, if not. It has two offices. Then at the center, there is veranda. So, veranda is sitting out.

SL: So, there is a veranda over it?

AK: Yes. So, I think this is a veranda.

SL: A little hood or something over the top.

AK: I don't know what to call it, but you can go out.

SL: You can walk outside.

AK: You walk outside.

SL: So, it is like a little patio or something.

AK: Well, it's just small.

SL: Very small. So, we are looking at the bottom of one?

AK: Yes.

SL: That is the bottom of the patio.

AK: So, you can see the area.

SL: It is small, very small.

AK: Don't you think it's a little bit peculiar? And, of course, I think that sort of adds complexity to this building.

SL: Not just vertical, but projections.

AK: So, there's a door open outside and you can literally go up.

SL: So, you could not only see the view, but you could actually go walk out?

AK: Yes. In fact, if you watch Woody Allen's movie Sleeper, he escaped from exactly this door and then he came down with the rope.

SL: So, he came off at one of the crow's nest balconies?

AK: Yes, right here.

SL: This actual one. So, the office that we are actually in.

AK: And then with a rope, he came down.

SL: But I heard he had a stunt double who did a lot of it.

AK: I don't know whether it's the real him or not.

SL: It might have been a mannequin you think? That is funny.

AK: No, no, no. Whether he himself…

SL: He himself did not. He was afraid of heights.

AK: I'm sure.

SL: He had a stunt. So, you would sometimes call up to people in the crow's nest and walk up and see them?

AK: That's right.

SL: Were the other scientists that you said they were postdocs?

AK: Scientist.

SL: But they were visitors?

AK: Very often, they're visitors. But mostly, the postdoc scientist because the idea is that they should be left undisturbed.

SL: Now, that is very interesting.

AK: So, it's really hard to reach that. In fact, I don't know whether you still hear story or not. But I was told that this door is normally locked. The reason that if scientists become distressed, they might – [laughter]

SL: Jump off the balcony. We are back online. Another thing that Phil Thompson and Walt Roberts was very interested in, in terms of where people would meet was the lunchroom or the cafeteria? Did you often eat in the cafeteria?

AK: Well, of course, I do eat every day at the cafeteria. Before we move in this building, as I mentioned, we have been to different –

SL: Yes, you have been to different places, right.

AK: We always try to go for lunch together.

SL: To a restaurant or something?

AK: Obviously, there was no cafeteria in those places and people come in. So, I think when this community was built, the cafeteria is a must. Well, I don't know the NOAA building cafeteria, but they don't have any cafeteria to speak of.

SL: Really?

AK: And maybe, they sell sandwiches and it's a little place to eat, but these are full-fledged cafeteria.

SL: Full-fledged cafeteria.

AK: And I think from the very truth, I don't know about how that idea of cafeteria was talked about.

SL: What Robert said was he wanted a cafeteria where people could meet with just two people or three or if they wanted to have six. But he wanted places where people would feel a little bit separated so they could discuss their scientific work. I was interested whether once you got to this building, the cafeteria was a place where people would have conversations about their research. Whether you would eat with other members of your group and sort of continue what you have done, or whether a cafeteria was a place you might see people from other parts of NCAR.

AK: That's exactly the cafeteria has been used even today. We don't have any kind of coffee room as such. When I was at Courant Institute, I think the very top floor, from 3:00 p.m. to 3:30 p.m., the institute would bring some helpers to serve coffee and cake. People are encouraged to join to have a break to meet people, but they didn't have any cafeteria. Sometimes they go lunch together with few people. But meeting some strangers, well, I shouldn't say strangers.

SL: People you would not know.

AK: Coffee is a nice location. So, each organization may have some kind of mechanism and income, of course, of the cafeteria. Other than the coffee after the seminar or something, they serve, for example, after seminar, you have the hall there, and then coffee, but that's not a regular one.

SL: Day to day, the place you meet would be…

AK: The cafeteria. I think it has been used for that purpose. I think I feel very important to do so. So, even today, I mean, every day, I ordered and I encourage people to eat at the cafeteria. I brought sandwiches, but nevertheless, I eat at the cafeteria.

SL: Did you yell up to your postdocs that they should eat at the cafeteria?

AK: Not anymore.

SL: But you would invite the postdocs to come?

AK: Yes. We tried to organize it.

SL: You tried to organize?

AK: Obviously, I don't ask people to do so. I'm retired so I don't worry. But I go about the place. I go up there. It doesn't matter whether no one is there or people join and I enjoy conversations.

SL: As you remember it, did people from different groups meet at different tables or did the same group of people meet at same tables?

AK: Mostly same tables.

SL: So, usually, it would be your own group that would be down there?

AK: Yes.

SL: Did Walt Roberts or Phil Thompson come out into the cafeteria to join people for lunch?

AK: Occasionally. In those days, they're both extremely busy. So, yes, they did from time to time, but not very often.

SL: Each day you would not see Walt Roberts in a different table or anything like that?

AK: Yes.

SL: Now, which groups were you working with most closely outside of your own? I presume that you had to get to know the computer people really well.

AK: That's right. In fact, that's probably the most closely connected group. Because in those days, around 1960, during the [19]60s, we have been using computers probably more than half of the time.

SL: Your group was using the computer?

AK: Yes, half the time. So, in those days, through submission of jobs and so on, it's not as simple things. The fact is, punch the card and the card has to be punched and the card is put in a tray. So, this is a huge tray. So, you have to submit that to run.

SL: So, they will do a batch of your card one time to run your model.

AK: Right.

SL: And who actually had to do all the punching of the card?

AK: There is an assistant to punch the card in the computing division.

SL: But you did not have somebody in your own group that is responsible?

AK: No, we can submit the job and it depends.

SL: How long would it take? Say, if you wanted to run a particular model, how big a process was that in those days?

AK: Well, first, we have to write down on the paper these instructions by hand.

SL: In code, in the computer language?

AK: Pretty much, in the very early days, it's computer language. But when IBM Fortran came out, we have to write in the Fortran. In fact, that's great to reduce some of the burdens of writing a program for input and output.

SL: So, Fortran made it much easier?

AK: Yes. It made a tremendous difference. That came out around 1950s or [19]60s.

SL: How long would one of these be typically in those days?

AK: So, there's a coding sheet, it's called, and then bring to the key punches. Then we get to tech. Then of course, we have to do this thing. We have the printers to do this.

SL: So, you would take this down to the punch card operators who would put the holes in the cards? Would that take them a day, week?

AK: It usually takes a day. So, you have to leave it overnight. So, next day, we'd get that. Now, for changing corrections, sometimes we are able to do it by ourselves. In fact, we did that. So, some impatient scientists very often even punch cards.

SL: Oh, do it themselves.

AK: But in a very, very early days, there's a punch card machine. Have you seen that?

SL: I have seen the punch card, yes.

AK: And then of course, it became more like a typewriter kind of things and then the card will go through it and punched.

SL: If you were one of the impatient scientists, as you said, and you wanted to do your own punch cards, did you have to go down in the computers?

AK: Yes.

SL: And they let you…

AK: We had, I don't know how many, those typing, punching machines.

SL: Most of the punch card operators were women, almost all?

AK: Yes, most of them. Well, sometimes if you have a huge amount, obviously, you have to ask how to get in. But you have a few cards, even ten cards, mostly people do that by themselves.

SL: Now, how many cards would it take to run one of the models you were working on?

AK: I'd say several hundred.

SL: Several hundred cards?

AK: Although once it's punched, then of course, we only change some of them.

SL: Did you have to check each card one at a time?

AK: Yes, but the sequence is important. So, we have to recap the printout. I still have it.

SL: So, you would check the printout again at the card?

AK: This is [19]74.

SL: 1974?

AK: Yes. So, [inaudible] used punch card kind.

SL: This is a document from a program from 1974 that would use punch cards. You have to check each of these lines.

AK: That's right.

SL: And this runs to how many lines?

AK: There are many programs and then subroutines, but some subroutines doesn't change. Then you don't need to even print.

SL: That must have taken a lot of time to check back to make sure that the sequence in the cards were right.

AK: One time we dropped the card.

SL: You dropped the tray of cards? How long did it take to put them back in order?

AK: Well, fortunately it wasn't too bad. It takes about six or eight inches with the cards.

SL: Half day? That was annoying. Did you work closely with programmers down there and put it to gather this?

AK: For input and output, we had programmers, but the so-called main program which do the arithmetic that has to be done.

SL: So, you did that yourself?

AK: Once programs is already formulated, you could ask programmers to do it. But sometimes, it's much quicker when people do it by themselves.

SL: Sure.

AK: I have done that a lot of times. In fact, I see a program and of course, there's no key punches.

SL: On the IBMs, do you remember what kind of IBM that was?

AK: Well, the NCAR started as a CDC, Control Data Corporation. In very early days, around late [19]60s, in fact, before coming to this building, we didn't have them on computers. So, our own computer was the first time after this building was –

SL: Did you use the university's computer?

AK: So, before then, we used the university computer.

SL: So, when you get to this building, at least you had your own computers?

AK: That's right. So, in those days, I think it's the university IBM computers. Then when NCAR started, I don't have a history of what kind of computer.

SL: They have a family tree of those computers.

AK: In fact, in the (SCD?) office. We can get that…

SL: Well, I will see Roy Jenne this afternoon.

AK: Ask him. Well, that's good. The graph is kind of a chart, what kind of computer NCAR used and then I think the speed of computation and so on. It's a really helpful information. Ask him about it.

SL: I will ask about that. That is interesting. What was it like when the first, I guess, it was a Cray supercomputer that must have arrived here sometime in late mid [19]77 or something?

AK: That's right. In fact, these are the old Cray computers. Control Data Corporations is what we have been using up to [19]70. I think Cray1 was first introduced somewhere around late [19]60s.

SL: We can keep that, but I am just wondering how that changed what you were doing.

AK: That increased the speed. It represents three-dimensional field. We have to use so called grid.

SL: A grid, right.

AK: So, when you have values at each screen, when you have equal value lines, contours, the

reality becomes – obviously, it's better if you use a finer mesh.

SL: The finer the mesh, the better your model will be.

AK: So, when the computer capability increases, then always the memories also increase. So, we can put more data and that means we can use much finer mesh.

SL: Sure.

AK: And in fact, even today, even the fastest computer series is not big enough in terms of memories. It's not fast enough to do the calculations.

SL: So, the models have always been ahead of the computational capacity. You could always imagine a model that was harder for the computer to do.

AK: Because after all, when you try to do the flow simulation, the flow is continuous. So, the higher the resolution, the better the visualization. Speaking of visualizations, you probably have seen lots of computer graphics.

SL: Yes.

AK: NCAR, it's not a first, but validly highest organization who has used computer developer, computer graphics, and you should ask about that to Roy Jenne.

SL: I will certainly do that. In the early plans, I know Pei thought that the computer should be kind of at the center of the building rather than in the basement, et cetera. I do not think he thought about it much.

AK: One thing I heard about is that this building has just about a hundred people.

SL: This is the one just off of the lobby?

AK: Lobby, yes. If you think about the organization, this NCAR size, that's the only auditorium is kind of funny.

SL: It is very small.

AK: Very small. The reason I had was that Walt Roberts and Phil Thompson probably too were thinking about if you had a nice auditorium and have this parking lot.

SL: Yes, they were planning an auditorium and a parking lot, yes.

AK: Then they think that the one in fact is called computing center and then they have an auditorium and computing center relative together. But the idea is that computer could be small enough, they can put it in the closet.

SL: In a closet? [laughter] I guess, they guessed wrong on that.

AK: That's right. That's exactly so. So, if we had a large serial auditorium, then you may not justify itself. My understanding is it intentionally made it small to begin with and to hope to build a large one.

SL: Now, they did build an addition for the computers, but underground.

AK: I understand it's now too small. So, the next generation computers cost to the house in some places.

SL: Did it matter from your point of view where the computers were?

AK: Not anymore.

SL: Not anymore?

AK: But I think in early days, that's not true because all the supporting people gather around the computer.

SL: You could not have worked with the university computer in the early days very easily?

AK: No, we have to wait the output to come back. You may see how this works. So, that's all right.

SL: You waited for the output to come back through the mail?

AK: Yes, in those days.

SL: It must have been a little frustrating.

AK: But that's not changed until – let's see, when was that? These first lines send information. Well, now, internet is so fast, usually in the same building, you could send everywhere in the world.

SL: So, nowadays, it really does not matter where the computers are?

AK: Yes, I guess so. Because in those days, as I said, like a chip punching has to be done and also for the majority [inaudible] purpose, the early days of your [inaudible] is essentially, you have a cathode ray tube.

SL: A cathode ray tube, yes.

AK: Which is data showing out or the [inaudible] places outside. So, in those days, they arrived at patterns and projected on this image. Then you used your certified [inaudible] 16 millimeters and takes the picture.

SL: An actual photograph of the units.

AK: Of the subtype units, and then the frames keeps changing. Because that's the only way to find out whether your model is working correctly or not.

SL: It is actually photographed like a film.

AK: And they're predicted on the cathode ray and then take a picture with the movie camera. Then we go through projectors. In fact, I think you can find this still in the library. So, the microfilm readers are used for producing those movie films and you can check the evolution of flows.

SL: So, you could see whether your model was working properly only after you had looked through that film?

AK: Nowadays, when Warren Washington was watching, the first thing in the morning is to look at all the output from the previous nights. Also, because they saw it on and so, all the models run during night because no other groups use this computer during the night.

SL: You were the only group using the computer?

AK: That's why I say we used it half the time.

SL: And your half was at night?

AK: That's right. So, those are produced in that form of a movie. So, we use the film readers and go to [inaudible]. Your problem is that in numerical modalities, you could write the program which is very straightforward fashion once model is formulated. But that's only about three percent. The rest of time, ninety percent time, is you have to check.

SL: I think the hard work was actually after the model has been constructed.

AK: Moreover, the question is how to locate where the error is. Since there are so many variables, there is a huge number of grid points. Then of each grid point, we have at least ten variables. Like a grid component, you'll be W and then the pressure and density, temperature, and moisture.

SL: And there are numbers represented for each of those at each point om the grid?

AK: At each point. So, when there is an error in one place, it may not show up the other field easily. However, if you run long enough, eventually that error in one place propagates everywhere.

SL: You had to kind of work back from those other errors to solve where it came from?

AK: So, we have to see it. We have to trace where the error started.

SL: How long might that take? How many runs would you have? Did you have to rerun the model each time then?

AK: In the morning, we take a look at the output. Then most of time, we can find some bugs, so called bug errors in coding. We hope that we can find more than one. Obviously, it's more efficient. But when it comes to the very end, it is extremely hard to find the other. So, even one correction, now, we have to submit the job again. Again, the following morning, we'll take a look at everything again and see the difference. So, in fact, we need to call the film readers to compare.

SL: Two film readers that compare them. Now, who would look at these? Just you and Warren Washington, just two people?

AK: Mostly two. Sometimes, we couldn't find the bugs and I remember that Warren Washington like finishing it, but Warren was looking at the output just like me. It is bad. [laughter]

SL: He could not go to sleep.

AK: At least five scientists or maybe more.

SL: Would this be simultaneously or did you work with Washington for a while?

AK: I worked with Washington for more than ten years probably, obviously, a little bit, nine years perhaps. Because we started doing from 1960, almost 1960 right after I joined. Warren Washington joined about same time. So, until [19]72 when I had an invitation to visit University of Stockholm. In fact, the University of Stockholm has a special significance for us because of the so called [inaudible] have done more than meteorology was developed by Carl-Gustaf Rossby.

SL: Oh, Rossby was from the University of Stockholm?

AK: From Stockholm.

SL: I see.

AK: At the time I visited, he already died long before. So, I spent nine months there as a visiting scientist. So, at that time, I pretty much handed out to Warren Washington to continue.

SL: So, he took over?

AK: He was there, yes.

SL: So, that little lunchtime conversation you had with Phil Thompson led to ten years of

collaboration?

AK: That's right. Almost 10 years collaboration. But Warren still, we talk a lot. So, in fact, the other scientist I've worked very closely is David Williamson.

SL: David?

AK: David Williamson.

SL: Williamson.

AK: He's still working on the model. He's the most senior person in this organization working on the climate modeling.

SL: How did that collaboration begin?

AK: David Williamson came latter part of [19]60 from MIT and he was interested in modeling. So, he started developing improvement of the model, but there are many aspects. Now, once you set a program, then obviously, it takes a long time to do the checkout.

SL: So, is a long time, months?

AK: Yes. Well, suddenly, several months to do the checking. So, and then afterward, we have to produce the simulation, which is a long run. So, the work takes, I think, two years or so, two, three years.

SL: Really? So, that is a long-term project?

AK: Yes. So, in that period, we don't have anything to show. So, I was kind of a managing person, the organization obviously expect some kind of result. So, I had to find the scientist to work on the related topic but produces the data much quicker than those numerical simulations. So, mainly, we act on different subjects simultaneously to keep organizations happy. Because numerical modeling takes a long time to receive. At least, it takes three years or four years to until even papers come out.

SL: That is a long timeframe, if you are in the university and you did not produce the paper for about four years.

AK: So, what we did is to have scientist work on some of the components or even somewhat unrelated, not directly related, as long as the topic is in our interest, mainly, dynamical aspects of atmospheric circulations, which covers a very broad topic. Practically, whatever you do, you can justify that. So, there's always some urgent matters to solve such as how to represent the two-dimensional field on the sphere. Now, it's not very simple to present the floor on the sphere because as you see it mapping of a…

SL: Mapping is flat, but you are moving into a sphere.

AK: So, that's why there's a stereographic map or (Mercator?) map. Now, think about that, suppose if you use a spherical grid, which is longitude, latitude. Now, you can take the equal increment, in terms of latitude. But if you take the equal incremental of longitude, then the actual distance becomes from the equator to pole through these changes.

SL: Sure. It would be distorted on a flat.

AK: So, when you set up a grid using a longitude, latitude grid, then in terms of physical distance, the increment is quite different at crater areas and to the pole areas. In fact, in the pole, when you come to very close to pole, there's such a tiny difference, right?

SL: Sure.

AK: So, the question is how to handle this. How can we reduce the number of our grid points around the pole? One sort of naïve idea is to skip points, but if you skip points, then one latitude line is down, there is no point.

SL: They are all the points that will be represented somehow.

AK: It's not always in the same longitude latitude line once you start skipping. So, when David Williamson came, he wanted to develop a quasi-uniform grid. For example, when you cut the honeycomb or the so-called icosahedron. It's called the matching of [inaudible].

SL: Yes, the geodesic dome.

AK: The geodesic dome. Now, actually, that's not exactly equal distance. It's slightly different. Because the [inaudible] on a twenty-one-phase object is only one which has an equal distance. So, by the start from that twenty-one-phase, you can now divide each one and then try to represent the flow problems, then you have almost uniform grid.

SL: So, was the idea of instead of a sphere, you use an icosahedron to represent this?

AK: Well, the icosahedron is supposed to be only twenty-one. So, that's one example, they use the grid, which is when you come near the pole, the number [inaudible] they use. But still, it's a longitude and latitude. The other type which I would talk about is more uniformed, quasi uniformed. That is one type, also. Although it's not divided from the side of icosahedron but you could imagine somehow.

SL: I get the idea.

AK: So, David Williamson was one of the first person to try to use this kind of quasi uniform grid. So, that's fairly well-defined problems. So, he can write papers and reports on the scientific paper.

SL: Now, was Phil Thompson the kind of person who sort of would exert some pressure to what

have you done this year?

AK: He never mentioned what you should work on. He has not mentioned to me anything about what organizations should work on. So, obviously, I want to be successful myself. So, that means I have idea of what organization wants. So, I have to think about what we should do to meet the goals of organization. I think Phil Thompson obviously knows, after, all the scientists, but in fact, what he said to me is he wants to hire a capable scientist and then just let that person to do whatever he wants. Now, obviously, we can't do that kind of things nowadays. But when the organization started, then how do you attract the person to join?

SL: Is that what attracted you?

AK: Well, it is. Because I have to do this, do that unless I wanted to do it. Otherwise, obviously, I have to think about it. But if he says, "Just join the organization, do whatever you want," how could you refuse?

SL: But you didn't get tenure, did you?

AK: Actually, in those days, there was even no such thing as a tenure or anything like that. That started after [19]74 or so. In fact, that was a kind of a critical time for NCAR existing. The reason is that when the NCAR started in [19]60, of course, that's the time right after the Sputnik era, and there was a tremendous emphasis on science in this country. In fact, it is sometimes referred to as a golden age of science. Actually, the atmospheric science like weather forecasting, the Air Force had a great deal of support.

SL: And Phil Thompson had interviewed for it.

AK: In fact, Phil Thompson himself is an officer in the Air Force. So, I think he has some sort of in-charge doing research on atmospheric science. When NCAR started, well, of course, (Water Law?) was conceived and so on. But actually, appointment to Phil Thompson was made when Phil Thompson was at Stockholm. So, the very beginning, the planning, research planning was done in Stockholm as far as scientific matter is concerned.

SL: Really? Was Thompson a visiting faculty member at Stockholm or what was his position?

AK: Yes, because the Air Force was funding Stockholm University. Lots of these organizations, the institute is really supported by…

SL: By the U.S. Airforce?

AK: Yes, the Airforce. Because of that, Phil Thompson was, I don’t know if it's a monitor, but it was kind of liaison officer. So, he was appointed there, and he himself did the research.

SL: In the Stockholm?

AK: Right.

SL: That is interesting.

AK: So, he accepted to be in charge of NCAR research and he started working in Stockholm.

SL: Before he ever got to Boulder?

AK: In fact, the secretary who is working for Thompson came from Stockholm to join NCAR.

SL: Was she Swedish?

AK: No, she wasn't a Swedish. She was, I think, English. I'm not quite sure if US citizen or not. I think she has English background.

SL: That is fascinating. I wanted to ask you before I forget about it. Since you had spent a long time at the lab, what features of it do most appreciate? What are the things about it that you particularly like as a space and a place to work?

AK: Well, I think this NCAR building meets the purpose very well. I certainly enjoyed the working at NCAR in this building.

SL: In what sense do you think the building or the architecture of it, the design of, say, the tower is and the small groups contributed to its scientific mission rather than just being a nice building?

AK: I never thought about it in that time. But if I say that house design building or environment has no influence on my life interest to achieve research. Sadly, it's not.

SL: So, the building did have some influence in it?

AK: The question is how that could be affected.

SL: One way I could imagine is the kind of interactions you have with people outside of your immediate group whether, in fact, having access to very good atmospheric chemists. Is that important, or to physicists or do some people outside of the modeling world.

AK: I think as far as the interaction goes, always there are pros and cons in any building. So, I think, I feel that uniqueness of this building gives inspiring effect of the person doing the things in this building, I think. So, I don't think this building is just a house. I obviously have a tremendous influence on what people do. So, I think that's sort of what you're painting on. You're interested in interaction between the building and…

SL: I think it is Winston Churchill who once said that you build the house and then the house rebuild you.

AK: That's a very good expression.

SL: I am sure I am not quoting him quite right. But being in this space may do a different kind of scientists than you would have been in some other space?

AK: Right. So, in that aspect, obviously, I.M. Pei's design has great success.

SL: I think it is fair to say that Phil Thompson among others had a lot to say about what the space would look like. Because when they saw that first design, they said, "Give us something else," where he wanted something more informal. Would you say that the last culture is informal?

AK: That's right. Yes.

SL: Was it more informal under Walt and Phil Thompson than it is today?

AK: Well, I think it had the same kind of speech has been carried through. I wouldn't say, now, it's more bureaucratic. Clearly, things doesn't work in the same way as in those states in criticizing some of [inaudible] today. It is not quite appropriate because the whole world is getting tighter.

SL: I am more intrigued that you say it continues to have something of the culture.

AK: I think so. Now, I may be giving a little bit of corny impressions perhaps, but I don't think that's an exaggeration, same kind of spirit that still led us.

SL: Do people stay as long as you did? I mean, one of the reasons you might imagine that spirit would stay is that you came here before the building was built. You are still here after all that time.

AK: When I started, I like to continue my research. I have no intention of just sitting, just passing your time. I do contribute to the organization.

SL: Is this basically the same size office you've own?

AK: No. [laughter]

SL: You got a bigger one?

AK: Yes. [laughter]

SL: The kind of office we are in now would have been for last senior scientists or –

AK: I think there may be still their office. It could be the office where the Washington is now and gave the same kind of setup. But some of the larger offices, say, now is divide into two. I don't think that's where Washington's office. Right now, it may be kept in the same.

SL: I noticed that the way you set up the computer in the desk, you are looking at blank walls

and not out the window?

AK: I have no choice because it used to be at the other building.

SL: You have a window in the corner, but it would be hard for you to actually look out?

AK: Well, there was a reason for that. I originally wanted to have a desk here, but then the electric charge is located here. I think that might indicate that even this will room originally sort of was one office, not connected office. I think it might be possible.

SL: So, you do not actually look out the window so often, I suppose?

AK: Used to be. I was in a different room. Also, the window opens, but not all the window opens. I think I had Phil Thompson asked to some of the offices open.

SL: I think that is right. Walt Roberts also said he wanted to be able to open the window and hear birds sing. In fact, he did not want air conditioning and he had to be convinced.

AK: You're right. That's very interesting because this building has been known to be very inefficient, ineffective, as far as the air conditioning goes.

SL: I think that was sort of forced on them. The NSF said you are getting air conditioning, but Walt imagined they would have a lot of open windows.

AK: That makes sense.

SL: As a kind of final question, if you had the chance, since you were almost there at the beginning, to have taught to Pei about the building and what it should have beforehand – in other words, having lived in the building for all these years, would you have told him to do something differently in the design? Was there anything that you would say?

AK: If I meet him, this is a marvelous design. The only thing I wanted to ask him is how he was able to conceive this building. Now, the story, which I was told, is that he was inspired by the Indian [inaudible]. Of course, he expressed that so. But whether he really traveled around to look for that building or the ideas –

SL: I've heard that story many times. If that had been quite exactly as he said it, his first design wouldn't have been a big, tall tower that Phil Thompson hated. Apparently, Phil Thompson went up to the Mesa and sort of tried to figure out how much of the mountain would be blocked out. So, I think that that's probably a little bit of after the fact how I was inspired. In my own theory, I am not sure it is true. But when I see what Thompson had to say, especially, I think he had a large part in deciding that the building would be broken down the way it is. So, it would not be a monolith, but it would be separate buildings where he could like, move along.

AK: But suddenly, when you look to Durango and see those Indian houses, it have some similarities.

SL: I think that is absolutely true.

AK: And of course, I heard about what he did. So, I didn't know he was designing a tall building, but you said you can go this way.

SL: But they thought about doing that. That is what they thought. They called it a (Grecian Village?).

AK: Because obviously, I don't think I.M. Pei will ever think about tall building because that's how it blocks some of the – so, if he designed, then I would think a few [inaudible]. But then Walter or Walt doesn't like that. So, back at the top.

SL: At the top of mind.

AK: For you, it's at the top so [inaudible].

SL: It is. That is right. If you had to put into a few sentences what you most like about the building, what would you say it was? Your favorite aspect of it.

AK: In terms of functioning?

SL: Functioning, yes, as a scientist working in a lab. You could work in a lot of places that would be very different.

AK: I don't know how the chemistry group feels since we don't have a number of [inaudible] to trail on. But as far as this work is concerned, I have not seen any building in other places such as – I can start in NOAA, NIST, university engineering, as well as some of the federal offices, nothing really appears to me it's better than this building.

SL: You are not going to trade?

AK: No. [laughter]

[end of transcript]