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TAPE RECORDED INTERVIEW PROJECT

Interview of T. T. Fujita
25 February 1988

Interviewer: Richard Rotunno

Rotunno: Today is February 25, 1988. We're in Baltimore. Perhaps you could begin by telling us a few of the basic facts about yourself--where you were born, in what year, who were your parents, what did they do.

Fujita: I was born in Japan, of course, way back in October 23, 1920. I'm 67.4 years old. My father was a teacher, and he was teaching at the grammar school there, and he wanted me to become a teacher. I thought it was a good idea. I have one brother, he's also a teacher, his wife is a teacher; therefore, I was born into a teacher's family. My mother was just a housewife. No more, no less.

Rotunno: What kind of education did your parents get?

Fujita: My education was very strange...

Rotunno: Your parents' education?

Fujita: My parents' education, I really don't know because in Japan, the system is quite different. To become a grammar school teacher, they have to go to teachers' college. He went to teachers' college and graduated, and started teaching at a grammar school and not science [but] literature. He died young, but he became the principal of a local grammar school.

Rotunno: Were there any teachers in your secondary school who you can recall having an influence on you other than in science...?

Fujita: When I was in grammar school, [that] school was right outside of town. Then I transferred into a city school inside a city of about half a million at the time--right now, it's one million. I was influenced quite a bit by the middle school teacher, and the first thing I did at that time was to observe the sun, observe [the sunspots]. But I couldn't do it because it was very expensive to buy a telescope, and of course, at that time, you couldn't buy [one] even if you had money. I used a

pinhole camera, not a camera, just a pinhole, a small hole; I held it and made a back contact, and I made a count of the sunspots. Of course, the period we were counting was not long enough to determine the sunspots' cycle, by any means, but I computed the rotation of the sun, assuming that sunspots stayed in the same place on the surface of the sun. Then I computed, and I was amazed to see that, after twenty-five days, [only] one turn. I waited and waited to see the sunspot go around and come back from the other side to this side.

Rotunno: How old were you at that time?

Fujita: I was, at that time, about fifteen...

Rotunno: So your interest in observing nature seemed to come at a very early age.

Fujita: Yes, that was the first one. The second thing I did was I wanted to measure wind, but I couldn't. I had a small sphere hanging and...when the wind blew, the sphere moved. Then from the displacement and direction, I thought I could measure wind. Then my father really got mad because when a typhoon came, he found I was standing on top of the roof. My father said, "What are you doing, my son?" I said, "I'm measuring wind." He said, "That's a most dangerous place." He dragged me down.

Long after that, after I came to the United States, I met Al Bedard. Maybe forty years later. I told him that story, and he said, "Well, we can work on it." And then, Al Bedard owned a joint patent on it. And he ?sold it at this meeting, you know, he _____ meeting, and he said, "Ted Fujita developed this." But that same principle I did on top of the roof before my father dragged me down.

I had a couple of interesting episodes around that time. I received some pretty bad points [grades], and my teacher said, "What are you doing? It looks like you are writing something and working some kinds of equations all the time, yet [your grades] are pretty bad. Why is that?" Then, I found out how to do a lot of calculations. However, multiplying some things seemed pretty hard. I was inventing a slide rule, changing the natural numbers into log. But of course, I was using the base of 100 base in a log. I was developing that, but my teacher said, "You'd better stop doing it." His comments were very simple: "You're wrong." I said, "Why?" [He answered:] "If you wait another year, you'll learn what you're doing is so-called 'log.' You'll learn log, if you wait another year, in just one week. But you're spending one month, you're wasting all month on the problem that you would learn one year later without doing anything."

That was one thing. The second thing was--it's interesting that before college, our teacher--an interesting episode was that in each year, once a year, in secondary school, they took us to a historical site. One site we went to was a place where one Buddhist monk dug a tunnel. A narrow road went along a cliff and lots of people slid down and died. The monk thought he should do something, and he was so patient he used to chisel and hammer, trying to dig a small hole so that people didn't have to go along the cliff. It was a very short one, about less than 100 meters. But he spent twenty years digging a hole using a hammer and a chisel. After we got back from that trip, we had to write about something that this monk did very well, we should show that same kind of spirit and so forth and so on.

But I didn't. I said that this monk did something but it was wrong. I got a "D" for a score; the reason is that I said the wrong thing to my teacher. I said, "I would never do that. If I were assigned to dig a tunnel--I wouldn't know, of course, if it would take ten or twenty years--but if I assume that it would take twenty years to dig a tunnel, the first ten years I would invent a tool. Then I would accelerate the job, and in the second ten years I would complete it. After my death, people would see both the tunnel and the tool. However, this monk worked very hard, but what he left behind was just the tunnel."

Rotunno: At what age did you expect to go on to college?

Fujita: I don't remember exactly, but there was a four-year college on the island of ?Kyushu, north end of the island, and then a technical school--since my family was poor, like a teacher's family. A grammar school teacher, my father asked, "Why don't you go to college?" Their option of getting a teaching degree or something, but that one gave an equivalent of a Bachelor's degree. The monk with the chisel and the hammer was in the back of my mind so I said, "I'll take mechanical engineering." Then I got into college and there were all kinds. It was a big college. I took mechanical engineering as a major. That probably was when I was about twenty.

Rotunno: What year was this?

Fujita: I have a "Japanese" year, I don't have it on record.

Rotunno: You were born in 1920...

Fujita: Maybe 1941, or so, around the time when the war started, maybe even 1939, before the war. I was about nineteen. Then I majored in mechanical engineering. However, I took a lot of courses, from astronomy to geology to physics. Before

the war ended, I was asked to teach Einstein's theory of relativity. I said, "Yes, I can." They told me I would be an assistant in the general education physics part of it. I was studying physics. What I did was just to teach and also did all kinds of experiments, electrical, too. I graduated in 1944 or so, after four or five years. They appointed me as assistant professor at the time. It was very unusual.

Rotunno: That was in physics?

Fujita: Yes, in physics. The appointment was in 1944.

Rotunno: At what point did you decide to get interested in meteorology?

Fujita: At that time, if you were to go through standard education--I would have to go to Tokyo University or something--before the war ended, even about three years after the war ended--Japan was on the German system. Therefore, if you wrote under the supervision of a Tokyo University or other university professor, then you could work on your thesis. After getting a Bachelor's degree, you could actually skip the Master's degree and with going through formal education, you could get the D.Sc, Doctor of Science. Then, I learned about it and contacted Tokyo University. You may not know the name, but Professor Shiono (?). [He] was a very productive person. He said, "O.K., I'll be your thesis advisor." Then I commuted back and forth to Tokyo University. Since 1947, I spent five or six years and got my Doctor of Science degree at Tokyo University in August, 1953.

In order to do that, I had to do something. I thought I could work on physics, but I decided to choose meteorology because at that time, meteorology was the cheapest; all you needed was paper and a color pencil. I was interested in studying the structure of a typhoon. I had all kinds of data from the Weather Service; I had made a good connection with the Service and worked on typhoons. I think my thesis title was, "Analytical Study of Typhoons." Unfortunately, I didn't say, "Mesoanalysis of Typhoons." I regret that.

Rotunno: So in 1953, you took your PhD. You began in 1947?

Fujita: I started in 1947, yes.

Rotunno: So that was seven years...all that time, did you take courses, or did you do research exclusively?

Fujita: No, I took courses, I went to the local Weather Service, and they gave the non-degree type of courses. It was a very simple one: what is the divergence, the vorticity and so on.

Rotunno: What sorts of things were being taught back then in meteorology?

Fujita: At that time, meteorology was pretty bad because it was after the war--

Rotunno: --upper air networks that were telling anything about--?

Fujita: They had upper air networks, but they used upper air almost exclusively for military use, to fly from one spot to the next, you know, what kind of headwinds, tailwinds do you have at high levels? Therefore, use of upper air soundings was pretty bad and mostly, they analyzed the surface chart. Prediction was all done by hand. There was no numerical computation of any kind at that time.

I made very close contact with the District Forecast Center, almost like [the one] at Kansas City, and they had periodic courses and _____ I took every one of them. Then they said that meteorology was the "cheapest." And that's what I found. Also, I went to hear all kinds of lectures on relativity, and physics, but it did not attract me a bit. I could do it, but I ended up with a teacher.

Rotunno: So it would be too expensive to go into the experimental science of relativity?

Fujita: At the time, we couldn't. But no radar. Therefore, I thought that I better use strip chart recording. There was no concept of digitizing anything at the time. You may not know that, but it was too early to think anything about automated systems. Therefore, we had to go through tedious analysis by using strip chart recording, which I did. However, I thought, back in 1947, I could observe something, and the local Weather Service offered me [the opportunity] to use a facility at the top of a mountain. I had lots of friends over there, and with one of my friends, we walked up the mountain to where there was a small wooden cottage. Inside was a microbarograph and just about everything, all recording anemometers and I could see everything good. At that time, I was interested in _____ pressure. There was no thing like hydrostatic at that time. When high winds came, the wind starts record at a very high speed and the pressure decreases because of suction. I thought, how can I trust the pressure. That was the first thing. Then, [I thought], don't trust hydrostatic. I completely avoided the hydrostatic equation. Then I observed a thunderstorm and found the noise(?) attracted me. Having a background in engineering, I believed that the thunder noise to be stagnation. And cold air combined, of course. But you have to have very strong impact. I worked, at that time, after observing thunderstorms, in the summer of 1947. I used that, and then I actually produced the one I showed during the banquet, every ten-minute map. It showed a peak rise like that, but

when you map it, you can map it every ten minutes. And yet, it has an area in it--it's not just a peak. I identified the peak's area, and then also it was a divergence, because it was spread out. Then, I estimated the vertical motion at the time because back in 1947, that's when, in the United States--we had no communication, of course, they were having a thunderstorm project--they had a thunderstorm project finishing up in Ohio. At the same time--

Rotunno: That was remarkable, this was going on right at the same time.

What was your family's attitude after they found out you wanted to be a meteorologist?

Fujita: My father didn't even think I would become a meteorologist because he thought that I would be getting an education and would take an education degree, just a couple of courses and get a diploma for teaching. My father said, "See, you're doing very well, and you better teach either music school or high school because I am ending my career as a grammar school teacher. Therefore, you'd better go one step higher."

His dream--he died around that time--was that I would be teaching one higher level of school [than he had]--either music school or high school. Then he died...

Rotunno: How were you supported as a graduate student?

Fujita: In Japan, it's pretty bad. At that time, in our local [area] (almost like a county)--they had scholarships. Then, my father died during my college year. I had one brother and one sister. However, I had to support myself and my brother. Then my mother died, and I couldn't do anything because I had to go to school. I finished my part, and before I got my father's position at a young age, I had to still support my family. Then I got a scholarship, but that was not enough. At night, I tutored, and I taught, you know, the sons of wealthy people at night. One of them took classes at the cooking school, and I taught her son. I think I made about three times more money than the scholarship paid for. I paid myself, paid my brother, my father died, but after that everything became quite normal.

Rotunno: I was interested last night in finding out that your first research project was the damage survey in the aftermath of Nagasaki and Hiroshima. That was 1945, so that was before you entered graduate school.

Fujita: No, I did not go to graduate school after undergraduate, getting a Bachelor's degree, all I did was get an advisor in a Tokyo University and worked on a thesis. Then I did nothing but research, while I was holding my faculty position.

Rotunno: So you were still faculty then.

Fujita: I [stayed on] the faculty until I came to the United States.

Rotunno: So you were a faculty member until 1953.

Fujita: No, even after that. Because actually, they paid my salary while I was here. They paid 75% of my regular salary because of the Japanese system, and they'll do it even now for everybody. After I went back to Japan, I contributed all of the money to my institute. I didn't need it.

Rotunno: I believe you came to the United States at the request of Dr. Byers, at the University of Chicago. Could you tell us a little bit about the intellectual atmosphere at Chicago in those days?

Fujita: Yes, it was very interesting. I sent my 1950 paper on microanalysis--it's actually now termed mesoanalysis. The subject in that paper may not be microanalysis. What attracted Byers was that I estimated that right in the middle of a thunderstorm, we have to have a down--I didn't say "downdraft," I said "downward current," you know, something like a 20 mph something. He said, "We spent millions of dollars to discover downdrafts." But then he asked me, "How much money have you spent to end up with this kind of downdraft?" I said, "I made a microanalysis, and maybe I spent $100 at most." He said, "Come over right away, but at that time, my degree passed at Tokyo University, the faculty voted. I said, "I want to wait until I get that degree." He said, "Just wait." Then I came over to the University of Chicago. My appointment was as a research associate for one year. Yet that thunderstorm project was over, more or less. However, he had a cloud physics laboratory, or a storm laboratory or whatever. That was not on the main campus in Chicago. His lab was south of the campus. That area was classified. He said, "I'm very happy that you came; however, we can't let you walk in this classified section." I was given a small room, not in his lab, but in a teaching portion of the University and when I came in, I saw Herbert Riehl, and Rossby once in awhile. It was a great school. [Sverre] Petterssen was there. I really opened up my eyes and said, "This is the real world."

[So] I worked for Byers in the unclassified section and then he told me he could give me a good assistant, "Who is studying like you. We'll give him, more or less, something substantive and he'll be working for you and with you." That was Krishnamurti.

I interacted with him quite a bit. He and I discussed common problems. I owe him an awful lot. He's a very nice person; we worked together.

Rotunno: How did you feel about leaving Japan?

Fujita: I didn't feel anything because when I left Japan, at that time I came here on a one-year assignment. I thought I was just going to the United States and [would] come back. So I felt nothing. But when Byers asked me to come back again, at that time I felt that Japan was a pretty nice country and maybe I would come back to the University of Chicago [in]? ten years or so. At that time the U.S. economy was 100 times better than Japan's. I thought, "Probably I will go back to the institute, and keep teaching." When I left, they asked, "Why don't you come back? Then we'll give you a new position or something." I never felt that I would be staying here this long, and at that time, when I came back with Ingram, the visitor, I never had the idea to stay in the United States and get citizenship because at that point my research budget was under Byers.

I knew Tepper, who was faculty and so the only person who could write a proposal and get the money. No grant would be given under the name of a post-doc or whatever. Therefore, I never felt, until I got my citizenship back in 1968, that I would stay here forever...that's the most difficult part of it.

Rotunno: So it was about fifteen years before that you accepted that you were going to be staying.

Fujita: But the research was very successful at the beginning. However, to stay here forever or just go back was a very, very hard decision to make.

Rotunno: Let's talk a little bit about your academic career at Chicago. When did you first get your assistant or entry-level academic position at Chicago?

Fujita: First I came in 1953, and I went back to Japan in 1956. I was here about 2 1-2 years. Then I came back about nine months later. Then, in 1957, I returned again. I was a research assistant during the first 2 1-2 years. When I came back, I received a letter that Byers classified me as a research professor. But this was not a faculty position--"research professor" and "teaching professor" are entirely different. I had no voice on the faculty, or anything. Then I had to wait to become faculty. However, Petterssen (who died in England) actually approached me to become an assistant professor, [but] the faculty had to take a vote to give tenure or not. He told me to skip the non-tenure appointment. Usually, it's very rare. Back in 1962, about three or four years after I started doing research, he proposed that I become a tenured, associate professor without going through the assistant professor rank...and [that's what happened]. It may happen, but it's a very rare situation. Then it took about three years to be promoted to full

professor.

Rotunno: When did you begin teaching courses at Chicago?

Fujita: 1962. I gave a lot of seminars. I had interactions, interacted with students quite a bit, and I enjoyed that. Also, I was teaching in Japan before then but in a different language. Teaching was very good, but officially I started when I got the tenured appointment.

Rotunno: Did you have any students who we should talk about?

Fujita: Yes. At that time, I had students but mostly I was teaching meso-meteorology at the beginning, but I did not sponsor PhD students for some time. Of course, I had a couple of students who got PhD's, but I played a fairly minor role. Roger Wakimoto announced yesterday that I sponsored Bill Bonner. He was quite a--it was a big honor, I should say. But of course, he came in and then I sponsored him in many ways. But usually, the sponsorship varies in many ways--you are advisor, and then some student takes off much more quickly than you can possibly advise him. Bill Bonner was quite a student. We predicted that he would be. But he went to UCLA before he came to NMC here.

Rotunno: In general, where and how did the staff at Chicago exchange their ideas about research? Was it a fairly open system, or was it a lot of people doing individual things without too much communication, or did that change over the years?

Fujita: I think it changed over the years, but in my case, since I did mesoscale analysis exclusively for at least ten years, or even more, my contact mainly was Byers. But Byers didn't do much research. He was more of a figurehead. I interacted with Roscoe Braham; I learned a lot about clouds from him. Also, I learned the philosophy behind field programs from him. I thought that was very good, because he was good in that respect; the Thunderstorm Project was the biggest field program in the early days. Roscoe actually inherited that because he was Associate Director with it. Naturally, he worked very hard for it. I learned, not through regular meetings, but we had all kinds of get-togethers. So I learned how to do field work.

Rotunno:: Let's talk about that. What was your first major field project in this country?

Fujita: 1961.

Rotunno: About how much did that cost? I know you mentioned your first field project...

Fujita: $100 or less. Actually, my first field program--that money was given by Charlie Anderson. He was at Madison, and I think he moved, but before then, he was at AFCRL, and he really wanted to study orographic clouds. Then he organized a proposal named "Hi-Cu"--high-level cumulus development. Then the Air Force put a whole-sky time-lapse camera to take pictures near Flagstaff, Arizona, [of a] cloud formation over San Francisco Mountain. Then, at that time, he gave me the money and he actually had about twelve strip chart recorders (?).

Rotunno: Where did he get the money from?

Fujita: AFCRL. Charlie actually gave the money. Then I designed the network and put the station on the top of the mountain around Flagstaff. That was my first exposure to mesoscale experiments.

Rotunno: Was that by yourself principally?

Fujita: He actually gave money to a lot of people, including Paul Mcready. Paul became very famous for aircraft and like that, but at that time he had private research at Pasadena or Altadena. He was given money and he had a whole-sky camera, and I designed a mesonet and a strip chart and also at the time I used a hundred rain gauges, using a small plastic cup that measured total precipitation. That was the first field program. I don't remember how much money I got, it was probably about $20,000.

Rotunno: I know you've probably heard this many times, but was there a particular point, the first time that you knew you found something really important? How did it happen, and how did it feel?

Fujita: The first thing I thought was important was the identification of mesoscale pressure and temperature and everything, and mesoanalysis to identify like a meso-high and meso-low, and also meso-cyclone and work on a meso-low [were] all about mesoscale divergence and convergent systems--

Rotunno: Did this come at one time, or did it come gradually over you--

Fujita: I think the first one was probably 1950, the mesoscale system, but I didn't identify it that way.

Rotunno: Were you just sitting in your lab and all of a sudden the idea came into your head or is it something that you always felt?

Fujita: It was something I always felt because the mesoscale divergence in Japan back in

1947. At that time, when I analyzed it I more or less identified it and [showed that] it actually exists. After coming here to hunt for mesoscale disturbances was my hobby. Like when you hunt for ?rabbits and like that, I [wondered] if there was anything else. Then, the second thing was the identification of mesocyclone and tornado relationships using a Fargo tornado case. At that time, I thought that was very interesting. My first excitement in scientific evidence for chasing a subject was a mesoscale system related to tornado formation. That was the first thing I really enjoyed.

Rotunno: That was rather remarkable because you did all that research after the event had happened, if I recall. And the photographs were all collected from people who happened to take photographs of the storm and the research was pieced together in a true detective fashion.

Fujita: I felt like a detective of some kind. I also felt--because I had lots of contact with local people--but that was the first time in Fargo that I went out and moved around and talked to people. North Dakota is a remote area even to most Americans. When I went out there, they looked at me. Some asked, "Where is Japan?" I thought the U.S. and Japan _____, but one day they asked, "Where is Japan?" Others thought it was a city. Then people were so friendly and [offered help.] They asked what I was doing. "I'm studying tornadoes." Then I got pictures and local t.v. analysis, and lots of pictures to handle.

Rotunno: What journals did you read regularly and publish in?

Fujita: At that time, we had only two. Now we have all different kinds, but then we had just one journal in Britain. Then I used a journal about thunderstorms in Britain. However, we had a problem.

Rotunno: That was the **Bulletin of the American Meteorological Society**.

Fujita: Yes, and the **Journal of Meteorology**. It was brown, not a regularly bound journal.

Rotunno: That was the precursor to the **Journal of Atmospheric Sciences.**

Fujita: That was the only thing we had at that time. For mesoanalysis, I had a problem. The first one I did back in 1957, I wanted to publish in color. Then I consulted with Byers, who said, "No, our journals will never take color. In the **Compendium of Meteorology** they did some, but if you want to publish your divergence and mesoscale pattern, then you have to go to Europe, to **Tellus**. So I submitted it to **Tellus**, and it was the first one in color. No publication charge, no

page charge for color. Thereafter, I had to go to--most people wanted to publish in color, because color is a wonderful emphasis--when you see the frontal cyclone or the frontal theory develop in Europe, they used color. But the person who influenced me was [Erik] Palmén. I met Palmén many times. He was a very classical person in a way, and he did not like to fly. He took a boat. When he went to the West Coast, he stopped by in Chicago--in those days, the trains were still running--and I met him at Union Station many times, and he told me that it was important to use a color pencil. Because all of the discoveries of polar cyclone, front--these were done by color pencil. That's what he said. Of course, I agreed with it. Most people wanted to publish in color, but naturally we couldn't find any publication. Then I used the U.S. Weather Bureau research papers, #39 and #42. I think it did very well.

Rotunno: So Palmén influenced your use of color, because one of the things you're famous for is your exquisite graphical--

Fujita: Excuse me, it was Bjerknes, not Palmén. I knew Palmén because he was sitting as chairman of the office (?department). But it was Bjerknes.

Rotunno: Here's a question that I know you'll enjoy answering. What were the subgroups in the field which had major conflicting interpretations of important research problems? I know there were several.

Fujita: There were quite a bit. When I first did mesoanalysis, there was no conflict of any kind because they would just look at it and comment, "Oh, yes, that's a very interesting chart. We never look at it in color. We never look at it in this scale. Let's do." At that point, I hadn't done much tornado work. Then I started to see that in the United States, everybody is very agreeable and works together toward a common goal and that goal was to identify mesoscale system. Then, my first obstruction was that I tried to find more about tornadoes. What I was interested in that a tornado really jumps and skips very high because of the vortex, you see. How can it skip and destroy one house, and then skip and go over another house, and drop down two houses down? I couldn't believe it. Then I said, "Well, at least I believe that all over this these, vortices should have a continuity, at least for some time, and it can't simply skip over one house.

I did lots of flying. I used a Cessna quite a bit, a rented Cessna, and tried to take air in the forest to find that it looks like after the passage of a tornado, I didn't see just one skipping line, I saw a kind of cycloidal, like a spinning mark, quite a bit of them, especially the Dallas tornado, every one of them had those kinds of marks. So then I thought, "It may not be skipping. Let's find out the nature of this." But way back in the North Platte Valley tornado in 1951, they also

photographed that. But they thought this would be a "scratch" mark because tornadoes can actually pick up something heavy over the ?object of it and then it would be captured inside a tornado funnel.

END OF SIDE ONE

Interview of T. T. Fujita

SIDE TWO

Fujita: ...identified this cycloidal mark as being a scratch mark, but how could a tornado funnel capture such a heavy scratching object inside a funnel but yet, being of an engineering background, we had to worry about centrifugal force because, as we know, the geostrophic wind, when something rotates, and especially when you have a heavy object, that should be just a centrifuge out. I didn't accept it. Then I learned how to take a picture by flying low and using a zoom lens and finally, in examining it, it was not scratched. I landed and rented a car and worked in rain-soaked fields to find that it was not a scratch at all. It was part of debris, only up to four inches of ten centimeters. Some of these scratch marks I found were chicken feathers. That _____ you can_____. Then I thought, "Well, what kind of weather system could do this?" I got an idea. Tornadoes are very small, maybe the smallest mesoscale, maybe not even mesoscale systems, but inside there is a much smaller vortex. That vortex is strong enough actually to collect all debris but the weak near the ground because the _____ ground is at u, v, w, = 0. Therefore, if debris is captured, right in the middle of the eye of a small vortex, after the vortex moves out, you see some kind of a pile of debris, which you'll see. Also, when the debris ends in the forest or something, that is where very strong destruction begins. Then I saw _____ vortex. Initially, after starting this Lubbock tornado, I saw a suction spot. But I quickly changed it to a rotating spot. Then I called it a suction vortex. It is in the mesoscale; it is a super-small mesoscale.

Then I got into a tremendous argument--you talk about a tornado, people take lots of pictures of a "nice" tornado [which has] one funnel. How can I say there's a small vortex running around, dancing around? That's what my aerial photos and survey indicated. I never saw the vortex, but not to have seen something does not mean that such a thing does not exist. I don't want to identify who argued about it, but this argument came from all directions, to Chicago. [They] said: "You're dead wrong." But I still pursued my concept, and whenever I went out, I tried to look for or take pictures of tornadoes, but unfortunately, I hadn't seen any tornadoes at the time. My idea was actually recognized by a t.v. station. Lots of t.v. stations told me that they saw some, several, fingers hanging down, but they couldn't tell if the cloud was rotating or not. It may not have been rotating. All of a sudden, when we had a super-outbreak of tornadoes, April 3 - 4, 1974, Indianapolis t.v. stations sent me a beautiful 16mm picture, a movie. That showed my suction vortices dancing around, and I went to the spot to find exactly what I

expected. One house was damaged, the one right next to it was standing, untouched. Houses located in between the path of suction vortices left standing confirmed everything. Strangely enough, thereafter, we got lots of pictures. I don't know why we got pictures, but we got still pictures from the Highway Patrol, and from just about everybody. I collected ten or fifteen different cases of pictures showing multiple funnels. I was so happy back in 1971 when I actually [presented] this at the Severe Storms Conference. Since lots of people didn't believe it, I put the year "1971--this is my concept." But fortunately, Dr. Lou Battan, before he died, wrote a book. His book used the same theory, and said, "This came from Fujita." He's the one who encouraged me at every stage of this conflict. Thereafter, people started using the word, but there are quite a few resistors, also. Because those who argued about the suction vortex never wanted to use the term "suction vortex;" instead, they wanted to use the term "multiple vortices." Then, if you have only one suction vortex, what do you call only one of the multiple vortices--but if you have two or more, then you can say that (multiple vortices). Furthermore, they start saying that, "Well, those are the secondary vortices, but they produce a primary damage." There was an end to it because thereafter I heard an awful lot: "Oh, we knew all about it a long time ago. Even twenty years, there were pictures showing multiple vortices. You're not the first one." That was not a fair statement, but I accepted it [because] this is human nature. It's interesting.

Rotunno: And what's interesting, this is not the only such conflict you've been through. I can remember coming into this field about ten years ago and, of course, as you just told us a little bit ago how your earliest research showed the existence of very strong downward currents in thunderstorms--which was also seen during the Thunderstorm Project in this country independently--the existence of the downward current was a well-established fact where sometime around the middle to the late seventies you had seen evidence for downward currents within these thunderstorms which were of such a small-scale intensity, that led you to suspect there was something fundamentally different about them that was going on. In fact, [this] led you to suspect they were indeed responsible for major air disasters in this country and around the world. Again, this was something that was very fiercely resisted in the research community at the time that is now generally accepted. It seems you've been in this position almost all your life, starting from your schoolteachers to now. It must be very satisfying for you--

Fujita: I'm glad that you asked that question because I think I am in conflict, meaning whatever I said was not acceptable, at least in the early stages. Because it is very hard to confirm before you really put your idea through. If you are a very careful person, you spend ten years confirming it, through numerical experiments or _____, but you don't do it overnight. But this aircraft case was

very urgent because when Eastern [Airlines] 66 crashed at JFK, and I actually analyzed it, but no matter which way I looked at it, this was a very small scale outflow--it just came and went. Also, one came and the next one came, but in between, there was a calm. I analyzed about an eighteen-minute period when there were more than ten aircraft around it. Some reported very bad wind shear, but the next one didn't. Even the control tower was confused. Knowing that I had all kind of conflict and criticism in the past (the suction vortex and like that), I thought I could wait. However, Eastern Airlines people called me and said, "It is very important; it may save your life. Why don't you find out what it was--something the pilot did or something." But because of ?others, and also my previous knowledge of the atom bomb ?[started], which I did back in 1945, I was brave enough to say it was a downburst. We knew about downdrafts since Byers and Braham's work. Everybody knew about that. But downdrafts just approach the ground; if a downdraft gradually disappears vertically, the velocity decreases, you wouldn't see a horizontal burst of wind on the ground. A downdraft may end a downdraft without even being noticed. I said, "This is a downburst." But they said no, because at that time, a main point of the argument was that it was a downdraft. The aircraft fell in a downdraft, but when the aircraft was only 200 feet above the ground, you don't expect such a strong downdraft to blow the airplane down.

I got quite a bit of resistance at the time, but I'm glad that I went through it. What rescued me at the time were the pilots. Many pilots said, "Yes, you said that." I was invited to a pilots' meeting and all of these things, internationally and in Canada, and they said, "We had the same experience. It looked very innocuous and we went through it and all of a sudden, it was not a downdraft, there was a loss of airspeed." Most meteorologists did not see it that way. One pilot complained of loss of airspeed, meaning loss of lift. Most meteorologists didn't care about the loss of--didn't hear about that. Instead, _____ the downdraft and the main criticism was that Ted Fujita was confusing downdrafts with downbursts because they [the pilots] were getting into trouble in downdrafts...

It was interesting, I enjoyed that.

Rotunno: We're going to change topics now. When, if any, have you served on any grant review boards, committees which enforce the way funds are given out in research?

Fujita: It's interesting. I didn't.

Rotunno: That's what I would have assumed. It seems like you were mainly doing research.

Fujita: I never, with the exception of NSF--I don't think I was involved with any boards that distributed money. I'm a recipient, not a distributor.

Rotunno: Did you ever think of changing your research to some other specialty, or other field entirely?

Fujita: No, not entirely. But I will stay in research on wind and storms. However, what I want to do is expand my research into global scale. It may not include the Southern Hemisphere, but I would like to study all kinds of cyclones, why we have more tornadoes in the United States whereas in China right behind Tibet, they do not experience tornadoes stronger than F-2. Why? Because everybody says that we need moisture coming from the south, and dry air over and dry air from the west--we need mountains. And a more spectacular case would be China with Tibet. They have lots of moisture from the South China Sea, but tornadoes [there] are very weak. Why does the United States have 75% production of all the global tornadoes? That's a question I would like to answer. To do that, I have to expand at least my scale to global northern hemispheric circulation. That's what I want to do. Of course, I don't rule out climatology, like El Niño, because this is one advantage of being a teacher: I teach one course every other year with a geology professor, present and paleo-climatology. My partner, the geology professor, teaches paleo-climatology going all the way to Cambrian. That means our continent would not have the same location. He moved the continent and then I tried to estimate the climate then. But of course many people are doing; we are doing some kind of forerunner research on that. I'm interested in El Niño and climatology, just about everything. But it boils down to the fact that I'm interested in a very careful analysis of all scales, including the stock market, if I may say so.

Rotunno: One final question on this topic. I mentioned last night about the possibility of going back to Japan. The question came up--what are your feelings about that?

Fujita: Since I'm reaching the age of 70, many people not only ask that, they tell me, "Oh, I heard that you retired." I say, "No, that's not true." Some say, "We heard that you're interested in going back to Japan." I might have said that back in the 1950's. So then I had to clarify my position. What I did was very interesting. I plotted (?) to go back to Japan, where they never talk about the U.S. dollar because upon crossing the International Date Line the money, U.S. dollars, changes to Japanese yen. Then I converted my U.S. salary into Japanese yen and found out that it's impossible to go back and stay in Japan economically. But it's not the whole reason. Last night, at the banquet, I joked about it, but the real reason is that in Japan the retirement age at Tokyo University is sixty, and even at the local universities it is 65. Just about all of my professional friends have

retired. That would mean when I went back to Japan I would see my friends holding their grandsons, and that's all I would expect to see. My social life would not be like my life in the United States. I joked about it, but please accept that yesterday's retirement joke is just a joke. The true story is that I'm a U.S. citizen, I'm very proud of it, I have lots of professional friends young and old. All of the conflicts and all kinds of different ideas I went through--but all of them are good friends. I will spend the rest of my life here, and that's my life.

Rotunno: I'd like to finish up with just a few personal questions, if you don't mind, a little bit about your wife. Where did you meet her and when?

Fujita: My wife comes from a family, also, of teachers. Her sister is working as a teacher; she's retired at the age of 55 or something. But anyway, through a teacher's meeting, I saw her sister and then actually, being from the same kind of teacher's family, I met my wife. She is interested in teaching. We had a little problem because when we got married she thought she married a teacher. I told her she had married a teacher. But she found out that I was flying around on these especially dangerous flights. I tried to hide it, but she found out through somewhere and she said, "You are living dangerously." I never fly on Friday the 13th in all of this, but now she understands it. But she may not be fully understanding--do I really have to do this the rest of my life? Her answer is no, but my answer is yes.

Rotunno: Could you tell me a little bit about what you do outside your working hours?

Fujita: Outside working hours--I don't keep working hours because--I didn't say this, but the whole U.S., since 1916, has maintained tornado data. About six or seven years ago, I think it was 1981, the Weather Service decided to discontinue Storm Data. I took it and said that I would do it for free. For one year, I used my students and my staff and gave up my weekends. I tried to go through the Storm Data, which is now being sent directly from 60 district weather substations directly to my office. I look over it every weekend. It takes a lot of time, it takes more time than people think. They said, "Don't worry about it. We'll be keeping tornado data in individual offices." But it doesn't work. They agreed to send all data to me. Beyond my weekend work, around that time, five days I worked on contract, and two days I worked for Storm Data. I haven't gotten it extended all the way, but I enjoy it. Now I'm getting all kinds of support little by little, and I have one man doing it, but I look over his shoulder and what makes me happy is that the Weather Service accepted my tornado scale. Each tornado will have the F-scale on it. Many people are using it. I want to make sure that the scale is proper.

Rotunno: Have you written many popular articles?

Fujita: No, not popular articles. I wrote three hardcover books. Those may not be popular. One is **Downbursts**, one is **Microbursts** and the other is **U.S. Tornadoes** (tornado statistics).

Rotunno: My last question is what have we left out? Did we miss something that might be of interest?

Fujita: I don't think we left out anything, but it's a great honor that you interviewed me for the AMS archives. I did my best and I'll do my best for the rest of my life.

Rotunno: The honor is ours. Thank you very much.

END OF INTERVIEW