American Meteorological Society
University Corporation for Atmospheric Research

Interview with: Fred White

January 26, 1994

Interviewer: Earl Droessler

TAPE 1, SIDE 1

Droessler: This is Earl Droessler and it's January 26, 1994, 9:00 a.m. in the morning and I'm in Nashville, Tennessee, at the Opryland Hotel, and with me is Dr. Fred White. We are beginning today an interesting experiment in oral history for during this interview/conversation Fred and I, Fred will interview me and I will interview him. Fred and I have been co-workers in the atmospheric sciences and we have also been close friends over all these years. I have known Fred for over forty years. Good morning, Fred, are we ready to begin?

White: Yes, I'm ready to start Earl. It is a pleasure to be here; let's review old times. I think I first met you in the Forties but I'm sure of the fifties because you were in the Pentagon and I was _____ office over at the Weather Bureau and we had a lot of top level meetings especially between the Air Force and the Weather Bureau forecasting matters, weather matters and occasionally he would ask me to attend a meeting and you would meet me there as a staff man for the Pentagon. It has been a lot of fun over the last fifty years and let's trace some of our history.

Droessler: Well, I thought the way we might begin this interview Fred is to think about our early days at the National Science Foundation from the point of view from the very early development of UCAR/NCAR, what do you think about that?

White: That's very very good. I'm sure you remember, you remember better then I did the Berkner Committee at the National Academy of Sciences and their very, very fundamental recommendation that NSF step in and develop a National Institute for Atmospheric Research which was later NCAR and also that NSF develop a program in the atmospheric sciences isn't that the way you remember.

Droessler: Yes and that's the reason really I came to the NSF. Dr. Waterman and Dr. Klopsteg invited me to come over and start the atmospheric sciences program. In addition to Berkner's report there was the IGY was under

way. The International Geophysical Year and it gave a great big burst of new funds and energy to the atmospheric sciences with most of the money from the IGY going to the University but some of it spread out among government agencies like the U.S. Weather Bureau for the good work that they were doing under the International Geophysical here and then there was a third element that was there that helped to promote an Atmospheric Sciences Program at NSF. It was the Captain Howard Orville Committee the national committee on weather control and among its recommendations was one that said to the National Science Foundation should establish a research program in weather modification and this recommendation was taken up by the Congress especially Senator Case from South Dakota who promoted it and pushed it and after a short while there was a new bill and a new supplement to the mission of the National Sciences Foundation.

White: What was the number – I wrote PL 4810 or something like that do you remember that number. Boy I wrote that thing a thousand times, but I remember that bill I remember very, very fundamental. It was very fortunate those three things came together right in the late fifties and that was the start of atmospheric sciences in this country. Now the modern atmospheric sciences, we had meteorology before but atmospheric sciences really started 1958/1959, right in there.

Droessler: And when I came to the National Science Foundation one of the first things I did was to look around for some really good help to move this Atmospheric Sciences program ahead and I was delighted you know when you came over so that the two of us then I think did a very commendable job in getting this program going the National Science Foundation and moving it out throughout the whole country.

White: With your leadership, Earl. It was a pleasure I enjoyed it very much but you provided the leadership for the whole program and it was a pleasure for me to work with you.

Droessler: Oh, thank you, Fred that goes without saying that I reciprocate, but I remember the number of that Bill was PL Public Law 510.

White: That's right, that's right, that's right, that's right I forgot.

Droessler: You – Fred you and I were the only two people in the National Science Foundation that could carry a two page bill around with us as Public Law which invited us to move forward in our research program.

White: Let's talk about UCAR/NCAR first and then later if we have time then let's come back to weather modification. We also will be just roaming all over the place. So UCAR – one of the first things that I did I remember

when I came to NSF was to write a grant to MIT to prepare the Blue Book. I think you had written a grant before to get the thing started. Is that the way you remember?

Droessler: Yes, after the Berkner Committee report surfaced then the twelve universities got together and established a university committee on atmospheric research UCAR, the same initials that later became the University Corporation for Atmospheric Research and the committee elected Henry Houghton Professor at MIT as the Chair and under his leadership they approached NSF, approached us and approached Dr. Waterman about the need for a small grant. I think it was around fifty thousand dollars to search out the feasibility of a National Institute for Atmospheric Research within the university community.

White: And then they met for what three months or so three months and then they agreed to set-up a planning committee and I think that's the grant that I wrote. As I remember it was about a hundred twenty-five a hundred fifty thousand and it went to MIT but it supported Braham and Malone maybe a few others working full time on the plans for this institute.

Droessler: Yeah once the decision was made by the university community that yes a National Center or National Institute of Atmospheric Research would be a splendid idea and a splendid thing to pursue then to have to flush out the plans and the details so that they would have in hand a proposal that could come to the Federal Government to the National Science Foundation and say here's how we envision this national center developing and that document is the so-called famous Blue Book.

White: Yes.

Droessler: White you have already introduced.

White: Half inch thick.

Droessler: And the editor of that and the chairman of that planning group was Tom Malone.

White: Right, right. Then the next step was after the government signed off on that the formal organization of UCAR, the selection of the first director and the selection of the site and you were active in both of those.

Droessler: Ah-ha. Well I recall that when the Blue Book the planning document reached the National Science Foundation we immediately circulated it within the Foundation to those people who would have to deal with the decision as to whether NSF would go forward and support this kind of a grand center and our boss was Randy Robertson the head of our division

and he was very, very positive towards the idea and thought it exciting for NSF to explore the prospect of supporting a major center within the university community. It was to be a – it was a first and unique thing to do, and then above Randy was Dr. Waterman, the Director of the National Science Foundation, and his Assistant Director Paul Klobsteg and so these three people played a very, very important role in the NSF excepting the plans for the center and selling it both to the National Science Board and to the Congress later on.

White: That's right. The Chairman of the National Science Board in those days going back from memory wasn't that Bronk, Detlev Bronk.

Droessler: Detlev Bronk yes.

White: He was involved in it to I mean he had to bless the whole thing but it went through very fast. When you think _____ the Berkner Report came out in early 1958, I think, and this whole thing took place within two years it was moving fast.

Droessler: Well I guess every once in a while you can get all of your ducks lined up in order you see. We had Dr. Bronk who was at that time the President of the National Academy of Sciences and also serving as the Chairman of the National Science Board and since the recommendation came out of the National Academy of Sciences and he had to sign off on it. He knew a lot about the atmospheric sciences and about the general scheme for such a center and was quite positive. The decision was made by the National Science Board when they were meeting in Jackson Hole, Wyoming, and neither of us attended that meeting, but Randy Robertson did and Paul Klopsteg attended the meeting and the word that I got back is that Paul Klopsteg made a very, very fine speech presentation of the National Center for Atmospheric Research. After that presentation by Klopsteg the Board voted favorably to move forward and except this as an NSF decision and asked the Science Foundation budget to be increased by the Congress and let's get on with establishing the center.

White: That's roughly the way I remember it. It seems a few short years ago but its really been forty years ago now so they aren't crystal clear but that's the way I remember it.

Droessler: Let me ask you Fred about the decision to name Walt Roberts as the Director of the National Center for Atmospheric Research. What is your recollection about that.

White: Going from memory now, Earl, as I remember this UCAR mechanism that was established under Henry Houghton appointed a committee to look into the director appointed a committee to look into site and they moved fast

within two or three months they came up with several candidates for director and several locations. When they focused in on Walt Roberts Walt urged them to have the Institute established in Colorado. He had been in Colorado for fifteen twenty years and he wanted the center to be set-up in Colorado. He also induced the City of Boulder to donate or to set aside some land, some beautiful land and all of these things focused in and he brought these recommendations to the science foundation and after some deliberation they went along with these recommendations. Is that the way you remember it?

Droessler: Yes, let me just add a few comments to your remarks, Fred. The first person that was asked to take on the directorship was Tom Malone and he was the choice of the UCAR committee and the UCAR board at that time. Tom came to Dr. Waterman and said, look, he said I have made a commitment at the Travelers that I am just not in a position to give up at this time and maintain my integrity and I hope you will understand that. To be director of this national center would be a wonderful, wonderful thing in my career but at this time I'm just not free to except that responsibility and Dr. Waterman said, "Fine, Tom, we understand," and the next person that was asked was Jim Van Allen, the upper atmospheric physicist at the University of Iowa, and Jim simply said no, no way was he going to leave Iowa because he was developing the Jim Van Allen faculty and students program at the University of Iowa and he had made a serious commitment there and he was also very, very happy there and he had a whole stream of funds coming from the federal government to support that work. So then the committee which was chaired by Dick Kassander, you know, cast around about the country. They had a list of about ten or more outstanding people who were under consideration for the directorship and I was privy to see that list, and one of the persons on the list was Walt Roberts. I found myself in New York City with Sverre Petterssen, Tom Malone, Berkner, Walt Roberts and others attending a wonderful banquet and evening given by a commercial group of people in New York City that Bronk had brought together to get them just knowledgeable about this national center at the atmospheric sciences program. I sat with Walt and I had known him from ONR days when he came to ONR and received a research grant for his solar terrestrial research at Mt. Climax in Colorado but you know I didn't know him all that well but I knew who he was and we sat down and talked. I was convinced myself that he should be the director. I just thought that he was the ideal person and so I twisted his arm for at least a couple of hours that evening sitting next to him having dinner with him and I'm not sure that this was the most effective push on Walt but anyway he did accept and I think we just had a very, very fine director to begin the National Center for Atmospheric Research. He not only was comfortable within the scientific community and with our field of meteorology but he also was comfortable in coming to Washington and

talking to the two of us and to Randy and to Dr. Waterman and to the National Science Board and whoever else.

White: Yes I think atmospheric sciences were very fortunate to have Walt Roberts as the first director, first president of UCAR. I don't know of anyone that could have gotten the whole community together the way that he did to develop this fifty million-dollar a year operation. I remember visiting Boulder oh this would have been early 1960's just after Walt Roberts had been appointed director. They had offices down in some temporary building but already he was getting a lab together. Getting a few scientists together – they have offices and they were working and it was really a pleasure to know the man.

Droessler: Yes, I think he's very outstanding. I want to go back just a minute and add a postscript on why we were so fortunate in the atmospheric sciences I mean not just you and I personally but our whole science in getting this new level of support for the entire field of research which included the establishment of this national center. One thing happened at that time to is that the federal government got together and we had support from all of the agencies, from all the important agencies the Defense Department, the Commerce Department where the Weather Bureau was located and the Agricultural Department so we all spoke with one voice. That, too, I think is kind of a rare opportunity and occasion and I remember I appreciated it at that time because this was a gigantic step for the National Science Foundation to take.

White: I think that really started back in the Defense Department when you were there. That was the start of getting the government together but then when the NSF got started you organized I think the name was Interdepartmental Committee on Atmospheric Sciences but don't hold me to that but I think.

Droessler: ICAS.

White: ICAS that's it ICAS and I remember we used to meet usually in NSF and you chaired the original ICAS and I think I helped put together the first ten reports of ICAS when we spelled out the year by year activities and the money and what money was going to and trying to develop a more cooperative spirit. Thinking back before that in the days of the Weather Bureau there was very little interdepartmental cooperation. Each agency was jealous of the other agency. Each agency was trying to do there own program but they didn't have the extra mural program that the government developed during the ICAS years. I remember we used to try to break out how much of the money went to in house and how much of the money went to universities and that was the start of atmospheric sciences. When you've got more then the government interested and you have got the

universities working and expanding. You have got industry beginning to come into it and that was the start.

Droessler: Before the National Science Foundation got into the business of supporting the atmospheric sciences almost all of atmospheric sciences was within the federal government.

White: Right.

Droessler: We had twelve universities that had graduate programs but these graduate programs were very very small as compared to programs today and they were started by the federal government, mainly the Defense Department to train meteorologists for World War II activities. So there was no industrial meteorology at that time. That was not that great arm of private meteorology. Everything was within the federal government and then the National Sciences Foundation sort of broke that open and gave a share of the future development of atmospheric sciences particularly to the university community and I think that was a very important step to be taken as we look back and reflect on how atmospheric sciences came from such a small beginning in the mid 1950's to what it is today.

White: Yes the formation of NSF was a big concern to other government agencies. I can remember _____ I announced I was going to join you at NSF and his concern was that well the Weather Bureau can provide all the leadership that NSF can provide. I said yes but you won't give the money out to the university you will keep in for in house and he said but we could develop an extramural program but the fact that NSF was organized to do this to support basic research out in the universities that was the key and you certainly kept pushing it and the way NSF was organized kept pushing it so that was the start.

Droessler: Well that was the charter of NSF.

White: Right.

Droessler: See NSF was an independent free standing federal agency that had one goal to reach and that was to provide funds and support and encouragement to basic research throughout the nation and most of the basic research was being accomplished within the university graduate training programs.

White: Right.

Droessler: And to Dr. Grikelderfer's credit though he was really a great man in Washington the last of the chiefs and represented us well. I mean as a community of meteorologists before the presidents and all of the other

government agencies he was a member of the National Academy of Sciences and he was the one who went to Detbronk and said look I need a committee within the Academy to help me to examine the meteorology, the U.S. Weather Bureau its relations with the military and so forth and help us to sort of look ahead. That was the – and they gave some support to the Academy for doing this. That was a committee on meteorology, which later was supported also by the National Science Foundation, and then that committee itself changed its name to the Committee on Atmospheric Sciences. _____ never did openly oppose the NSF and the NSF programs and so publicly he was there supporting us. He also served on the Orville Committee and while he didn't like a lot of what was going on that Committee because I knew I was representing the Department of Defense, nonetheless he made his point as vigorously and as certainly as he could and he was a very very elegant committee member and could make a point and make recommendations and so forth as good and better then anybody but when the committee came together and issued its final report which included this recommendation that the NSF support a basic research and weather modification ___ went along with that too.

White: That's right.

Droessler: And so we – he must have known down inside of himself that within the Commerce Department he had limitations on what he could do and could not do in an extramural program.

White: That's right, right. Well back to UCAR now – after the site was selected, after the director selected, after they started organizing the laboratory. We had know idea how big it was going to grow, how many people – the size of the laboratory. I don't ever remember that being discussed. They needed a building and the university group went out and looked at the various architects and they finally selected Pay I.M. Pay. I think that was Walt Roberts' number one suggestion and he brought it to the Science Foundation and the Science Foundation signed off on it. I can remember meeting down in the auditorium of the old NSF building when Pay came in and presented his suggestions and the Science Foundation bought and it was a masterful architectural job. He designed things that I just didn't visualize but he did a goo job. Then it took a couple of years to build it while the staff was growing all that time. When was the dedication along about 1966 or 1967 I remember we both went to the dedication out there. It was held in the lobby of the new building and I can remember Walt Roberts up there thanking you for your guidance and leadership during the years and that was the mortar, that was the building that was the start of the laboratory and since then UCAR/NCAR has just been steadily climbing up.

Droessler: Well even in the early days when Walt took over as the director of the center he would speak before the Board of Trustees and I was always invited to come as an observer to the Board of Trustees. I didn't make them all but I was invited to be present and so I was there quite a bit of the time and he always said that he would like to limit the laboratory to more then five hundred people. He said five hundred people is the reach of one man, one person can lead or direct a laboratory of this sort of five hundred people. Once it gets beyond five hundred people then his reach has been overextended and he must have other people in to help him vice presidents and so forth and then as a leader the type of leadership he wanted to give which is what he did give, and that is to personally know all of the members of the NCAR staff from the janitors on up to the chief scientists and to be familiar in real ways with the research activities of the center and the outreach the center had in its mission to provide aircraft and other equipment to the universities. So he spoke very warmly about that and held to that as long I think, as he was the director of the center.

White: Yes he certainly knew the building inside out. Shortly after the building was constructed I was out there and he gave me a personal tour from the basement to the top, stairways, labs everything else and he knew every brick in the building but he was a good director. Well there is just one more thing Earl in the early days of UCAR NCAR that I think we ought to bring up. The yearly budget battle and I guess it still goes on today when UCAR would bring a budget to us I remember you would argue long and hard with Walt and your staff about the various things and in the end we would argue with Randy Robertson. It would have to go up to the director; it would have to go to the National Science Board. It was not an easy thing to get the funds that materialized for UCAR and NCAR. We certainly didn't get everything that they wanted. The battles over the computers sometimes they would go on for two three years before we would be able to get the adequate funds for some expensive items aircraft, laboratories. Working together working between your office the rest of the foundation, working with Walt and his staff we worked together and we managed to put the whole thing together.

Droessler: In some ways when you look back it is a little bit like a miracle that we were able to get the money to build a building. That was a separate amount of money over there you know that had to be tucked into the NSF budget and argued out on the hill and then maintained in the budget and then that budget was transferred into a contract with UCAR for the building of that splendid building out there and at the same time while the building consideration was under way we had to be always watchful that we didn't let the scientific program down and the orderly development and enhancement of the scientific staff and the scientific activities at UCAR NCAR so I'm glad you brought that up because I can share your view you know that you and I had to work pretty hard sometimes.

White: Yes and after you left the Science Foundation and went to Albany you continued to remain very deeply involved with UCAR. You served on their Board of Trustees, became their President of the Board of Trustees for a term. I continued to try to handle the situation in Washington. It became bigger and bigger when I retired from the foundation. The budget was up to seventy-six million dollars in atmospheric sciences I remember. I forget what NCAR was getting but they were getting around forty million I think something like that. They are up to sixty seventy million today I believe, but its always been a struggle to get the money that was needed but over a lifetime now we've seen a very very good institute develop. Now before we leave UCAR let's spend just a few minutes and review the mechanisms as a review ____ both within the NSF and within UCAR. As I remember it one of the first things that you did was to develop an advisory panel for atmospheric sciences. One of the jobs of this advisory panel as I remember each minute at each meeting you spent oh twenty/thirty percent of the time talking about NCAR what NCAR was doing and what NCAR wanted to do and how it was coming along. I remember the big issues, the big issues like computers the advisory panel up and down advising you whether to support it or not whether not to support it. Now within UCAR UCAR had its Board of Trustees which served as an advisory guiding light to Walt Roberts then they developed there internal revere mechanisms there spec reviews where they would review different segments of NCAR every three years. After you left the foundation I remember the advisory panel that I had conducted an in depth review at Boulder. Bill Gordon who was the Chairman of the Advisory Panel at that time took the whole committee out there and we broke into groups and looked at each section of NCAR. The point I am trying to make is that NCAR/UCAR was allowed to grow but everyone was looking over there shoulder both within NCAR science and within the foundation side so that it grew into a health organization with a lot of guidance. Now do you remember it that way.

Droessler: Yes very much so and I think that the relationship between UCAR the corporation and the National Science Foundation was always a good and a strong one but we in the National Science Foundation always kept our ability and our interest in asking hard questions of the management of the national center. We would have the director of the national center come in, we would have Walt Roberts the President of UCAR come in and we would have some of the division leaders from the NCAR come into the NSF when they were defending there budget. We with our panel would ask some very penetrating and some very hard questions and making sure you see in our own minds that we had a sound and good program that we were backing at the national center.

White: It was even broader then that as I think back on it. I can recall that the National Science Board the highest science board in the country in those days met in Boulder at least two to three times in my lifetime.

Droessler: Right.

White: And that was fundamental. Here were physicists, chemists, astronomers, and biologists looking at NCAR so they were looked at by many groups.

Droessler: Yes and NCAR at that time would put on a program before the National Science Board and let them know what they were doing at that time, where they were and what was up ahead.

White: I don't think that's being done these days but maybe it is. I haven't heard of the National Science Board being out there in the last ten years but maybe they have been.

Droessler: I'm not sure either because I am out of the loop just like you are Fred and when you are out of the loop your out of the loop.

White: Right.

Droessler: And this kind of information doesn't roll to you as readily as it did when we were there as part of the mechanism. Fred I think that we may have finished the UCAR NCAR NSF connections and of course if anything comes to our mind later on we can always pause and insert it. I would suggest that we now move over to the field of meteorology called weather modification because that was a very very interesting task that we did within the National Science Foundation and for the U.S.A. to provide the support and underpinning for weather modification research. After NSF received this authority from the Congress and received additional budget to pursue this program. So why don't you start by making some remarks about that weather modification program.

White: Okay just to think back you mentioned earlier the Orville Committee, the report of the Orville Committee, the act by Congress, the setting up of the Science Foundation Program in Atmospheric Sciences which met with the modification was a big thing. 1958 when I first ____ NSF I don't think we were receiving over a half a dozen proposals per year which were directed toward weather modification. The word went out to universities, the word went out to the world that money was available in weather modification. It was slow in developing but over the next ten years you put together a program that was more then likely pulling in thirty to forty proposals and we were spending three million dollars a year in support of weather modification. Now one of the big things in weather modification as I remember were the annual reports which you first started in response

to the congressional act. We were reviewing the entire federal program in weather modification. Each one of these ___ had some weather modification activity. The agricultural service had a program boy I can't remember the name I can't pull a name on it right now.

Droessler: Lightening suppression.

White: What.

Droessler: Lightening suppression.

White: Lightening suppression and this was something Montana or something.

Droessler: Ah ha.

White: Oh yeah lightening – what was the name of the man you see.

Droessler: Thurqui.

White: Yeah that's it, that's it, that's it Thurqui and interior of course had a program, the Weather Bureau had a program, the Defense Department had a program and you coordinated them all together in this annual report which was published and I bet in my library some place I still have copies of all of those reports but that will start with the weather modification you say something now.

Droessler: I'm glad you recall that because you see again mentioned something which was unique in the government and which only the National Science Foundation probably could move forward and that is the collaboration cooperation and coordination of the total federal programs. We did not have a special mission axe to grind because our mission was a general one to support basic research and so we were the obvious agency I thought to bring the federal government agencies together for discussions and for work sessions and to help us develop the information needed for these annual reports which as you mentioned as called for in the Public Law 510. You may remember every year we would have a weather modification review group up in the Skyline Drive and we would take all of these folks off from the government agencies and we would bring in a few of the science leaders and have a program up there and we would all get together and we would do some planning about what our agencies were going to do the next year and that way we started to learn to work together.

White: The weather modification activities started in 1958 I recall the last Skyline meeting that I chaired which was about 1974/1975 but weather modification was transferred within the science foundation from the

atmospheric sciences over to a new outfit called RAND don't tell me Research Applied to the Nation's Need I think it was and the program director for meteorology when it was transferred over to that division about that time.

Droessler: That was Peter Wykoff wasn't it.

White: It was after Pete died I believe Ed Barry is the name that sticks in my mind.

Droessler: I see he moved from your program atmospheric sciences over to the.

White: Maybe Pete Wykoff was still alive and went over there first.

Droessler: I believe he did.

White: But I remember Ed Barry was there and then they dropped the special charge to NSF to develop weather modification and in these days weather modification is way way down but I still think it's a very very critical thing to the atmospheric sciences.

Droessler: Well it certainly was at that time it gave us another heading under which to support basic and applied research. The first year of the Weather Modification Program Dr. Waterman made available one million dollars out of his reserve so that we could get started.

END OF TAPE 1, SIDE 1

Interview with Fred White

TAPE 1, SIDE 2

Droessler: So we had the money from Dr. Waterman to begin the program in weather modification research and then it was up to us to get on the phone and travel around and beat the bushes and bring some proposals in because this was a very unique program to the National Science Foundation. It was the first applied research program within the Foundation and it was a good deal of internal discussion about whether or not the NSF was on the right track by excepting this responsibility from Congress. After all what could we do, there was a public law and the public law said NSF get busy and so we did our best at that time and I think the program went along splendidly for a number of years. Once it was transferred out from the Atmospheric Sciences Program though it lost its nurturing within NSF because you know the engineers didn't have that much of a feel for this kind of research and the importance of getting on with it. Then when the Public

Law 510 was rescinded that to lowered the interest and nurturing within the National Science Foundation for this program but what the heck we had a good long run there and that's all you can ask for in this world.

White: I retired from the Foundation one of the first things that I decided to do was to take a staff job in the Department of Commerce NOAA or ESA I think it was NOAA. They set up a national advisory weather modification national advisory committee I forget the exact title of the committee, Harland Cleveland was the chairman of it. About twenty people served on the committee for one year and we tried to assess weather modification point a guide toward the future. I thought a very nice report came out of it around about oh 1978, 1980 some time along in there and but it didn't catch on. Nothing materialized out of that study.

Droessler: One of the other accomplishments of the National Science Foundation of which I am really quite proud is that we were able to support some individual meteorological research activities and the first one was the support of Bernie Vonagut at Arthur D. Little and this raised a lot of questions within the National Science Foundation because among other things we were supporting a for profit organization and there overhead rate was not twenty percent which was the standard rate in the National Science Foundation at that time but it was one hundred percent. (Laughter) So weaving this proposal and the recommendation had to be supported through the Foundation was quite a lot of work at that time and it would never have happened. That is a research contract would never have been issued except that Dr. Waterman intervened and said look we have this public law and the public law does not state that all of the funds must be spent at the universities and we must spend these funds in weather modification where ever we find expertise and where ever we find good management for the research work and following that lead then we were able to support Bob Elliot and some research and analytical studies that he wanted to do and just this morning when I was sitting at the CCM meeting next to Tom Henderson he reminded me that NSF provided a research grant to Tom Henderson's company and this was for the analysis and publication of the results of his contract work that he had accomplished in the field for say a decade or so.

White: I remember we had a proposal from Bob White in Traveler when Bob White was the director of Traveler's Research and I forget whether we supported it but I remember the proposal. So yes we did get into the industrial business and it was new for NSF.

Droessler: Oh yes we cut some new ground for the National Science Foundation.

White: Yes.

Droessler: And we were very fortunate to have the folks like Randy Robertson fully behind us and Paul Klobsteg the assistant director and the director Allan Waterman. They shared our vision of our community that this was something worthwhile and that we were doing something that would have a great benefit for the application and technology in meteorology and our field of meteorology was right for this kind of general support.

White: There were some very fundamental work done in weather modification too. Roscoe Bram's work, Peter Hobbs work, Lou Batton's work, Dick Cassandra's work, Workman's work down in New Mexico very fundamental work under the name of weather modification was important to science.

Droessler: One of the ventures that we were able to accomplish was with the U.S. Weather Bureau and we support the modification of the hurricane research fleet so that they could dispense dry ice and this was done under a proposal that we received through the Weather Bureau from Bob Simpson who at that time was a director of the National Hurricane Center in Miami. That led to the opportunity for the U.S. Weather Service to selectively seed several of the hurricanes. So you know the NSF again did not limit itself through the support of universities especially on this program in weather modification but reached out we supported the Agriculture Department and the U.S. Forest Service to expand somewhat and to analyze the information that they were receiving on hail suppression. We never did support the interior department because they always had adequate funds. They were in the business of precipitation increase because the interior departments bureau of reclamation was the federal government's manager of the western water resources of our nation and if weather modification techniques could bring about an increase in precipitation and the supply of water this was all on the positive side as far as the Bureau of Reclamation was concerned and that was a very active and far sided group over there in the Bureau of Reclamation and they made there own way through the Congress and got the funds to support there program. Fred there are two people that I would like to mention before we leave weather modification. One is Captain Howard Orville who followed the weather modification activities within NSF as we started the program and moved along and I still have today a note that I received from him which said Earl I don't think you are asking for enough money for weather modification research. Look what the oceanographers have done and I still – I treasure that note from Captain Orville and did have an opportunity to get back to him and tell him that funds within the National Science Foundation are tied to the community that they serve and that one of the problems we had and opportunities we had in weather modification research was to develop the community engineers, chemists, meteorologists they were just not in the business of doing this kind of research statisticians and so there was a limit to the amount of money that

we could usefully employee in the weather modification research activity. Whether we are always pushing that limit or not I can't say because that's a difficult call to make, but anyway he was a great supporter of the program and continued to be so throughout his life. The other person I would like to remember in these remarks is Ruben Gustoffson who at one time was the President of the University of Nebraska and then he moved to Washington to become the President of the Resources for the Future. The NSF picked him to be the first chairman for our weather modification advisory committee and we certainly made the best choice there that we possibly could. He was a big midwestern man with a big hand and a big smile and a lot of intelligence to go along with that. So again he was able to present our program before the congressional committees, before the Congressman and Senators with a great deal of fielding and these two people really helped us a great deal in moving that weather modification research program up and onwards within the National Science Foundation. I wonder if there are others that came to your mind Fred that you might wish to mention.

White: Well you had an awful lot of good scientists on your weather modification advisory committee. They gave a lot of good advice – I am trying to think of the man's name a member of the National Academy of Science and worked for – was up at Dartmouth New Hampshire what was his name. I can't pull this fellow's name out of my head right now it will come to me in a minute. Well other people like John Tukie was on it.

Droessler: From Princeton ah ha.

White: Max Woodbury a famous statistician was advising but there were a lot of people involved in weather modification a lot of good people involved in weather modification.

Droessler: Well we drew in the best statisticians in the country and asked them for their help to give us there very best ability from a statistical analysis point of view to design field experiments and then those field experiments we would have some ability to analyze and determine whether or not we were having any effect that is whether man was having any effect on increasing precipitation producing more snow fall or diminishing the lightening production in the atmosphere. So that was kind of a nice thing to do because we met a lot of wonderful people that we wouldn't have met otherwise. I remember the famous statistician from UCLA Jersey Nerman my word you know he was one of the best in the world along with Tukie and Curly Lucas from North Carolina State University and they all jumped in to help us. I think in part because they wanted to do what they could to help the NSF and to help the program in weather modification to design and evaluate the best kind of field activity that we knew how to put out into the field.

White: Okay Earl there are a couple of other things before we stop on NSF. Besides developing atmospheric sciences weather modification looking at some specifics I will always remember how you developed a program to start new groups. This was unheard of in the Science Foundation. You had to get special approval from the National Science Board but you developed a program that would start new groups, such groups as Colorado State, University of Oklahoma, University of Nevada where you would give a chunk of money to the university to go out and hire a meteorologist to develop a program. You were supported for three years and at that time the university would take over South Dakota School of Minds.

Droessler: Right.

White: New Mexico Institute of Mining and Technology these were places that's one thing I would like to mention. Another thing I would like to mention is block – what referred to as block grants. NSF in the 1960's early 1960's had the reputation of small grants one year twenty thousand dollars, thirty thousand dollar grant to an individual. By 1965, 1966 in there we had developed a reputation of giving a block grant to a principal investigator which would support him for five years, support him and some graduate students for five years. Some of the big ones I remember were Charney at MIT; he developed an enormous number of graduate students that owe their development to NSF. The third thing that I ought to mention is the development of major facilities. Besides NCAR development of the aircraft facility, the field ____ facility at NCAR, the Langmur Observatory in New Mexico owes its credit to NSF and this is all back to your guidance.

Droessler: Well thank you very much for recalling that because we did I think break a little ground in the National Science Foundation by insisting that some of our people in weather modification research and in meteorology would be better served it we could issue two, three and up to five year research grants and also the National Science Board approved for general use in NSF the idea of supporting facilities and I think we picked that up real quick because we needed facilities in our field. Ours was a developing field; we had very very few university groups in it so I think that all added measurably to the growth of the atmospheric sciences in all of its dimension. Another thing that we did at NSF, which I thought, proved to be very valuable. We defined the field of atmospheric sciences as that field of scientific activity which included the atmosphere of the sun in which the earth and other planets were imbedded and this gave us a outreach in atmospheric sciences in such areas as solar terrestrial research and also in agronomy the high atmosphere and as our atmosphere blends into our space you see that whole area could be supported if we found

proposals that came in from scientists. So we had agronomy we had solar terrestrial research, meteorology, weather modification we had about five or six programs there and I think by taking the broad view of atmospheric sciences NSF did a real service to this field of activity and I'm delighted that we did it because again we had an opportunity to meet and get acquainted with and support scientists of many kinds. We support a physicist, we supported engineers, we supported chemists and just to name three and so we were a field of activity within NSF that did not put barriers on the kind of person that we would support. I remember by ____ program directors in chemistry and mathematics and physics were a ___ when they would talk to me and find out that we in atmospheric sciences would support mathematicians, statisticians, physicists and chemists because in their fields within NSF if you weren't a registered chemist you didn't get a grant from the chemistry program and if you weren't a mathematician you didn't get a grant from the mathematics program and the same thing happened in physics and the same thing happened in astronomy but then they were different from us because they were larger older more developed fields especially fields like chemistry and physics as compared to atmospheric sciences. We were just at the beginning of our development.

White: Yes you're absolutely right Earl. We actually started a program in atmospheric chemistry in the early 1970's this was shortly after you left and I remember arguing with the head of the chemistry program. He was against atmospheric sciences starting an atmospheric chemistry program for the reasons that you just synthesized but when it went to the Science Board they backed me up and we started the program and atmospheric chemistry now is one of the biggest fields in atmospheric sciences.

Droessler: It's not only big but it's a very productive field and its in training a lot of the best minds that we have in atmospheric sciences because the chemistry of the atmosphere is an immense puzzle that has to be sorted out but that same program director in the National Science Foundation in the chemistry program would not support atmospheric related problems. At the same time he didn't want to use one of his favorite words you see.

White: Chemistry.

Droessler: Chemistry.

White: Right.

Droessler: Well I'm glad that you stuck by your guns and did it Fred because that certainly has been a very productive field and at the national meetings you know where they have the atmospheric chemists coming together they are

a very exciting group of young people discussing some wonderful research work that they have under way.

END OF INTERVIEW