

**National Center for Atmospheric Research  
University Corporation for Atmospheric Research**

**ORAL HISTORY PROJECT**

**Interview of:  
Nelder Medrud  
26 May 1988**

**Interviewer:  
Kristen Rasmussen**

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Rasmussen: —Rasmussen, on the 26th of May, 1988, at the Mesa Lab of NCAR. The first question is about your education and your research before you came to NCAR. You want to give us just a brief run-down of your life's history?

Medrud: My background in education has been rather mixed. I was never privileged to go through college, for instance, as most people do, that is, go to a school, go through four years, and finish. I had about a semester prior to World War II, when I volunteered for service during the war. On returning from the war, I attended one academic year at the University of Utah and thereafter returned to the Air Force for military training in meteorology. I got—most of the education for my bachelor's degree was obtained at night through various schools, so that when I finally obtained a degree from the University of Alaska, with a major in general science with an emphasis in physics, I had attended perhaps six or seven different colleges. It was the aggregate of credits that permitted me to do this.

Rasmussen: [laughs] Sounds more like the '60s!

Medrud: [laughs] Yeah. It was, in a way. Thereafter I again attended night school, was accepted for graduate school at the Pennsylvania State University, where I obtained a master's, again with a short time in school and a lot of hard work afterward, and was selected for two years of education toward a doctorate at the University of Stockholm some years later. That was between '60 and '62.

Rasmussen: And that was all in meteorology, the master's?

Medrud: The master's work was in meteorology, and the post-master's work in Stockholm was also. I had hoped to complete a doctorate there, or the *Filosofie licentiat*, which was their basic degree, but I was unable to do it in the two academic years that were allowed. I was in the Air Force. The Air Force had a job for which they felt I was particularly suited, and they asked me to terminate the training and assume this particular job.

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Rasmussen: Which was what?

Medrud: It was as a staff meteorologist to the research and technology division in the aeronautical systems division of the Air Force Systems Command at Wright-Patterson. It was really the management of a small corps of consultants to the engineering efforts of those two divisions. I should perhaps add that after coming to NCAR I again hoped to complete the doctorate that was unfinished and started at the University of Colorado in the geography department in climate, where I think I needed only 15 or 17 credits and a dissertation, but my assignment at NCAR changed, involved a lot of fieldwork, and ultimately I dropped the goal.

Rasmussen: So your whole background is meteorology rather than chemistry?

Medrud: That's correct. I've only a minimal amount of chemistry, I think a year and a half. We do have meteorology underway, an insignificant degree within the atmospheric chemistry division. We have a full-time meteorologist whom I supervised who serves as a consultant to the chemical research.

Rasmussen: And who is that?

Medrud: That's Phil Haagenson. So the background is quite useful, but it is not directly chemistry, which is a mainstream effort.

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Rasmussen: Let me see if I've got the dates straightened out here. Obviously you were in the war and you were in school for some time after that. When were you in Sweden?

Medrud: I was in Sweden from 1960 to '62.

Rasmussen: And then you came back here to be the staff meteorologist?

Medrud: This was at Wright-Patterson Air Force Base.

Rasmussen: How did you learn about NCAR?

Medrud: During my tenure as a student in Stockholm, which was incidentally coincident with Phil Thompson's, one of his period there as a staff member and with Paul Crutzen as a fellow student, I became acquainted with the existence of NCAR primarily through Phil Thompson. And then in 1963, I believe, my wife and I and our two children undertake a See America vacation of some three weeks. We stopped in—oh, and Henry van de Boogaard was also a student there in those years—so we stopped in Boulder to visit them and coincidentally NCAR. We fell in love with the area, thought how wonderful it would be to live here. Also, NCAR was doing research something like the Institute for Meteorology at the University of Stockholm. And I found that something much to my liking as well.

So it was in a way two dreams coming true when an opening occurred here at precisely the time I was able to leave the Air Force.

Rasmussen: What kind of an opening was that?

Medrud: Applied climatology was my principal specialty during my military years, and in 1966, there opened a group which is something like the present-day ESG, that is, it undertook applied research, was its intention. It existed only three years, and the UCAR board decided that once more they would emphasize only basic research at NCAR. But during that period there gathered a small group of people of mixed discipline who were to seek applications to societal problems of the basic research results that were coming out of the basic area here.

Rasmussen: So that's how you came in. When you came here, what did you expect to do, to accomplish?

Medrud: It was to work in this particular group, called a Program in Applications Analysis. The immediate focus was on the matter of the consequences of hail to society. The National Hail Research Program was just in being, and our purpose initially was to make a contribution to the application of the results of hail research to societal needs. We were diverted in large part into research on a location for a new observatory for the High Altitude Observatory, and I spent perhaps most of six years in research on the problems of astronomers in getting the highest quality observations from earth-based stations. It involved a fair amount of travel, which was enjoyable, a lot of applied research, which I likewise enjoyed, and ultimately, insofar as NCAR was concerned, it came not to naught, because the research was use elsewhere, but a decision was made in regard to the observatory that for that small aspect of their research which was ground-based to remain, it would be done at Sacramento Peak, and that their principal focus would be into space, where observations of the

corona and other activity of the sun are less prone to atmospheric distortion.

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Rasmussen: What were some of the sites you were looking at?

Medrud: We looked at quite a large number worldwide, in Nepal, in Peru, Chacaltaya. The final emphasis was reduced to three or four, one in Arizona for its convenience, Hawaii because of the extremely stable boundary layer area there, with a focus on Mauna Loa, which lacks vegetation at its higher elevations, and near La Serena in Chile, where elevations were higher and where the surface inversion above the boundary layer probably produces as stable of conditions as exist in the world. It's since become an incredibly paper place. Observatories have sprung up in that area almost like hair on a dog. [laughs] At the time we went, there was only one small one.

Rasmussen: Was that before the Mauna Loa solar observatory went in?

Medrud: There were observations being taken at Mauna Loa by the HAO with their coronagraph already, and of course the University of Hawaii's efforts on Mauna Kea were well in progress.

Rasmussen: And now there's a NOAA site out there, too, I guess.

Medrud: I think so. I'm not sure. I haven't visited in many years.

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Rasmussen: When you came here, what did you think of NCAR, when you first got here?

Medrud: Physically, the first few weeks I drove up the mesa, which was in September of '66, and found the Flatirons glowing purple in the morning sun. I actually got little shivers of delight. I couldn't believe that I was working in a place of such utter beauty. And then the research in particular was exactly the kind of thing I wanted to do and was most experienced in. And so overall it was a tremendous delight to be here and to work here. I had wonderful colleagues, excellent interrelationships through NCAR. It was smaller and more family-like in those days. I don't think I could have found a place in which I would have felt so warm about working and so proud to be a part of.

Rasmussen: That's a pretty glowing recommendation!

Medrud: It's a fine place. It still is.

Rasmussen: Let me pause here for a minute. The question is, how did the NCAR staff help or hinder you in achieving your goals?

Medrud: I think I can say that particularly in the early days, I could point to nothing but help. The warm relationships that existed at every turn. We had not grown sufficiently in those days or had made enough mistakes that we had to have dozens of policies to cover each new mistake that occurred.

Rasmussen: [laughs]

Medrud: It was, I think, an idyllic place. I'm deeply grateful to Walter Roberts for his encouragement, and I have admired him and his efforts all my life. John Firor was the earlier director of HAO when I arrived, and as I've stated earlier, my earliest research was on HAO's behalf. He was exceedingly helpful there and after his move to NCAR to become its director. Gordon Newkirk followed him, and I moved, on the demise of the program on applications analysis, I continued my work in the High Altitude Observatory until their decision to use orbital platforms for observations. During that period I was responsible directly to Gordon Newkirk, who was the director and who also was very supportive, as was the entire staff at HAO.

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In those days, too, one had the assistance of professional programmers. You didn't have to do much of your own programming. It was a wonderful thing to have available some very bright young doctoral students to do the programming and keep things on the right track. A beautiful time, overall.

Rasmussen: After the program for application analysis folded, you said that went on for three years, you were in HAO for a while?

Medrud: Yes.

Rasmussen: How did you move onward? What other projects were you on?

Medrud: I've tried to keep moving. About the time people are going to catch up to me, I try to move on to another location. [laughs]

Rasmussen: Aha! [laughs]

Medrud: At the time that program was terminated, there were three possibilities that appeared within NCAR that seemed appropriate to my background. One was with the computing division, which was not as directly appropriate as the others. One was with the research systems facility, and one with the field observing facility. I was given my choice of the three. I choose the

research systems facility and then had my mind changed by the director of ATD, who decided that the need was really greater in FOF. So I began a five-year tenure with FOF, principally as a project manager on field projects, the oversight of radar field projects in particular. But the most exciting of all, the management of the logistic aspects of the 1973 eclipse in West Africa, where I spent three months with a crew of FOF people, setting up a research facility there for experimenters who came for one month and observed the eclipse.

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Rasmussen: How was it that FOF became involved in that kind of thing? I know they no longer would be.

Medrud: In the early days, they were often made the managerial agency for NSF-type projects. I think this occurred during the Gate [?] period, and that was probably the last one. Some were internal to NCAR and some were sponsored by NSF. A number of eclipse expeditions which were undertaken on HAO's part but had much of the logistics done by FOF staff. I think this occurred principally because it was a repository of expertise in that area. FOF was regularly on field trips, and the project engineers or project scientists there, the majors, had a great deal of background in it. A number of people doing this in the early days, when this was a focus, were people with military backgrounds who had experience, so I think it was a natural progression.

Rasmussen: How did that come to an end?

Medrud: I'm not quite sure, but it's clear that there was a management decision that the focus of NCAR's work would be more nearly on its—on supporting individual university research and supporting NCAR's scientific research. There have been large projects in which there's been an NCAR participation since. The Monex Expedition in India, for instance, is one. But there's tended to be outside management. FOF resources were focused more on the acquisition of data thereafter rather than the provision of a managerial resource for putting expeditions of other people in the field.

Rasmussen: That's interesting, because now Dick Dirks's Office of Field Support—well, actually, no, that's in MQ, isn't it? I thought it was moving back in. I'm pretty sure it's in MQ.

Medrud: I thought it was UCAR.

Rasmussen: It was the director's office for a while, and over in UCAR they have \_\_\_\_.

Medrud: I think we just have to recognize that these things may have a cyclical nature. It's like the program on applications analysis, which was an

applied research program within NCAR. A policy change led to its demise, and then several years later we had ESG formed, performing quite parallel functions, and it continues to this day. Perhaps some time in the future they'll be a decision again that we should do only basic research.

Rasmussen: Yeah, I guess they worry about that somewhat over there! When ESG formed, were you interested in going back into that field?

Medrud: I was decidedly interesting, but I was at a disadvantage in that I was absent from the area on one of the many field trips, and I never got—I gave an expression of interest, but I was never able to follow up, nor were people able to talk with me. That happened, actually, on a couple of occasions in my career, when there were either major openings for which I felt qualified or things like the formation of ESG occurred, and I simply was not in a position because of my duties with the field observing facility to put forward my case properly. And in some cases not at all. I'd find out it had happened on my return.

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Rasmussen: When you would go on these field projects, how long would you tend to be gone?

Medrud: It was quite variable. There were those that were only three or four weeks in duration, and the maximum, I think, was the eclipse expedition in West Africa, which was about three months. An intermediate expedition in the savannah area in Venezuela was about two months. Mostly they tended to be a month, month and a half, two months.

Rasmussen: What was life like on those field trips? Did you always have the same crew?

Medrud: Normally—often you had different people. Most of time, I think that would be true. And living conditions and working conditions varied I guess to over-absolute extremes. On the eclipse expedition, it was in the middle of the Sahara in July on an oasis. Temperatures would reach 115 to 120 degrees. The sky was filled with dust. The dust blew visibly one day out of two, roughly. The sun didn't set, it just kind of faded away about 10 degrees above the horizon.

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There were health problems as well, in the earliest days. There's a period of acclimation to the extreme heat and the body desiccation which occurs. I recall drinking six liters of bottled water and you'll excuse the word not being able to piddle all day. [laughs]

Rasmussen: Goodness!

Medrud: There was one person who went three days without passing urine, and over whom I was beginning to panic, but finally, on the fourth day, he came through before some serious body poisoning set in. We slept on the cement floor or on the roof or out on the sand for the first—well, it was about the first month we were on our own. We were completely out of communication until the second week, when we were able to install a radio antenna of sufficient strength that we could contact the capital and ultimately the martial field site out here. On the positive side, we lived in hotels on a project in upstate New York, ate in restaurants, visited, when there was free time, some of the sites in the area, tasted the wine in upstate New York, and had a wonderful time. In contrast to the heat of Mauritania, we erected a radar dome on the shore of Lake Michigan in a snowstorm in the bitter cold. It was quite variable, sometimes pleasant and sometimes quite unpleasant, and always kind of marvelous in retrospect.

Rasmussen: Yeah, sure. The worst ones make the best stories!

Medrud: Yeah, they sure do.

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Rasmussen: I'm fascinated thinking of going off to these countries where there might be no other particular reason to go there except that scientific conditions would be good. How did you—for instance, the eclipse expedition, how do you choose one of those sites?

Medrud: I did the meteorological research which led to the choice of sites there. Weather data of the conventional kind is quite sparse. As we well know, the Sahara is not densely populated, nor are there the amenities at the few oases that exist which would permit the taking of weather observations. I relied mostly on satellite pictures to establish a cloud climatology for the area, and then chose those places of least frequent cloud cover, one of them being Chingeri. A second element of the research expedition went to Kenya, where they had much finer accommodations, but also a very exotic setting. I might add, too, that places like that are exotic. You encounter incredible problems in attempting to handle logistics. For the most part, people in Mauritania, which is in French West Africa, almost none spoke English. The educated spoke French. In preparation, I was given eight three-hour lessons with Madame Rose in Denver.

Rasmussen: [laughs]

Medrud: [laughs] So that I had a modest vocabulary in French. Which I admit I exercised tremendously.

Rasmussen: You probably got a bigger one before you left.



Medrud: It was interesting. We did have an interpreter we'd hired from the University of Colorado, a doctoral student in French, but when I got there, we'd shipped all the equipment via boat to Dakar and there we rented six-wheel-drive trucks to cross the desert with, and they were supposed to follow us into Mauritania but didn't show up within the week, and you might know my interpreter's visa ran out just at that time, and I had to make the trip to Dakar and conduct business myself. [laughs] So I did exercise my phrase book and my limited knowledge a great deal.

Rasmussen: Good for you!

Medrud: It was fun. But we had the good fortune to encounter a young African who was mixed Arab and black and who had an adequate knowledge of French to communicate, but also knew a number of dialects in Arabic. He and I became inseparable at the camp, because the French interpreter stayed in the capital. I owe him tremendously for the success of the expedition, a wonderful young man. Spoke English passably, French passably, and dialects fluently.

Rasmussen: Did he just happen in on your expedition?

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Medrud: It was very fortuitous. On the second field survey trip, we were in the American embassy, and because he spoke some English, he had come in to just look around and see the displays. We began the conversation, found out his background, recognized our need, and hired him on the spot.

Rasmussen: That's great. That's lucky. We might as well go on through some more of your time at NCAR. You were five years in FOF, which was up until what year?

Medrud: About '78.

Rasmussen: Where did you go after that?

Medrud: An opening came up at the aviation facility for the manager of project managers, in effect. Although I received no promotion in terms of classification, it was a challenge, a new area. My military history is in aviation also, so I had a good fit, I had experience in project management and I had a background in aviation. It was certainly one step higher in terms of the responsibility, although there was no change in classification associated. So I applied for it and was fortunate to be appointed to work out there. As I said, instead of managing projects, it was managing project managers.

Rasmussen: Did that mean you weren't going out in the field so much?

Medrud: Yes. It was more like one or two shorter trips each year, rather than an average of perhaps three months away from home. An interesting anecdote. My wife, during that time when I was gone so much, I came under a great deal of pressure actually to leave NCAR, because she didn't like the idea of my being gone that long.

Rasmussen: I don't blame her!

Medrud: When I came home from I believe it was the African expedition, which was a full three months, she said, "Med, I'm learning how to get along without you when you're gone so long, and if you continue this, you may return and find out I just don't need you any more."

Rasmussen: Oh!

Medrud: So I reasoned with her. I said, "Well, gee, if I quit my job and you should decide to leave me anyway, then I'll have neither a job or a wife!"

Rasmussen: [laughs]

Medrud: So I thought I'd better keep the job and take a chance on the wife.

Rasmussen: [laughs]

Medrud: Then I got my present job, from which I do not travel at all, and she was taking advantage of my absences when she could to travel herself and has now, in an avocation with a charitable group, traveled immensely. And after she came home from an extended absence, this is about four years ago, I said, "Mary Agnes, you know, I'm getting to be able to get along without you when you're gone so long, and one of these days you may come back and find I don't need you any more."

Rasmussen: Did she remember those words?

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Medrud: Yeah. She gave a sickly grin and walked on in the house.

Rasmussen: [laughs]

Medrud: And we haven't heard any more about that problem! [laughs]

Rasmussen: That's funny!

Medrud: It depends on which foot the shoe is on.

Rasmussen: I guess so! So then you were in RAF for a while.

Medrud: About a year and a half. A very pleasant, if intense time. I give the RAF a great deal of credit for—I don't know it well presently, but everything I hear suggests the same, a very dynamic and aggressive and hard-working group dedicated to putting out a maximum effort. And I formed many friendships there that exist to this day. In saying this, I don't mean to knock FOF. There were many friendships and many fine people, too, and today an incredibly expanded mission over what they had when I was there.

Rasmussen: That's interesting, because from what you tell me, it sounds almost like they—obviously they've cut back on the things that you were involved with in FOF. What's the expansion that they've got?

Medrud: The expansion is into new areas. The research systems facility, you may recall, was ended some years ago, and resources within it were distributed. And FOF got the major share of those, the Gantt group, some research functions. And it expanded its energies well beyond the more conventional approaches which existed when I was there into a vastly expanded effort and capability in radar observations of weather and the implementation of the PAM system, the portable automated mesa-scale system, which grew from a concept with I was there into now a major contributor to mesa-scale research. So the FOF has expanded tremendously in function, both in type of function and in magnitude.

Rasmussen: Do you know how that came about, who was involved in those decisions to change?

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Medrud: Of course, it all follows the normal procedures through NCAR management and the approval of the UCAR board. The movement into modern radar meteorology occurred with the arrival of [Robert] Serafin, who came with a doctorate focused particularly—well, his doctorate was not in radar meteorology, but much of his research was. I think his doctorate was in electronic engineering, which is the absolutely basis for radar weather observations. So it was his interests and capability which launched it into the major expansion which has occurred in radar meteorology. But also Fred Brock, who came from the University of Oklahoma, brought with him an expertise in instrumentation, and he was the person who generated the PAM—he was the prime mover in the first PAM concept and in the development of the first PAM stations, and ultimately the first major network. Since then, of course, the concept has expanded greatly, and its capabilities have.

And today Tony Delany, who was in ACD during most of my tenure there is and still now on a part-time basis, is over there incorporating a chemical sensing capability to the mesa-scale network.

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Rasmussen: Tony's working on ASTER. Is that pretty much his baby?

Medrud: Well, no, ASTER itself I think had its origin among a number of scientists. His principal contribution is in making the chemical measurements, and Tony has unique abilities and insights in that area. I understand it's going well, and I'm delighted.

Rasmussen: Yeah, I'm anxious to do a Staff Notes story on it. So we've left you dangling at RAF for a year and a half, which brings us up to '79 or '80, I guess.

Medrud: '79. 1 January.

Rasmussen: And then what happened?

Medrud: I read the Staff Notes, like many other NCAR employees. I had long coveted a job as a deputy in one of the divisions. It's clear, I think, that my background was most suited to the atmospheric technology division, because I have aviation background, experience in radar meteorology, field project management, and so on. But the availability of a position in that never occurred coincident with my availability. I did see that they were advertising for—well, I think they called it a division administrator, in the initial advertisement for the atmospheric chemistry division. It was then called the atmospheric quality division, I believe, under Paul Crutzen. I thought that I had sort of wanted to do that kind of work. It was to be a one-step upgrade from the level of support scientist 4, under which I'd functioned almost since my arrival at NCAR.

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Then also, I'd have just that little short trip up the mesa, as compared to a 12-mile drive out to the airport. All of that sounded fine, so I assembled a background appropriate and applied for the job, with some concern over leaving the RAF. Harry Vaughn was then the manager. I admired, respected, and liked him very much, and I was somewhat reluctant after just a year and a half to apply and leave. But I told Harry about it, and he was very understanding, so I did apply and was ultimately accepted. And thus began on 1 January of 1979 my tenure with the atmospheric chemistry division and Theresa LaCray [?], who's now Theresa Leaviss [?], as the division secretary. We began at desks close to each other, and we have now worked almost like brother and sister, I think, for what is almost nine years. It's been a very good time. I was exceedingly fortunate

that she was the person who happened to occupy that desk. It's meant a lot to me over these nine years to have someone of her capability and character to prop me up in places I'm short. Really nice.

Rasmussen: Wow. You have a truly unusual set of NCAR experiences, then, because you've worked in so many different divisions.

Medrud: You can understand I had a moment of terror there. Each successful move was farther from the mesa. I moved to the HAO, to 30th Street, out to the airport, and I had envisioned my next assignment being in Palestine.

Rasmussen: [laughs]

Medrud: But I was given a reprieve and the possibility to start the circuit again.

Rasmussen: And after that I guess there would just be New Zealand.

Medrud: That would be exceedingly welcome but never occurred. What a wonderful place that it.

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Rasmussen: I've never been there. I'd love to go. Since you've seen all these different divisions of NCAR, you're really a good person to answer this question on the list. Who do you perceive at NCAR as having been influence in setting scientific priorities?

Medrud: That would be exceedingly difficult to respond to. We have the three scientific divisions, plus the ASP, and certainly I think that we shouldn't neglect the atmospheric technology division, which through its contribution in terms of capability puts a sharp torque on the direction that science takes. By and large, I think NCAR has had fine leadership, and we would have to look to the particular division directors and the senior scientists who advise them. I would find it exceedingly difficult to point to any particular person as having been markedly influential beyond the contemporaries in other divisions in pointing the direction of research. We in chemistry are fortunate perhaps in these recent years in that there's been a national recognition of the importance of chemistry to the potential quality of life on the planet and there we have been given a preeminent place by circumstance.

And I think my boss, who is now on a semi-sabbatical in place, has been a major contributor in that area. He's given us some fine leadership. But this certainly does not negate the leadership that has occurred in the other divisions. So it would be very hard for me to point at any individual. It was easier, perhaps, in the early days when the NCAR directors, such as Walt or John Firor and so on, were at the helm of a smaller institution and

exerted a tremendous influence in the direction it takes. We have become more corporate in structure as we've grown and as the complexity has increased, and the contributions of many people have to be considered, and the advice of many people.

Rasmussen: So you do think the director now has the extent of influence as in the earlier days?

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Medrud: I think it's harder now. When you had a small place with a very few senior scientists and an intimate group, where it was easier to gather, that it was easier to direct. It's not that the power doesn't exist and isn't exerted and that the present director and the preceding directors don't have power to move it in directions that they see fit. Certainly they do. But there is still a lot of creative intellectual capability that exists across a broad front, and any good manager is going to be listening to all of the input from these sources. It's not formed by people gathering around a table any more, like it was in the early days. So I think the influence on direction is more diffuse.

Rasmussen: I wanted to follow up on you saying that sometimes changes in technology in ATD put a torque on the direction of research. What did you have in mind when you said that? Any particular advance?

Medrud: Well, I think a number of them. Scientists recognize as a group the important questions in basic research. But many times it's impossible to attack those questions unless the technology exists to do it. The prime example, perhaps, is the computing facility and the increase in power. When Richardson first was putting together the equations of motion and dynamics which form the basis for numerical prediction, it would take time perhaps ordered in years to do computations. That means that this dynamical approach and thermodynamical approach to prediction was not feasible, however he might have imagined it and wanted to do it.

With the advent of a Cray computer, it isn't just orders of magnitude. The difference in capability is incredible in pursuing that type of research. When you look at thunderstorm dynamics, you have the same thing. In the earlier days, the best you could do was fly an airplane through it and hope it would survive, and aircraft were armored to do that. They didn't have good motion sensing. Radars were not useful at that time in penetrating a thunderstorm to determine the dynamics of motion within it. Today we have multiple Doppler radars capable of defining motion throughout the storm in not an instant of time, but in a very small order of time.

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So there's the possibility now, due to the availability of technology, to examine thunderstorm dynamics, particularly the hydrodynamics of it, in incredibly fine detail which did not exist at all when I walked into NCAR. It's this kind of thing that's remarkable.

The PAM system has permitted to look at mesa-scale phenomena that we never dreamed of. In this way, I think technology does torque change, point the direction of research, has a distinct impact.

Rasmussen: I'm going to go back to Nancy's list here and get a few in here. What about NCAR's relationship with the universities? Have you seen much university reaction? How would you describe it?

Medrud: I think that there's tremendous interaction. It's always a subject over which there is controversy. In a way we compete for funds. University researchers normally get small grants, and we're block-funded, and that is seen by universities or university people oftentimes as a disadvantage. But what we do provide is an exceedingly strong visitor program in which people from universities can come here and use facilities, or in these days, use the computer from the university. But the facilities of the field observing facility, the aviation facility, all of these are at university disposal in large programs. So NCAR does provide an enormous base in technology for university people, and it provides the cross-fertilization that comes with visits of our staff to universities and visits of university staff to NCAR.

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I've seen a concern about this aspect, about this relationship throughout my career here, a deep concern on the part of NCAR scientists and managers to assure that the possibilities of research are in some way equitably distributed and it's clear that the facilities are a tremendous plus for any researcher who in a university does not have access to the magnitude nor the quality of research instrumentation which we have.

Rasmussen: Outside the facilities, and I expect there's probably a lot of people coming to use the facilities, perhaps are there more than can use them in an average amount of time?

Medrud: Always. During my tenure with the aviation facility, it was part of my job to manage the annual presentations of the applicants for aviation time. There was a university and other advisors who sat around to judge the scientific importance and the likelihood of success of these things. Inevitably, we had more quality research proposed than we had the facility to provide. So every time there had to be judgments made about the importance and likelihood of success, some people had to go away

disappointed who had perfectly good and proper proposals, but lost in the competition for one reason or another.

Rasmussen: So the way you choose—how would you choose people then? If you had to, scientists with proposals that were both legitimate and a good use of resources, what were the factors on which you would be able to choose only one?

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Medrud: The assembled group, which included occasionally NOAA people, but mostly university people and some NCAR scientific participation, would look at what was perceived as the importance of the resource, its potential contribution to the body of research, which was necessary, the viability of the program, how well it was planned—all of these things that contribute to the possibility of success. I think those were the major factors. Individuals may in their mind think of other aspects, but I know that there was every attempt to be objective in the assessment. And I think by and large that most people, should they go over it again, would agree with the panel. And the field observers facility does the same thing, I just didn't have an intimate participation in it.

Rasmussen: Outside of the facilities, where we had some very obvious ways that people would be interacting with NCAR, for instance, since you've been in the chemistry division, how do these interactions go? Are they often initiated inside or outside?

Medrud: They come from both areas. But an amazing number of the published papers will contain the names as co-authors of NCAR staff and outside scientists.

Rasmussen: Yes, that's true.

Medrud: That plus the physical presence of visitors. We put a lot of our money into visitors. Every time we have any kind of carry-over money, it goes into visitors. We perceive it as tremendous value, and I believe that those scientists who have come here and worked with our staff perceive it in the same way. The problem is, of course, that it is not unlimited. We don't have the financial possibilities in an unlimited way, and our space is limited and our laboratories are limited, and therefore we can't respond to all of the people who apply, and certainly not even those people whom we feel could contribute tremendously to our program and us to theirs. But the program does occupy a very high priority and is an active one and a value one.

0:54:41.9



Rasmussen: This question is about interdisciplinary work at NCAR. It's a policy here to foster relationships among the different disciplines. Have you experienced that?

Medrud: In the division, I think that we'd have to say that is a very important facet of effort. I believe that often major advances in science occur at the intersection of disciplines, when the techniques of one can be applied to another. Atmospheric chemists by nature can't be isolated. You can do a lot of research on chemical reactions, their rates and so on in the laboratory in relative isolation, but the proof of the pudding is when atmospheric dynamics and chemistry are mixed. You can follow the paths of chemical components through the atmosphere, observe their interactions, and then ultimately arrive at some kind of estimate of their present prevalence and their potential future prevalence and then the implications of that to the factors which affect society. And these are certainly interdisciplinary. For that reason we're a somewhat mixed division.

We have people who are quite pure chemists, who are working in basic chemistry. I think I'd cite in that particularly Jack Calvert's group, which does a lot of laboratory work on reaction rates of various chemical compounds or one with another. And we have John Gilly's group, which is focused much more closely on meteorological phenomena and the chemical presence within those phenomena. Garcia does a lot of work, his basic training is meteorological in hydrodynamics particularly, and he looks at the transport of chemical components and constituents in the atmosphere.

0:57:10.4

Many of our modelers have backgrounds in hydrodynamics. It's almost a requirement—well, it is a requirement to do good modeling, but it's the chemical factor that's inserted which is necessary to the prediction of the future and what it means. So I would say for us, just within the division, we have a tremendous amount of interdisciplinary activity. And as I noted earlier, we have a full-time meteorologist looking at the impact of the meteorology of the atmosphere on the chemical experiments that are being made. They're absolutely interrelated. Can't do one without the other, any more acid rain out through the thermosphere.

Rasmussen: Do you have any sense about the other divisions, since you've worked in so many of them? Do you think that's equally true for the other people?

Medrud: I don't think it's true in the same intense sense, because the chemistry has little value without the dynamics. And there are many aspects of atmospheric physics which can be undertaken with less. Of course, you always have interactions with mathematicians. That's important. And you

have interactions now with oceanographers and atmospheric physicists because of the importance of the ocean-air transport and interface. The emphasis has been largely on meteorology early in the facilities. The aviation facility has long had a chemical component and flown chemical investigations and data acquisition flights. This was less true in the FOF, but now with the ASTER program, in particular, we're seeing a quantum step in that direction.

I think that within the facilities we'll see a growing interest in the complications of chemistry and meteorology. I should add that recently Greg Coke [?] has also moved into a half-time position with the aviation facility doing instrumental development work much like Tony Delany with FOF. So we have made a tremendous jump in that direction, I believe, in the past two years or so, and largely through a concern of the facilities manager, the ATD director, and Ralph Cicerone in ACD. I think it's been visionary, and I think there'll be a big payoff in years ahead.

Rasmussen: How does HAO fit into all this?

1:00:18.7

Medrud: HAO is—we sort of feel it's on the periphery. It actually isn't because of the tremendous implications the sun has for all aspects of physical science on the earth. And they pay special attention to that interaction. So they're not as far afield as you sense in just saying, "Here's an observatory looking at the sun, and here we are looking at the earth's atmosphere." No. There are decided interactions, and they've made great progress, and they're a group of very high-quality people. I think that most of NCAR scientists who look at it are delighted that they're here with us. You may recall that about I think it's three years ago or so, the interface was so close that we actually transferred one group out of the atmospheric chemistry division, which was studying thermal dynamics, into the HAO.

Rasmussen: I was just going to ask you how that came to be. Was it a decision between, say, Ralph and I guess it was Bob McQueen then?

Medrud: Yeah. The two directors talked over the kind of interaction that was going on at this interface between the two disciplines and ultimately decided that probably the home for these people was more appropriately in the observatory than in the ACD, recognizing that they have a contribution to both and that their research is at the interface.

Rasmussen: So all they had to do was pack up and move down the hall, that wasn't too tough.

Medrud: That worked very well. They seem to be thriving and happy.

Rasmussen: That's good. Do you see weaknesses in research at NCAR, areas where you wish there were more money or you just think people have ignored?

Medrud: I don't know that there—well, the possibilities for research are endless, and the funds are limited. And so judgments have to be made. I certainly wouldn't want to try to second-guess the assembled—

Rasmussen: [laughs] Oh, come on!

Medrud: —senior scientists. From a parochial point of view, I would like to see added funding and added staffing of my own division, the atmospheric chemistry division. I recognize that—I know that it is recognized nationally as an exceedingly important facet of research—

Rasmussen: That's true.

Medrud: —as we look at the health of the planet into the future. I'm well acquainted with the fact that the Congress has viewed it that way in appropriations. And I would personally like to see an expanded focus on this particular element, let's say from a selfish point. I have children, I have grandchildren who are going to live on this planet, and the environmental consequences of pollution and the chemical dynamics that are going on, which produce some rather scary potential for the future of the earth, I believe demand extreme attention when we—in relation to some other aspects of science, which are also certainly important, but maybe not of the immediacy that atmospheric chemistry is.

Rasmussen: Since you've been in ACD for about eight years now, how has the perception of the chemistry division changed?

Medrud: Remarkably, you may recall that chemistry at NCAR was essentially decimated in about 1974. There was a major chemical effort here when I first arrived. It was almost abandoned in the period around 1974.

Rasmussen: Why was that?

1:04:54.8

Medrud: There was a perception, I think, that it just wasn't as important as was at study of the physics of the atmosphere.

Rasmussen: But in '74, didn't they already know about CFCs and their possible atmospheric effect.

Medrud: At least you weren't hearing about it.

Rasmussen: I thought Ramanathan was working on it in the mid-'70s. He might not even have been here then.

Medrud: He wasn't here then, no. The chemistry effort—there may have—I wasn't privy to the inside workings. Maybe there was a perception also of quality. I don't know. But I do know that chemistry was downgraded in priority and that there was little left. There was an aerosol effort under—I can't say who, I'm sorry, and Gilly had some effort, but as I've said, his focus wasn't chemical, it was more stratospheric dynamics and things like that. We had a rebuilding when Crutzen came, which was probably about '77 or '78. He was only here a short time. It was probably '78, somewhere in that area. So there was a brief hiatus and then a rebuilding, and the rebuilding was focused on problems like CFCs and the ozone relationship. It was called atmospheric quality because of the emphasis on pollution and things like that.

Pollution was an early concern, because there were major projects. I wouldn't want to hazard a guess as to why the demise occurred. I guess I don't know well, but it clearly happened, and then there had to be an entire rebuilding into the present structure. So we've gained markedly in strength and importance, starting shortly before the beginning of my tenure with the division.

1:07:22.2

Rasmussen: I keep hearing rumors that there are currently plans to beef up the chemistry division even more, is that true?

Medrud: Last year we had the exciting possibility growing out of the global tropospheric chemistry program for over a \$.5 million increase in our budget, which was tremendous. But it was lost in its entirety, and we had an additional funding loss of \$90,000—some dollars that came out of just carrying on the program. So the problems of the federal budget as they affected NSF and consequently NCAR last year were a disaster to the expansion of the effort in atmospheric chemistry.

Rasmussen: That's too bad.

Medrud: Boy, we thought so, too! We really did. Even in November we were still hoping for a tremendous boost, and by January we were saying goodbye.

Rasmussen: That's a pity. Let's look at the flip side. Are there particular strengths that you see in NCAR research? You've mentioned a lot of things already that are strong.

1:08:56.4

Medrud: You can go across the board and we have really quality research going on. In our own division, I think just across the board. CGD and MQ, I think the reorganization will have strengthened MQ by bringing together some people with common interests in the mesa scale which were separated before. NCAR is loaded with talent and potential. It'd be hard to point to a weak place. When you have funding difficulties, you have a deep and dark problem deciding what you're going to give up. It's a fine institution with some very able people.

Rasmussen: A fun place to work, too.

Medrud: Yes.

Rasmussen: The next question on the list, I'll just ask you and you can react however you like. To what extent has the evolution of atmospheric science changed the way scientists do their work and interact with each other?

Medrud: I think the technology aspects that we spoke about before are clearly the principal factors. Just without a doubt. The possibilities of research depend on technology and the interaction of people depends on technology. The use of electronic mail, the access to computing from remote locations, the ability to define atmospheric motions, chemical reactions, all of these are technologically dependent, and they have grown at an astounding pace over these past—over the 20 years or so that I've spent at NCAR. It's staggering when you consider it, and these are a controlling factor, I believe, along, of course, with the creative ideas, but of tremendous impact when it comes to both the direction of research and the interaction of researchers.

Rasmussen: I have a gut feeling that perhaps in chemistry, the better instrumentation that's now available has been really essential in even some pollution-type research that's going on.

Medrud: Oh, yeah. The capabilities just proceed apace. Technology, particularly in the areas of electronics and those electronics-related facets of research, they move so fast that they're blinding. People just can't keep up, except in their own specialties. But in the aggregate, they give science an incredible boost.

1:12:21.4

Rasmussen: You're in management now. You've been in management for a while, actually, haven't you?

Medrud: Yeah, I'm afraid I've lost some cutting-edge knowledge of mathematicians and atmospheric physics that I once had.

Rasmussen: I expect that that's also inevitable, once you're away for a little while.

Medrud: It is. Conceptually you recall, but the specifics are difficult.

Rasmussen: What kind of atmosphere do you think management has created for the scientists who work here?

Medrud: At NCAR? It's hard to say that it improves over the years, because as I noted earlier, it's not—and it doesn't mean that any present leader particularly at higher levels is any less capable. Perhaps presently they are better and more capable. But what happens with time is that you become in a way muscle-bound. Not directly as a relationship with time, but because time tends to bring with it expansion, and expansion brings added reports and added policies and added restrictions and the impossibility of interacting over the broader front that occurred in a smaller body. It's much more difficult today to interact, I would say—interactions today between, let's say, ACD and CGD and MQ. In the good old days we were pretty much all in this building, there weren't so many of us. It's hard now for people to interact fully with any division, to say nothing of crossing the divisional borders in significant ways.

1:14:24.5

The physical separate of MQ indicates this, the added reports that we all have to do, including scientists, grow with time. And all of these things, they don't cause an atrophication, but I think becoming in a way muscle-bound is a better analogy. And thus in a way the dynamic and free-moving quality of a small organization that existed when I moved into this building is inevitably lost. It's nobody's fault, and it's very hard to change. Sheer numbers create that problem.

I would say that the problems of Rick Anthes and Bob McQueen today exceed those which Walter faced when he was—he had the problems of setting it up, but he had more resources, I think, not in quantity, but in those that were available to focus on the smaller group. He had the intimacy and the freedom that goes with it. And there's no way, I think, but what most of us old-timers, if I can use that word, would look on those early days, those early years, as the golden years. It doesn't mean that we don't have equally bright people, equally energetic, equally capable today, but the nature of the organization changes with growth, and growth is almost inevitable, and we do more and better work today, but we don't have the intimate relationships that we did earlier.

1:16:19.5

Rasmussen: You say you think this is inevitable. Is there any way it could be changed or avoided or could have been done differently?

Medrud: I don't—every—they turn out MBAs every year, too, by the buckets, and they turn out new theories of management, and I've seen many different theories tried here. You go to zero-based budgeting or something, you manage by objectives. All of these get traded, and I confess I have a rather cynical view. I've operated under many of them, and in the end, it's largely common sense and coping with the situations that arise that get things done. I don't know how you can avoid some of these muscle-bound problem in a larger institution as opposed to a small one. I wouldn't want to propose a thing. I fault no manager today. All the theories get looked at the tried, and some help a little here or there. But the factor of size just creates physical problems that can't easily be resolved by managerial techniques.

Rasmussen: I guess it's sort of like a democracy when it moves from ancient Greece to modern U.S. It just doesn't work the same way.

Medrud: Exactly. You end up with some representative structure instead of a participatory structure. And that's inevitable, because it's not physically possible to put 200 million-some people in the U.S. in one town hall and let them shout.

Rasmussen: How do you think this has affected the work of the scientists over the years, these management changes, this muscle-bound characteristic?

Medrud: The interactions across the broad spectrum are inhibited in some degree, but I don't think we're putting out any less quality work. I think in fact the research that goes on, the productivity is certainly equal, and when you consider the increases in technology that support it, it becomes superior. So I don't see a problem in that regard at all. What I see lost is the intimacy, the family spirit that comes with it, and I feel, as I said before, that's an inevitable penalty that you pay with size and the magnitude of the money, of the people, of the technology. I don't think it can be avoided. But I was here in the golden years.

Rasmussen: Yeah.

Medrud: And they're good days today, they're good days, but we are not the little family that we once were.

Rasmussen: That's too bad.

Medrud: It is, in a way, but it's still a wonderful place.

1:19:49.2

Rasmussen: You moved from being a field support person, you've been in a lot of support positions. How did you feel about becoming a manager? You said you wanted to—

Medrud: I was a manager long before I came here. In fact, that was really what I was. I managed a consultant staff of graduate trained meteorologists who were active in discovering and presenting the environmental impacts on engineering and planning and things like that. That was not new. I'm less a manager today, I think, than I was earlier.

Rasmussen: What are you instead?

Medrud: I'm more of an administrator. I manage a support group, but I'm called a deputy director for administration. In my perception, there are people who like administration very much, but I don't find it as rewarding as I had hoped when I approached it. [laughs]

Rasmussen: What do you think is the difference? What's different than you expected?

Medrud: A manager normally control resources and has authority to implement them. An administrator controls fewer resources, has little authority except that which is derivative, and does a lot of iteration. The freedom of management to make decisions and move on them is the positive aspect of management. It's essentially the converse in administration. In my perception, I would much rather be a manager directly.

Rasmussen: When you say it's the converse in administration, you mean the administrator doesn't have—

Medrud: An administrator has very little authority. The only authority the administrator has is derivative from the manager above. And the administrator doesn't set policy, the administrator proposes policy and then has it approved or disapproved by a manager. The administrator implements policy which originated with the manager. But the only authority in implementing it derives from the manager, and the manager's clubs, if you will. The power of a manager in a private institution like this derives from control of salary increases, which are related or derived from the appraisals of individuals. And that's all it is, except in the extreme case, where there is the prerogative of discharging a person who is too obstreperous. But between that level and the maximum level of performance, there is a tremendous interval over which the power of the manager lies in essentially the carrot which an appraisal presents.

An administrator does not do the appraisals. The administrator may have some input into them, in a modest way, but the appraisals are not within the administrator's prerogative, so even that carrot is not part of an



administrator's job. So most administration I think occurs by diplomacy and wheedling and occasional vacant threats.

Rasmussen: [laughs]

Medrud: And it's just not the most precise and efficient way to go about getting jobs done.

1:24:15.2

Rasmussen: So you haven't really enjoyed it all that much?

Medrud: I wouldn't put administration at the top of my list. I've worked with some fine people. I've been blessed with that. I've had two bosses, Crutzen and Cicero, whom I admire tremendously as individuals and who are very fine and compatible people to work with. And for a person in my position, if that did not exist, then the job would become unbearable. But I've just been really, really fortunate in my association with each of those people, and I have had wonderful people, for the most part, to work with around the division. And it goes both ways. I mentioned early that Theresa's and my relationship has made my job infinitely better than it might have been had I had someone of less capability and certainly of less integrity of character. I've been lucky in that respect. What I've complained about is the kind of work, which is never done, which is always overdue, and which you're always in trouble about. [laughs]

Rasmussen: Sounds like a nightmare to me!

Medrud: It's not that bad, but I can say that the added hours above the normal 40 have been ordered in years over the whole sweep.

Rasmussen: That's awful!

Medrud: It's not awful. It's been—as I said, NCAR is a wonderful place to work, and I can't tell you how much I treasure having had the opportunity to be here and to take part in it. Its goals are noble, really, and when you're privileged to be part of that, even though your own contribution may be small and there may be aspects of work that you find more pleasurable in doing something else, in the sum, I wouldn't trade the years I've spent here for any other possibility that I can think of.

Rasmussen: Wow.

Medrud: It's a fine place with a truly noble purpose.

Rasmussen: Why don't you tell me what you think the purpose is?

1:26:59.9

Medrud: The present purpose is almost basically the salvation of the planet, as I look at it. But beyond that, as you're aware, I spent many years in a military career, and I don't regret those years, either. I did what I believed was right. And during the Vietnam era, I came to believe that what was being done was not right, and I had a problem with conscience. And when I arrived here, I was able to work at something which isn't just benign. Doing a benign thing is a good way to make a living, as opposed to doing something that may be detrimental to society.

But here, the entire focus is on the positive. No matter what you do here or where you work, you contribute to a betterment of the society and the world we live in, to the understanding of it in some areas, and in particularly crucial areas, in the extreme, survival. And I think that is an exceedingly wonderful kind of an effort to be part of. I feel that very deeply. And I was lucky enough to get to be one of them.

Rasmussen: Wow. That makes me feel better about my job! [laughs]

Medrud: Yeah. I think no matter what we do here, we contribute to it. It's not that isolated things we discover here might not be used somehow in a detrimental way. You can never guarantee that with science. But the focus is on the positive, the intent is on the positive, and the probably result is also positive. It's hard to find a really better place. There are those, there are people with careers in many helping professions who contribute that way. Here it's on the grand scale rather than the personal scale, and that makes it a little remote. And I know I recognize in my work and I have to deal with people to whom this is a job, and "I want to get mine out of it." But it's bigger than that.

Rasmussen: Do you think that perception is shared?

Medrud: I think at least in a certain degree. We don't talk about it a lot. We don't often talk about philosophical things.

1:30:02.5 End.

**END OF INTERVIEW**