Jinny Nathans: This is Jinny Nathans, I'm the archivist at the American Meteorological Society. It's June 6, 2018 and I am doing an interview with Dan Keyser at the WAF-NWP meeting in Denver and now I'm going to turn it over to you, Dan, thank you.

Dan Keyser: Where should we start; what question do you usually start with?

JN: I usually start with asking you about who mentored you and how you feel about mentoring other students and that usually kind of leads into talking about your career.

DK: Why don't I tell you how I got started?

JN: Perfect.

DK: We'll work our way forward. I began my career at an early age through an unpaid internship as a meteorological technician at the Franklin Institute in Philadelphia between 1964 and 1971. I got interested in weather in 1964; I was in fifth grade. My teacher took a course designed for teachers that was offered by Wally Kinnan, who was the TV meteorologist at WRCV in Philadelphia, which eventually became KYW. Wally Kinnan was one of the pioneers in broadcast meteorology and he had the audacity and confidence to show actual weather maps on the air. I don't think anyone would do that today, but he had a wonderful way of communicating the weather to the public and he also taught courses for teachers.

And my teacher brought the weather unit back to our class and I was captivated by it. I was interested enough that she took me to the Franklin Institute to meet Wally Kinnan, where they had an operational forecasting service at that time, and they had junior high school (i.e., middle school) and high school students working as interns, primarily on weekends. I became an intern, and I learned how to plot weather maps and Skew T diagrams, and even do a little bit of hand analysis and assist in the forecast process. My internship at the Franklin Institute spanned the time I was in fifth grade through the time I graduated from high school and went to Penn State.

At Penn State, Rick Anthes was my adviser for all three degrees. Rick had a profound influence on my career for which I'm forever grateful, and I thank him whenever I see him. One thing led to another, and other influential mentors, in addition to Rick Anthes, include Mel Shapiro, Louis Uccellini, and Joanne Simpson. Mel, Louis, and Joanne also had a profound influence early in my career, when it really matters and makes a huge difference.

An aspect about my early career trajectory, which in retrospect I see as significant, is that I closely observed colleagues whom I greatly admired and respected. I think I subconsciously and instinctively tried to borrow their best ways of thinking and working, in other words their "best practices," and rather than copy these practices, adapt them to fit my purposes. Now, as a professor, I try to instill that same approach in all of my students, but especially my graduate students. In fact, I have found that my best graduate students absorbed and took advantage of advice from everyone and they knew intuitively how to bring out the best in everyone. I think that's a talent. If I see someone who has that talent, I encourage them to cultivate and apply it throughout their careers and lives.

So that's how I got started.

JN: It's interesting because at this meeting with the interviews that I've been doing, it has been more than, for example at hurricanes where I just was, this has been much more academic people who have mentored their students, and a lot of the conversations are like this instead of sort of going from school right into to research and talking about that, rather than becoming a teacher themselves.

DK: I also want to say some more about my career trajectory, as we were talking about that. I attended Penn State from 1971 through 1981: B.S. in 1975, M.S. in 1977, and Ph.D. in 1981. During the summer of 1977, I participated in the NCAR Summer Fellowship in Scientific Computing program, where I met Mel Shapiro, who, along with Don Perkey, coadvised my fellowship research project. I then proceeded to the Naval Postgraduate School, for the 1977–78 academic year, when Rick Anthes held the first Haltiner Research Chair and invited me to accompany him and participate in adapting the-then Penn State mesoscale model (I believe this version was referred to as MM0) to run in a forecast mode in near real time. I also want to mention that while at Penn State I taught introductory synoptic meteorology during the fall semester (or fall term as I think it was referred to then) of 1980. What happened was the professor assigned to teach the course left on short notice, so the Department needed someone to fill in. That's how I got started teaching and when it occurred to me that university teaching might be a viable career track.

But university teaching receded to the back of my mind, because after I graduated from Penn State in 1981 I worked in the Severe Storms Branch of the Laboratory for Atmospheres at NASA/Goddard Space Flight Center until 1987. And that's the career phase where I experienced, and thrived under, the mentorship of Louis Uccellini and Joanne Simpson. In talking informally (i.e., "hall talking") with Joanne whenever I could, I was exposed to the history in which she participated as a pioneer in tropical meteorology. I found these talks fascinating especially because Joanne knew all the other pioneers in tropical meteorology and she had great stories to tell about them and their scientific contributions. I also should acknowledge Dave Atlas as a mentor during my NASA/Goddard phase; Dave was a pioneer in radar meteorology with as much history and at least as many stories to relate as Joanne.

What I recall making such a lasting impression was that Louis, Joanne, and Dave communicated the human motivations for doing science in their respective fields, which made the scientific progress that they witnessed and to which they contributed so much more interesting and compelling than was possible from reading the scientific literature alone. Talking to them also gave me ideas about where my own fledgling research might fit into synoptic-dynamic meteorology, in the sense of linking my research to prior scientific advances and attempting to anticipate future research directions in this field.

JN: That's really interesting. Actually, I want to go back to when you were in the fifth grade and began your internship. What made you first get so interested in the weather that you pursued that, and that your teachers saw that you were so interested in learning about the weather and began to open the doors for you at the Franklin Institute?

DK: It's hard to pinpoint exactly what got me interested in weather, but I think a lot of it was the idea of being able to understand what I could observe. I had this habit of looking out the window rather than at the blackboard. I began to realize that there are reasons for the weather changes that I could observe through the window. And also it was the idea that the weather is a manifestation of the environment that we live in, that the weather is predictable to a certain

extent, and that I could relate weather predictions to the weather maps shown on the evening news. I think that was the essence of it.

Also, I come from a family of artists and I find the aesthetics of skies, clouds, and weather maps appealing. Another appealing aspect, which I became aware of as an undergraduate student at Penn State, was that there are mathematical equations that can be used not only to predict the weather, but also to understand the weather patterns that one can analyze and the weather changes that one can observe. When I taught, I often would say that scientific understanding is achieved when you are able to describe what you observe in words, pictures, and equations; that is verbally, graphically, and mathematically. I think I was probably just beginning to sense this perspective early in my career but I couldn't yet articulate it, and it would take a number of years to be able to distill this perspective into such a simple statement.

So that is how I got interested in weather. Perhaps if it hadn't happened this way, I would not be sitting here talking with you today.

JN: Well, and maybe if you got yelled at when you were looking out the window.

DK: I think looking out the window led my teacher to recognize and appreciate my fascination with the weather.

JN: Yeah, no, I think there are so many ways that things can go in different directions. That's really interesting.

DK: Oh, and I also should mention that when I started at Penn State, I was fully determined to become a forecaster in the National Weather Service; that was my plan all along. So my goal was to get a Master's at Penn State and move on to the Weather Service, but it turned out that I passed the Master's comprehensive exam at the Ph.D. level and Rick invited me to continue on for a Ph.D., which got me onto the research track. Speaking of influential experiences, I think these were on your list of questions. One such experience came about when Rick invited me to spend the summer of 1974, between my junior and senior years, at Penn State. A time-honored method for a professor to entrain an undergraduate into graduate school is to get them started on a research project, often related to the professor's grants. During that summer, I worked with Rick and several of his graduate students on a project that related to research they were conducting on model initialization. The project consisted of numerically solving the nonlinear balance equation to derive the geopotential height (i.e., mass) field from the wind field for tropical and midlatitude mesoscale applications. Working on this project got me thinking that perhaps I could do research, which would not have occurred to me from just taking courses. So this was a great way to learn about research, to be exposed to graduate student culture, and to be made aware of educational and professional opportunities to pursue in the future.

JN: I think also the timing of when you were there was a particularly golden period for the kind of work that you were starting out to do.

DK: Agreed. My Penn State phase culminated in my appointment as an instructor the semester before I graduated, which turned out to be pivotal for my future career. I believe I have some notes on the subject of getting started professionally. I can read these notes, which will sound a little stiff, but when I received the Edward N. Lorenz Teaching Excellence Award from the AMS in 2014 I was interviewed and one of the questions was, why were you interested in becoming a professor? Is it OK to refer to that interview now?

JN: Sure.

DK: What I stated is, as a graduate student at Penn State I filled in for faculty when they were out of town, and I also taught introductory synoptic meteorology when the assigned professor resigned on short notice. I realized I had a lot to learn and some growing up to do; teaching this course as a first-time instructor was quite challenging--at times I felt that Murphy's law applied in the sense that if anything could go wrong it did. After graduating from Penn State I went to NASA/Goddard Space Flight Center to work in the Severe Storms Branch of the Laboratory for Atmospheres as a research meteorologist. I had given little thought to teaching, but was encouraged to consider doing so by two respected colleagues, one senior and one contemporary: Dick Reed and Kerry Emanuel, respectively.

At NASA/Goddard, I enjoyed working one-on-one with the two postdocs I supervised: Michael Reeder and Joe Zehnder. When a faculty position in synoptic-dynamic meteorology was posted at the University at Albany in late 1986, I applied and became a member of the-then Department of Atmospheric Science the following year. I then had ample opportunity to learn how to teach and advise students on the job through the time-tested method of trial and error and I've been learning ever since. And that's how I became a professor.

I also was asked in the interview, what's one of the best parts of your job? I stated in response, the rewards of seeing my students develop professionally and do at least as well, if not better, in their careers than I have. The graduate students I've mentored who have gone on to become professors at research universities, Greg Hakim, Gary Lackmann, and Dave Schultz, have done magnificently. They are hard-core academics--they all have written books. Greg, Gary, and Dave have exceeded my expectations--doing better than I have--an aspect of mentorship that I find to be eminently rewarding and satisfying.

JN: I think you're right, and Gary's stopping by later.

DK: Right. And Dave, who I'm sure the AMS knows well.

JN: Dave is huge fun. Anything he's asked me to do or I've had to find for him is, you know, sometimes it's not easy, but he doesn't mind if you ask questions and need more information and that sort of thing. He's not one of those people who gives you half of the information and just expects you to get it done really fast without everything you need.

DK: One of the hallmarks of Dave's research is that it's better referenced than that of almost anyone I know. He really has a terrific sense and knowledge of, as well as a deep appreciation for, the history of synoptic-dynamic meteorology and related disciplines.

JN: I completely agree with you.

DK: Dave and I used to talk about referencing the literature when he was a doctoral student at the University at Albany and I was coadvising him with Lance Bosart. Now that I am looking at my notes, I see that a question I was also asked is how the AMS contributed to my career. That's on your list as well.

JN: Well, that was actually going to be my next question to sort of lead you into talking about things like that. I was going to ask when did you first join AMS?

DK: I joined the AMS in 1972. At home I have a folder of meaningful career memorabilia, which contains my letter of acceptance as a student member, dated 1 November 1972 and signed by Ken Spengler.

JN: So quite early on.

DK: Yes. I was a sophomore at Penn State. And I think part of the encouragement to join the AMS came from Al Blackadar, who was Department Head at the time, and I'm sure he was saying "you should join the AMS sooner than later." So I finally applied for student membership, which turned out to be a very good thing to do. I think I may have started subscribing to journals as an undergraduate, but I know I received the *Bulletin*. Reading the *Bulletin* was beneficial because it exposed me to the atmospheric sciences domestically and internationally. There not only were research articles, but also coverage of the diversity of issues under the purview of the Society. And I've been reading the *Bulletin* ever since. Now, of course, I don't read as much of the *Bulletin* as I once did, as my reading time is spread among many other publications and the *Bulletin* has gotten a lot busier over the years. Back in the mid-1970s, the *Bulletin* could almost be read from cover to cover. Now the *Bulletin* seems to be more of a reference or archival document. There is a lot going on in there; my personal view is perhaps it doesn't need to be so busy and cluttered. But I continue to find the kinds of things I'm looking for and I continue to read the *Bulletin*, which remains the go-to publication to get a sense of the pulse of the profession and the science.

JN: I completely agree with you. In fact, the *Bulletin* is really the primary document of AMS's institutional history.

DK: Yes, it's the institutional memory of the AMS. Anyway that was the impact of becoming a student member of the AMS and getting into the habit of reading the *Bulletin*. This habit led directly to reading the journals and developing a personal sense of the trajectory of knowledge in areas of interest to me, which at the time were synoptic-dynamic and mesoscale meteorology, weather forecasting, and numerical weather prediction.

In your email to me you mentioned influential papers. I think the papers that I remember most when I was getting started were those by Fred Sanders on surface fronts, which led to my doctoral research, and Dick Reed on upper-level fronts, which led to my postdoctoral research. I was introduced to their papers as a graduate student in an advanced synoptic meteorology course at Penn State, taught by John Cahir, and what impressed me about the papers were the hand-drawn analyses, and the original interpretations and inferences on the structure and dynamics of fronts based on these analyses. And Sanders and Reed were skilled writers; they wrote with such clarity and precision that everything they stated made perfect sense, which is a hallmark of their papers throughout their careers. I first met Fred Sanders at the Eighth AMS Conference on Weather Forecasting and Analysis, here in Denver in 1980. I distinctly recall a large group of graduate students following this professorial-looking fellow around, who turned out to be Fred Sanders. I may have introduced myself then; over the years I got to know Fred and found him to be even better in person than in his papers. And I met Dick Reed at about the same time. What I appreciated and respected about both of them, in addition to their science, is how receptive they were to answering my endless questions about their personal histories and the motivations for their research. In retrospect, I would give anything to have recorded my conversations with them.

JN: Many of the other people that I've interviewed have said something very similar, in terms of saying that the AMS conferences are very important because they were able to meet the people whose papers they read, and that they idolized these people...

DK: Thanks for bringing that up; I agree completely.

JN: And that they were very, very approachable, which was surprising to someone who was a young graduate student.

DK: It was remarkable to me; I was amazed that they had any time for me.

JN: Yeah.

DK: They were very open and readily approachable, and I want to return the favor to early career scientists.

JN: I think that's why it's very important to continue having these kinds of meetings, because there's nothing like meeting face-to-face and being able to have a conversation with somebody whose research, you know, you read six months ago.

DK: Lance Bosart and I have a long history of coadvising graduate students, and one of the hallmarks of our coadvisement is encouraging our students to present their research at conferences on a regular basis. This process not only drives their research forward, but also enables the students to meet and make themselves known to members of the research community. As a result, I find that when the students start job hunting, they have the advantage of being well known to the research community through their presentations at AMS conferences.

At this point, I want to acknowledge the recognition that I have received from the AMS at various stages of my career through its awards. I am the proud recipient of the Howard H. Hanks, Jr., Scholarship in Meteorology in 1974, the Howard T. Orville Scholarship in Meteorology in 1975, the Clarence Leroy Meisinger Award in 1989, the Editor's Award in 1989, and the Edward N. Lorenz Teaching Excellence Award in 2014. I also was elected to Fellow standing in 2005. I deeply appreciate the efforts of my colleagues to make this recognition a reality, and I feel incredibly fortunate that the AMS has been here for me at all stages of my career, not only when I was a student.

JN: That's absolutely wonderful to hear. I think the AMS has great importance and people like yourself realize that.

DK: Thank you. The AMS has been vitally important to my professional life. Also, I want to emphasize the importance and value of AMS publications--I have a substantial collection of AMS publications, both books and journals, populating the bookshelves in my office.

JN: Actually that was the next question I was going ask you, just because scholarly publishing has changed so much and so rapidly, from just receiving your print journal and the time it took to produce an article and then see it in a journal, to the way things are done today. The AMS tries to keep up and has gone digital, and has early online release. Do you think the organization is doing what it needs to do in terms of that?

DK: I think so. I subscribed to the print journals for many years, but I eventually stopped for the practical reason of where to store them. And many people now say they don't want to receive print journals because they are available online. I will digress with the following anecdote: When

I was a graduate student at Penn State, I think Hans Panofsky was retiring at the time and he was placing his journals in the hallway outside of his office, since he didn't want to take them with him. I found an original collection of the *Journal of Meteorology*, which contains Charney's classic paper on baroclinic instability, as well as the Sanders and Reed papers that I mentioned previously. I adopted the collection and still have it after a number of office moves. I have volume 1 number 1, which I will always keep, but I know that eventually I will have to dispose of the remainder of the collection, which will be hard to do.

A potential drawback with digital journals is that they require more discipline to stay current, because if you aren't paying attention before you know it you're six months behind, and you're more likely to miss things in the digital journals than in the print journals. With print journals, they are either on your desk or in the library, you can peruse them, and through the magic of serendipity you will find things that you aren't looking for. With digital journals, you need different reading habits from those that I learned and cultivated.

JN: It's true, I mean you saw how directed the search was that we did for the seal, and that was the thing that came up and there was nothing peripherally.

DK: That's what I find to be the case as well, and that's true if you do a Google search and you get right to what you want, but serendipity is lost, and a lot of good science results from serendipity. The next topic probably is not on your list, but one of the things I really do miss is the way we used to present our talks at AMS meetings. Back "in the day," we used transparencies and had access to multiple projectors, and we had the capability to display graphics on one projector and text on the other. This capability allowed us to point to the graphics on the one projector and say what was important about them, and everything that was important to say appeared on the transparency on the other projector. With PowerPoint I feel like I'm in a straitjacket because it's only one slide at a time, and if you try to put too much content on a slide then the slide becomes overly cluttered, and the audience won't get the point of what you are saying or even worse won't be able to see what you are showing.

So that's another example of where technology is today--it's inevitable, one isn't going to back up--but the way we access and present information has irrevocably changed during my professional lifetime.

JN: Right. That makes a lot of sense. Having to conform to new technologies. Sometimes you gain something, sometimes you lose something.

DK: I try to keep an open mind and not sound and act like a Luddite. One evolves with the technology. Also it's important as a professor that you teach your students how to take advantage of the technologies available to them. From the time I first read their papers, I have been drawn to the work of the generation of research synopticians who practiced during the 1950s and 1960s, including Ed Danielsen, Dick Reed, Fred Sanders, and Chester Newton; the analyses rendered manually by this generation of research synopticians qualify as graphic art at its finest. The manual analysis techniques of the 1950s and 1960s have been replaced with computer graphics packages utilized by the current generation of research synopticians, including the graduate students Lance and I coadvise, for analyzing weather maps and visualizing gridded datasets. When prepared skillfully, the computer-rendered analyses and visualizations produced by this generation of research synopticians qualify as graphic art just as much as the manually rendered analyses of their predecessors.

So those were some of the topics I wanted to cover. I know you have some more items on your list.

JN: Well, that's okay. And you really don't have to hit everything quite so diligently, and I hope we would always have an opportunity to talk again.

DK: Thank you**.** Let's go through this checklist quickly if we have a few minutes; I hope I'm not keeping anyone else away.

JN: No, that's fine.

DK: Here is another anecdote that I meant to include in our discussion today because it relates to my development as a research scientist: The transition from Penn State to NASA/Goddard after being awarded the Ph.D. was very rushed. The rush was to get me into a civil service position, which required being on site at the time a position opened, which could occur on very short notice. In the interim I was employed as a contractor with Research and Data Systems. After arriving at NASA/Goddard, I was advised to return about a week later after I had settled into an apartment and established Maryland residency. And so I figured, I finally have a job after having been in school for so many years, and since everybody is accountable to somebody I would be assigned tasks to perform and projects to complete. But no one said anything to me for at least several days. So I said to myself that I would get started working on research projects of personal interest.

Several days led to a week, a week led to a month, and one month followed another. In looking back, I continue to be amazed that I was given so much freedom from my first day on the job. I checked in occasionally with Louis Uccellini, who was responsible for tracking my progress as a contractor. And when I checked in, Louis would ask me what I was doing. And after several months had elapsed, when I told Louis what I was working on his response was to keep working on it. And I received the same question and response from Joanne Simpson when I would check in with her now and then. In retrospect, I am incredibly fortunate that Louis and Joanne were sufficiently confident in my ability and potential to treat me with benign neglect as I was starting my research career. And what I took away from this experience, in addition to doing everything in my power not to disappoint them, is that I do my best work when I'm left alone and given the freedom to think and try things, and to make mistakes and chase down dead ends.

I had a privileged professional upbringing; most of the six years that I spent at NASA/ Goddard consisted pretty much of doing what I wanted on my own terms. I didn't quite appreciate how special that experience was at the time, but in looking back I am forever grateful to Louis and Joanne for providing me with a supportive environment and the freedom to pursue my science, which enabled me to mature into an independent research scientist.

JN: Absolutely.

DK: We have talked about some of the milestones in my career, so I would think that our conversation is nearing completion.

JN: I think that's fine, I thank you very much and I hope I haven't taken you away from anything.

DK: Meeting and taking with you has been a special experience that I will always remember. Thank you for the invitation to stop by to be interviewed; I wouldn't have knocked on the door if I hadn't received your email.

JN: That's great, I will thank Keith.

[This transcript of the interview between Jinny Nathans and Dan Keyser, conducted on 6 June 2018, is a revised version of the original transcript of the interview prepared by the AMS. The revision was undertaken by Dan Keyser to improve the coherence and clarity of the original version and was completed on 17 December 2020.]