AN OLD FORECASTER LOOKS AT MODERNIZATION—PROS AND CONS[1]

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1. Introduction

It is an honor for me to speak to you tonight. The NWA is a forecaster's association, and I take pride in being a forecaster. My 1982 NWA Award "For outstanding contributions to operational meteorology" is a cherished honor. My talk tonight will include some reminiscing and a discussion of challenges and possible pitfalls that I see facing the NWA and forecasters in the 1990's.

I have given considerable thought to what an older, or as Tim Crum suggested "experienced," forecaster should say to the NWA. Often old forecasters hold on to the past so strongly that they impede progress and acceptance of new ideas. I have tried to avoid that pitfall by continuing to teach part-time at the University of Utah and to accept Academy of Science committee appointments. Doing these things has tested my marital bliss. My wife, Lynn, says that I have flunked retirement. Right after tonight, I plan to raise my grade from an F to at least a C. But, it is going to be tough because meteorology is such an interesting science.

To set the stage for my remarks, I would like you to recall the difference between a thermometer and a thermostat. A thermometer senses and adjusts to its environment; a thermostat, first senses its environment and then adjusts the latter to the conditions for which it was set. The NWA in the 1990's has the choice of being a thermometer or a thermostat. My hope is that it will be a thermostat and a moving force in the exciting future of weather forecasting.

2. Some Reminiscing

You are looking at a very lucky guy who has had a rewarding and enjoyable career as a forecaster. It started in the late 1940's in the Chicago Forecast Office under Gordon Dunn, one of the best forecasters who ever worked for the Weather Bureau. I remember him telling me that forecasting then was 80% hard work, experience, and art, and 20% science, but that by the time I retired it would be 80% science and 20% hard work and experience. That forecast has verified well, just as did most of his weather forecasts.

My first job under Dunn was to plot and analyze upper-air charts for use by line forecasters. Before each morning forecast was issued there was a map discussion (not a briefing, but a no holds barred discussion) to decide what general weather trends would guide the forecasts issued over the next 24 hours. Mr. Dunn nearly always participated. His paper work took a back seat to weather forecasting. These map discussions were enjoyable learning experiences for me. At the time, I was an intern doing part-time graduate study at the University of Chicago. On a day when the forecast was difficult, I was being a good thermometer content in listening to the discussion until Dunn turned to me and said, "Len, what do the latest ideas on the jet stream bring to this forecast problem?" I was speechless and unprepared. You see, Dunn knew that Rossby was testing results of his new jet-stream premise and research on his graduate students, and he wanted his forecasters kept up to date. It is hard to believe today, but at that time there were relatively few observed winds at 30,000 feet. Also high speeds were considered anomalous. You can bet that I was well prepared for subsequent map discussions, and even became a thermostat in volunteering information on occasion.

Another important step Dunn initiated so his forecasters would be on the cutting edge of the science was to bring about collocation of the Forecast Office and University of Chicago Meteorology Department. When this took place our morning map discussions were joint affairs with professors and graduate students participating. One incident I shall never forget took place shortly after the collocation. The University people were discussing the "major" and "minor" trough and ridge movements and developments, a new concept in those days. We call these "long" and "short" waves today. The briefer stated that a "minor" trough was moving across Minnesota. He was abruptly interrupted by a forecaster almost yelling. "The hell it is. It is snowing 4 inches an hour in Minnesota." Of course both spokesmen were right.

We communicated better with the University people as time went on. If you look at the Chicago local forecast verification statistics you will see that 24 – and 36 – hour forecasts improved significantly during this collocation period. The University-Forecast Office cooperation also resulted in publication of AMS Monograph #5—"Forecasting in Middle Latitudes", a significant publication for forecasters in the early 1950s.

It is important to note that it was middle management leadership that motivated forecasters and gave them an environment in which they could stay up-to-date on the state of the science and incorporated as much science as possible into operational forecasting.

3. Current Forecasters' Concerns

A major concern of many forecasters these days is, "What will be my role in the future and in what environment will I be working?" In listening to papers yesterday afternoon, I noted that some, like the keynote address by Dr. Uccellini, suggested that forecasters should have a prominent role in preparing the product including studying all scales of motion. I interpreted others to be suggesting a lesser role of merely looking at computer printouts and using details of the meso-

[1]Len Snellman was our invited speaker at the 1991 NWA Annual Meeting Awards Banquet on October 9, 1991 at Salt Lake City, Utah. The message Len presented was an enlightening look back to his early years in forecasting to bring us relevant lessons learned for the forecasters of the 1990's and beyond. Len has graciously allowed us to share the manuscript of his presentation with Digest readers. Tim Crum, 1991 NWA President.

scale to do nowcasting. Certainly the forecaster's current preparation routines will be changing considerably as new data and technology become available. However, if we are going to produce the optimum forecasts that the science and new technology will support, the "man" part of the "man-machine" mix must include an in-depth diagnosis of existing synoptic regimes, in addition to studying mesoscale details.

This reminds me of a consultant visit that I made to the Weather Forecast Office at Wenatchee, Washington, many years ago. I was promoting a new forecast tool, apparently so strongly that my pitch was interpreted as being for the only tool you needed to use. A wise and experienced forecaster looked me in the eye and said, "Len this is great but you have to be a complete meteorologist and consider all appropriate tools to be a good forecaster." He was absolutely right.

This larger role of forecasters is not going to happen on its own. We need the type of middle management in the 1990's that Dunn displayed four decades ago to motivate and educate both new and experienced forecasters to incorporate new data, new ideas, and new technology into a higher level of practicing meteorological science. It is easy for forecasters and others to be scientifically lazy in this computer age. Computer products are good enough today to use directly and be "pretty good." I use the words "pretty good" advisedly because I recently read a poem about being "pretty good." The central theme was, "Being just pretty good leads to a lack of fulfillment of what you can be and to loss of job satisfaction." We can do better with an intelligent man-machine mix.

4. Meteorological Cancer

I am sure that many of you would be disappointed if I didn't bring up the subject of "Meteorological Cancer", a phrase that I coined in a 1977 paper. Meteorological cancer is defined as the increasing tendency of forecasters to abdicate practicing meteorological science and becoming more and more just a conduit of information generated by computers. Like the life disease, meteorological cancer is still widespread and needs the attention of organizations like the NWA. The latter could assume a role similar to that of the American Cancer Society, only striving to eliminate the disease from weather forecasting—an American Meteorological Cancer Association, if you will. This cancer can lead to the 20% human input into forecasts shrinking to near zero during the 1990's.

While Mark Matthewson didn't imply it in his paper yesterday, I see carcinogenic ingredients coming into the practice of some forecasters once his system of computer prepared word forecasts is in use. Mark's work is important, and I hope it proceeds rapidly and is successful. However, as I listened, I envisioned unmotivated forecasters taking a cursory look at graphic forecast displays, and pushing a button to send a "pretty good" forecast to the public. Radiation treatment or surgery by middle management will be needed if Mark's work leads to increased meteorological cancer.

5. Diagnosis And Time To Do It

The first step in making the best forecast that the science permits requires a thorough high quality diagnosis. Successful short range forecasts are more the result of good diagnosis than of prognosis. Uccellini referred to it as knowing the "cause and effect." Using the latest technology plus new data coming on stream will permit a far superior determination of what is going on in the atmosphere and how it will change with time than was ever before possible. What a wonderful era and challenge to look forward to! We must make the most of it. I wish I could turn my biological clock back 30 years and be a participant in the Modernization Era of the '90s.

Data from NEXRAD, more detailed imagery from GOES I, and wind profiler and lightning data coupled with improved computer products will give forecasters the best opportunity that has yet existed to apply known physical principles to the preparation of day-to-day operational forecasts. I am especially intrigued by the new wind profiler data becoming available. Its use alone should be important in improving daily forecasts as well as those involving severe weather. Profiler data should lead to better diagnosis of stability changes taking place between rawinsonde observations. Hopefully, this will enable forecasters to put more information into sterile daily summer forecasts of "scattered afternoon and evening showers." The ability to issue forecasts with details of time and intensity of severe weather as well as ordinary day-to-day weather changes will be great fun as well as more helpful to users. This increased job satisfaction, and being the best that you can be, will take place only if forecasters are given time to be a scientist (thermostat) and not just a communicator (thermometer).

Making a good diagnosis takes time, even when following systematic and efficient procedures to digest the voluminous data available. During this morning's session, I marveled at reports on outputs of NEXRAD. Then I wondered how much time it would take to extract the important information available and incorporate it into an operational forecast or warning. Will forecasters of the 1990s be given enough time to do it? Several of us on the Academy of Science committee looking into the NWS modernization planning are concerned about this time factor. NWS top management and especially the NWA need to be leaders in showing how important it is to give forecasters enough time to operate as scientists. In addition there needs to be strong middle management to see that this time is used wisely.

It is my opinion that the NWS never developed the use of AFOS, the current computer-video weather system, to its full potential because there was insufficient instruction and motivation given to forecasters. By promoting and sharing ideas through publications, work shops, and meetings the NWA can be a leading force to ensure that new systems coming on board are put to best use. This annual meeting is an example of what can be done. Very often if you plant the seeds of good ideas, members will take the ball and run with it.

6. Decision Trees and Forecast Funnels

Let me share with you two ideas I think need to be promoted.

1) There is an immediate need for the development of interactive decision trees. These are schemes whereby a computer program guides forecasters systematically through appropriate data sets and charts to consider in making a forecast. It is important for provisions to exist that permit the forecaster to interact by asking questions or changing data values, similar to the SHARP and COMET workstations being demonstrated at this meeting.

2) Such decision trees need to encompass both large and small scale regimes. Forecasters must not be myopic and just

concern themselves with details of the small scale environment. They need to know what game they are going to play before they check out the equipment needed. Due to my Chicago experience I find that following the concept of a forecast funnel helps organize the large amounts of data available today. By a forecast funnel approach, one first gets an understanding of what is going on in the larger scale before considering mesoscale and local systems as the synoptic scale drives the mesoscale. With gridded model data and other computer products, the time necessary to make larger scale diagnoses will be small, compared to time spent on mesoscale diagnoses.

In this regard you can see that I am trying to hold on to the past. I am so old fashioned that I still mourn the loss of 500-mb barotropic forecasts. Because the NWS Western Region fought so hard to keep barotropic forecasts on AFOS years ago, at my retirement, NMC presented me with a large psi symbol, the notation used to represent barotropic streamlines. Comparison of simple barotropic forecasts with sophisticated baroclinic forecasts provides insight into whether forecast deepening and filling result from baroclinic developments or redistribution of energy. This difference can be significant in understanding and evaluating associated model outputs of vertical motion, etc. Daily barotropic forecasts are produced at the University of Utah. It is a great diagnostic and teaching aid.

Let me give you three examples, two old and one new, of the importance of following the funnel concept in preparing local forecasts. One night, as a young aviation forecaster on the midnight shift at Chicago, the terminal forecast problem was: Is significant ground fog going to occur? I was being very conscientious in tracking every detail of temperature/dewpoint spreads, wind changes, and cloud movements. Changes in these details convinced me to forecast fog for several of the required 17 terminals. Just before sunrise my relief arrived. He looked over the larger scale features without concern for the details and then said, "Snellman, why on earth are you forecasting fog?" When I took a step back and looked at the larger picture, it was obvious that I had made a stupid forecast. Then he added, "And you amend every one of those before you go home." I did.

Several years ago at a daily NWS Western Region Headquarters map discussion led by Jim Fors, the current deputy Meteorologist in Charge at Bismarck, there was a cloud and rain shield over the state of Washington moving southward. The "no-diagnosis-in-depth" forecast was to move this weather into northern Utah in 12 to 18 hours. Jim's thorough diagnosis of the synoptic scale changes indicated the cause of the weather was weakening and therefore, he forecast the clouds and precipitation to dissipate as they moved toward Utah. It was a gutsy forecast to make and his "no rain" forecast for northern Utah verified well. Looking at just the details would have resulted in a poor forecast.

A more up-to-date incident occurred a few weeks ago. I had the opportunity to visit an office on the east coast that recently had NEXRAD and other new systems installed. At mid morning there was a cloud mass over Ohio. When I asked a forecaster why it was there, the answer was, "It is residual debris from nocturnal thunderstorms associated with a dying front." Based on no echoes and a moth-eaten looking cloud shield on the satellite picture, the forecaster said that clouds were moving slowly southeast and dissipating. Looking at the 500-mb chart, it was apparent that these clouds were associated with a migratory temperature trough. With the help of diurnal heating afternoon thunderstorms were likely. Several hours later driving west I encountered such heavy rain I considered pulling off the road until it let up.

My point is that even with new tools available there is a need for in-depth diagnosis of more than mesoscale and local data. If forecasters aren't motivated to make good diagnoses there will be many in the new era killing gnats and letting elephants run loose when preparing local forecasts.

7. NWA Challenges

Recently I became associated part time with COMET, and was pleased to see the great teaching potential of multi-media techniques and to see how easily the forecast funnel approach can be incorporated into routines for forecasting heavy precipitation. Beyond this, I envision forecasters having access to multi-media facilities as they prepare forecasts in the AWIPS Era. Sitting at a work station, forecasters will have the opportunity to follow interactive decision trees incorporating conceptual models, graphic still and animated gridded NWP fields, satellite imagery, etc. What an exciting time, and the most important computer in the activity must be the one between the forecaster's ears. Further, I believe most of these decision trees and conceptual models will be developed at field stations.

For such a wonderful development to come about, we need enlightened and visionary top and middle management backed by publications and activities of the meteorological community which discuss forecaster activities in the sea of new data. As much emphasis needs to be placed on how the new data are to be used as to how the hardware works and what it produces. There is much work to be done.

I think the NWA should be a strong leader in continually promoting the above philosophy through newsletters, articles, and Digest papers. Also, papers on the subject should be solicited and there should be more meetings like the present one involving the Modernization Era.

The need for the NWA and other organizations to inform and educate operational forecasters was highlighted in a recent letter from a forecaster to Dr. Hosler at Penn State that I read. The author had read some of the literature regarding modernization and was rather negative about wind profilers, ASOS, and AWIPS. Obviously, this forecaster, although not well informed, was motivated and interested enough in his future to write the letter. These are the type of people the NWA should listen to and help.

Another area where I think more NWA Digest papers are needed involves ASOS, the new Automated Surface Observation System, which is currently being installed at NWS and FAA locations across the country. Originally, I had misgivings about this system. As I learn more about it, and reflect on the shortcomings of human observations, my misgivings are fading. The NWA should promote discussion of the ASOS program and its impact on operational forecasting. This can be done by inviting Digest authors and meeting speakers to present papers on integrating ASOS observations and satellite imagery. This will provide forecasters with information to evaluate the gains and losses associated with ASOS weather observations as compared to the present day less frequent human observations. Once forecasters are informed and taught the merits and use of new data, opposition and meteorological cancer will be diminished.

The September report of the Forecast Systems Laboratory activities contains a review of experiments in progress that are designed to determine the human contribution to aviation

forecasts in the new era of mesoscale model output. Results of these experiments are to be given at a forecast symposium in Atlanta in January 1992. The NWA should be informing members of events like this.

We are at the beginning of a great new era in weather forecasting. The NWA can provide an important contribution toward making operational forecasting more exciting and rewarding than it is now. I will close by reading a short poem on excellence, as a guide to 1990s forecasters and the NWA.

EXCELLENCE CAN BE ATTAINED IF YOU:
Care more than others think is wise.
Risk more than others think is safe.
Dream more than others think is practical.
Expect more than others think is possible.

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