*Editor's Note: This is a recent talk given by the author at a local service club.*

# WANTED: A LONG-RANGE WEATHER FORECAST

L. W. Snellman
National Weather Service
Western Region Headquarters
Salt Lake City, Utah 84147

Being a meteorologist these days is a rewarding experience. Not only is meteorology an exciting and challenging science but it gives the practitioner rewards similar to those that you must get participating in your service club activities -- i.e., rendering service to mankind. In addition, however, we have the thrill of participating in the use and advancement of new computer and space-age developments.

Of course there are certain occupational hazards, like people using double standards when evaluating our work. We are supposed to be 100% accurate -- being only 87% accurate, to hear many people comment, means that we are always wrong. Using this standard, I wish my stock brokers were always wrong. Also we put our product out every day for all to see, but we are criticized for hedging if we try to tell the truth in those statements by expressing our uncertainty through the use of probabilities. Nevertheless, there is great psychic income knowing that we save people money, inconvenience and sometimes their lives by our predictions, be they occasionally imperfect.

Forecasts can be characterized into 4 classes: (1) detailed, highly accurate forecasts for the next 6 to 12 hours. These are based on extensive use of radar and satellite data; (2) rather specific forecasts for tomorrow and the next day or two. We base these on computer products and forecaster experience; (3) 5- to 30-day general forecasts when computer and statistical techniques plus forecaster experience are used; and then (4) long-range forecasts of several months. This latter type of forecast is what I shall address myself to today.

One very disappointing part of my profession is the inability of our science to support these long-range forecasts even in a general way. The need for such forecasts is very great. I consider that it ranks with the need for a cure for cancer. Like cancer, since science has not developed far enough to produce the needed result, it opens the door for unethical opportunists to take advantage of the need and to sell useless cancer cures and long-range forecasts to laymen.

The state of the science as seen by the National Academy of Science and the American Meteorological Society regarding forecasting states that specific forecasts are feasible most of the time for periods of 1 to 3 days, and, on occasion, out to 5 days. Beyond that period, average conditions of temperature and precipitation for periods up to a month show some skill but seasonal forecasts covering 3-month periods can be made for mean temperatures only and then with just a small elementary skill. There is no skill in precipitation outlooks on average rainfall beyond a month. Therefore, when you hear a forecast of a big snow on a specific day next week or sometime next month, you know it is not based on sound meteorological principles. Wait a minute, you say, "I have heard forecasts like that and some of them were correct." My reply is, "thank goodness for that, because if such forecasts were always wrong, it would show some negative skill and that could be useful."

Let me illustrate what I mean. When I was on the John Prince radio show last October 31st, I asked the audience to make a no-skill forecast for each day in January by putting the climatology of Salt Lake City's January weather on 31 slips of paper, e.g., normally there are 6 clear, 7 partly cloudy, 8 cloudy, 6 rain or light snow, and 4 significant snow days in January; so, 6 slips were to be labeled "clear," 7 "partly cloudy," 8 "cloudy," 6 "precipitation," and 4 "snow." Then the slips were to be drawn one at a time from a hat. The 1st slip would be the forecast for New Year's Day and the 2nd for January 2nd, etc. Our girls in the Personnel Office were intrigued and made a January forecast this way. The results are revealing. January actually turned out to have only 5 clear days, 5 partly cloudy, 7 cloudy, but 14 precipitation days with 4 significant snows. The girls forecast the weather correctly 10 out of the 31 days, catching 2 of the heavier snow days. And if you give them a leeway of ±1 day on precipitation events because the forecast was made 2 months in advance, they hit 8 of 14 precipitation days and 3 out of the 4 heavier snow days of the month and that is pretty good. Two young meteorologists in my office made the same type of forecast, but apparently their graduate training in meteorology caused their drawing of slips out of a hat to be inferior to the girls. But they still had 8 out of 31 days correct and forecast 4 of the precipitation days correctly although none of their snow forecasts verified. Thus, you can see,

random no-skill forecasts are correct some of the time, and you should not be deceived by an occasional hit.

Let's extend the time period. Because of last winter's drought, there was great concern last February regarding the forecast of precipitation for the rest of the year. Late last February, a local TV station published a year's forecast for the state of Utah by month made by a well-known opportunist. Our Personnel Officer also made a forecast for the rest of the year at the same time; only she used 5 slips of paper and a die from Las Vegas. First, she labeled 5 slips of paper defining precipitation as: "normal," "above normal," "slightly above," "below," and "slightly below normal." She pulled the slips out of a hat one at at a time and assigned a number to each drawn. The 1st drawn was labeled "1" and happened to be above normal, the second draw was labeled "2" and was slightly above, etc. Next, she made the forecast for each month starting with March by rolling the die. If a one was rolled, the month was forecast to have above-normal precipitation and so on. Sixes didn't count. We then verified the 2 forecasts as each month passed using a matrix of error points such that near misses were worth 1-error point while a bust forecast of below normal when it was actually above normal or vice versa, was given 4 points. The no-skill die forecast won with 17 error points against 18 for the opportunist. Both had 1 month correct and 4 near misses but our girl Dobbie had only 1 4-point bust, while the opportunist had 2 busts.

If you believe what I just said is a valid test to show that long-range forecasts have no skill, then what is a person to do who wants to be progressive and use meteorology in planning next season's business activities? One suggestion might be to hire our personnel girls. Maybe they have ESP or maybe it was beginner's luck and you shouldn't hire them. A much better solution is to make use of climatological relationships. By that I mean using relationships found in past weather records that give indications of future weather conditions. A very simple example of using climatology would be to forecast for a visitor, say, from another planet who didn't know anything about our weather that SLC temperatures will be cold in January and very warm in July. The application of climatology to solve given problems is not usually a simple task. In essence, you must ask the data the right question to get a meaningful answer. Our Utah climatologist (Arlo Richardson) is an expert at doing this. As a result, over the last 4-plus years, he has done an outstanding job of helping state planners and others use climatology in coping with the drought, spring freezes, business plans, etc.

We, in meteorology, have not done a good job of selling the usefulness of climatological relationships to help fill the void of needed long-range forecasts; also, laymen are reluctant to put much faith in past weather data, when the future weather is what they want. People who know, tell me that climatological relationships and trends are more reliable than most financial and economic trends widely used by business executives in planning future actions by their companies, and that we should not be so passive about filling the long-range forecast void with climatological inferences. Rather, we should be aggressive regarding the use of climatology and that is why I am grateful for this opportunity to talk to you today.

Of course, climatological indications may not exist to answer the question you need answered or if they give an answer it may not always be correct. Utah could have had a second dry winter in a row, even though Arlo's climatological projections indicated this was highly unlikely. But most business executives are used to taking such risks. Maybe an example will put these ideas in better perspective. In sports, owners frequently spend large sums of money to purchase a baseball player who bats over .300 for 2 years in a row; he does this knowing that the player might only bat .250 for him but he believes the odds are on his side. A company will pay well for an executive, who has a track record of successfully managing other companies, to come and work for them. So you are not using any new principles when you use climatology, you are using the past performance of the atmosphere.

The Federal Government has recently recognized the importance of climatology to the future economy of the Country and has been planning a new climatological program for the past 2 years. With us moving out of the most benevolent 35 years -- weatherwise -- in the last 1000 years, weather extremes probably will become increasingly more frequent over the next decade as compared to the weather period from 1940 to 1975. I'm sure most people in the East believe this statement is already verifying after the severe snow storms of the last two winters. The increasing global population is also making the impact of severe weather conditions more critical. Thus, climatological trends and relationships are becoming more important in managing our agricultural and energy resources on a National level. Let me give you an example. India has had a favorable monsoon season for growing crops for the past 5 years. Climatology indicates that they are due for a monsoon and crop failure in 1978 or 1979. The resulting food shortage could affect our grain markets.

An international panel of experts on climatology recently made the following statement in a United Nations publication: "We have little or no ability now to predict natural changes in the state of the climatic system. The possibility should be recognized that future developments of global climate

may not be inherently predictable in sufficient detail and over sufficiently extended ranges of time to satisfy many of the needs of society for such information." Partly because of this state of affairs, the Federal Government is in the midst of a vast, strong effort to greatly expand the National endeavor involving climatology and its uses. To put this effort in perspective, the planned budget is many times the $1 million it cost to run the last year of the old Federal Climatological Program in 1973. However, a major part of the new program is research. The program is to include:

A. Considerable basic research in computer-simulation studies to further our knowledge of the complex relationships of land, sea, atmosphere, and sun to climatic changes.

B. Expand the activities of the center which translated the latest global climatological data into real-time crop and energy projections, and

C. Establish another center for developing analysis and prediction techniques with the hope of extending routine outlooks with skill beyond 3 months.

Thus, we shall have to rely on current climatological statistics for sometime until this new program bears fruitful results.

In closing, I thought that it would be good to give you an outlook for the coming spring and summer. The winter has been abnormally warm and is well on its way to being the 2nd or 3rd warmest winter in the last 44 years. Our concern this February is not water supply, but the fruit crop. The warm winter has advanced budding of the trees to where the buds are going to be severely damaged by just usual temperatures to be expected in March. You hear some people say that a warm winter signals a cold, wet spring. That is probably because they remember it happened that way in 1970. However, in 1934, northern Utah experienced a warmer winter than this year and the spring was abnormally warm also. Our state climatologist tells me that climatological statistics indicate that this spring is just as likely to be abnormally warm as it is to be abnormally cold. Even the National Weather Service average temperature outlook for the 3 months of this February, March, and April indicates an indeterminate temperature forecast for northern Utah. So, it is one of those cases where I must say, like a doctor does, on occasion, "we need to wait and see what later data shows. Although the odds are slim, let's hope that temperatures stay high enough so that we don't lose our fruit crop this year."

Thank you.

## TRADING POST

Technical Procedure Bulletins -- The newest TPB #223 entitled Sea Surface Temperature Analysis, North Atlantic and Northeast Pacific Oceans is now available. Please note that the correct address for requests is: Dr. Duane Cooley, Chief, Technical Procedures Branch, W111 National Weather Serice, NOAA, 8060 13th St., Silver Spring, MD 20910.

## A METHOD FOR MAKING QUICK FAHRENHEIT/CELSIUS CONVERSONS

Introduction: A few formulas have been tossed around the meteorological world to quickly approximate an equivalent temperature from the Fahrenheit scale to the Celsius scale (or vice versa). But here is a method to make an almost instantaneous mental conversion to the nearest whole degree.

Is your office wallpapered with Fahrenheit/Celsius conversion charts? Are you frustrated by constantly having to refer to these charts? Do you refuse to plot Canadian Surface data because the temperature and dew point are in Celsius?

The Metric Age is coming to America, but as yet, not here. To the weatherman who presently has to work in both temperature systems, a method for quickly converting fron one scale to the other without making his mind look like a mental scratchpad would be welcome.

A few simple formulas to approximate (within a few degrees) a temperature conversion have been developed. But now, here is a scheme in which exact conversions (to the nearest whole degree) can be made without doubling, halving, taking 10 percent, subtracting 32, etc.

To employ this method, two basic concepts must be understood:

(1) What we will call "Exact Conversion Equivalents" (ECE's), and

(2) The pattern other Fahrenheit/Celsius equivalents form around each ECE.

Exact Conversion Equivalents

Of course $0.0^{\circ}C = 32.0^{\circ}F$

But these exact equivalents are also true,