

AN EVALUATION OF THREE  
LONG-RANGE FORECASTS  
FOR THE WINTER OF 1979-80 --  
AND A TALK WITH  
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Small wonder people were concerned over what kind of weather the winter of 1979-80 would bring. Consider what the previous three winters had delivered.

During the winter of 1976-77 unprecedented snow fell as far south as Miami in January. In that same month, it was so warm in Alaska that bears, thinking it was spring, came out of hibernation. But residents of Buffalo, New York, went into hibernation as the city disappeared under an awesome blanket of winter white. In ironic contrast, an earth-cracking drought stalked California; and the Rockies and Cascades were virtually devoid of snow. Through the Ohio Valley states an acute shortage of natural gas aggravated the social and economic suffering that accompanied the coldest weather on record there.

Wild weather continued in the winter of 1977-78. The drought in California turned into a nightmare of mud and floods as repeated heavy rains soaked the area. Meanwhile, howling blizzards and roof-breaking snowfalls paralyzed various parts of the East at different times. A number of locations approached or surpassed maximum seasonal snowfall marks. A February blizzard in New England left damage totaling at least \$300 million in its wake. Frigid Arctic air gripped much of the Midwest through the winter, and temperature records tumbled for the second straight year.

There was no relief the following winter. Record cold extended from the northern Rockies across the central Plains to the Midwest. Below normal temperatures blanketed virtually the entire nation, and January 1979 garnered the dubious distinction of being the coldest month known on a

national scale (2). Snow and ice cover across North America exceeded all previously observed extents (2). In Chicago, the furor over snow removal cost the incumbent mayor re-election. And in New England, bitter February cold caused fuel oil supplies to dwindle to a frightening 3-day reserve.

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A lot of professional meteorologists were concerned, too, though perhaps from more academic points of view. Long-range outlooks for the coming winter were in great demand as the autumn warmth of 1979 disappeared. There was no dearth of such outlooks, either. Perhaps there were too many. The Lawrence Livermore Laboratory, under contract to the United States Department of Energy, developed a consensus forecast for the winter of 1979-80 based on 11 different experimental forecasts (3). Those 11 outlooks didn't even include those commercially available.

Not having the resources of the Lawrence Livermore Laboratory in my basement office, I thought it would be interesting to take a more modest approach and see how just a few of the outlooks for the winter of 1979-80 worked out. For my "few", I chose three: the outlook of the Climate Analysis Center, National Weather Service, NOAA; the outlook of Dr. Jerome Namias, Scripps Institution of Oceanography; and the outlook of Dr. Hurd Willett, Professor Emeritus of Meteorology at Massachusetts Institute of Technology. I consider the NWS, Dr.

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Namias, and Dr. Willett to be the "heavy hitters", the "old pros" in the business. The NWS (and its forefathers) has been issuing extended-range outlooks for over 20 years. Dr. Namias founded the NWS long-range forecast group before moving to Scripps. (Perhaps he was prescient regarding Washington's recent winters.) And Dr. Willett has been studying climate trends for over three decades.

Not only do the three different sources represent a depth of experience, they represent a cross-section of the spectrum of approaches to the problem of long-range forecasting. The NWS uses mainly lag correlations between winter 700mb heights and those of previous periods to predict height anomalies from which precipitation and temperature forecasts are derived (4). Dr. Namias relies primarily on North Pacific Ocean sea surface temperatures and anomalies in Atlantic Ocean circulation to predict, based on correlations and "teleconnections", 700mb height anomalies over the U.S. (5,3). Dr. Willett is of the school that believes there is a connection between solar cycles and weather regimes. His extended-range outlooks are based on atmospheric circulation/solar-cycle analogs (6). I suspect, though, after talking extensively with Dr. Willett over the past five years, that his forecasts rely more heavily on the circulation analogs, and less so on the circulation/solar - cycle analogs. This probably stems from the fact that he believes solar cycles more effectively influence longer-term climatic trends or fluctuations (e.g., over a period of several decades), and that year-to-year weather variations are more the result of change mechanisms working within the climate or general circulation system.

The winter 1979-80 temperature outlooks of the NWS, Dr. Namias, and Dr. Willett are shown in Figures 1, 2, and 3, respectively. Typically the outlooks of the three are readily available to the public, if not in national publications, then at least for the asking. (Dr. Willett's was an exception last year, as business technicalities prevented him from releasing it to the media or upon

request. He was kind enough to give me a copy, however, and it is presented here with his permission.)

The NWS (Fig. 1) gave temperatures in the Midwest, South, and southern Great Plains "a 65 percent chance of falling below normal for a fourth consecutive year", but felt they "need not equal the intense cold of the recent winters". Dr. Namias (Fig. 2) foresaw the area between the Appalachians and Rockies as being "especially cold". And Dr. Willett (Fig. 3) expected temperatures to average "significantly milder than last winter" in most areas east of the continental divide, and thought that the most severe cold would shift to west of the Rockies. However, he anticipated "no recordbreaking monthly departures" such as occurred during the winter of 1978-79 in the Midwest.

The observed temperature departures for the winter of 1979-80 are shown in Figure 4. I have arbitrarily defined temperatures within 2F of normal as being in the normal category. This is not the same as verifying temperature departures against a strict three-category system (normal, above normal, below normal); but it does permit one to make a quick, subjective comparison between forecast and observed temperature departures.

In stark contrast to the winter of 1978-79 in which virtually the entire nation averaged colder than normal, the winter of 1979-80 brought significant mildness to many areas. In particular, the Southwest, the northern Plains, and the upper Mississippi Valley averaged warmer than normal. The biggest positive temperature deviation occurred in northeastern Nevada where the winter mean was over 8F above normal. Much of the country averaged near normal to slightly below normal, but the large negative temperature departures which had been present the previous winters were absent. Nowhere did the winter average as much as, or more than, 4F below normal.

On a purely subjective basis, the NWS outlook for the winter of 1979-80 appears to have been relatively close to the mark. It generally defined the

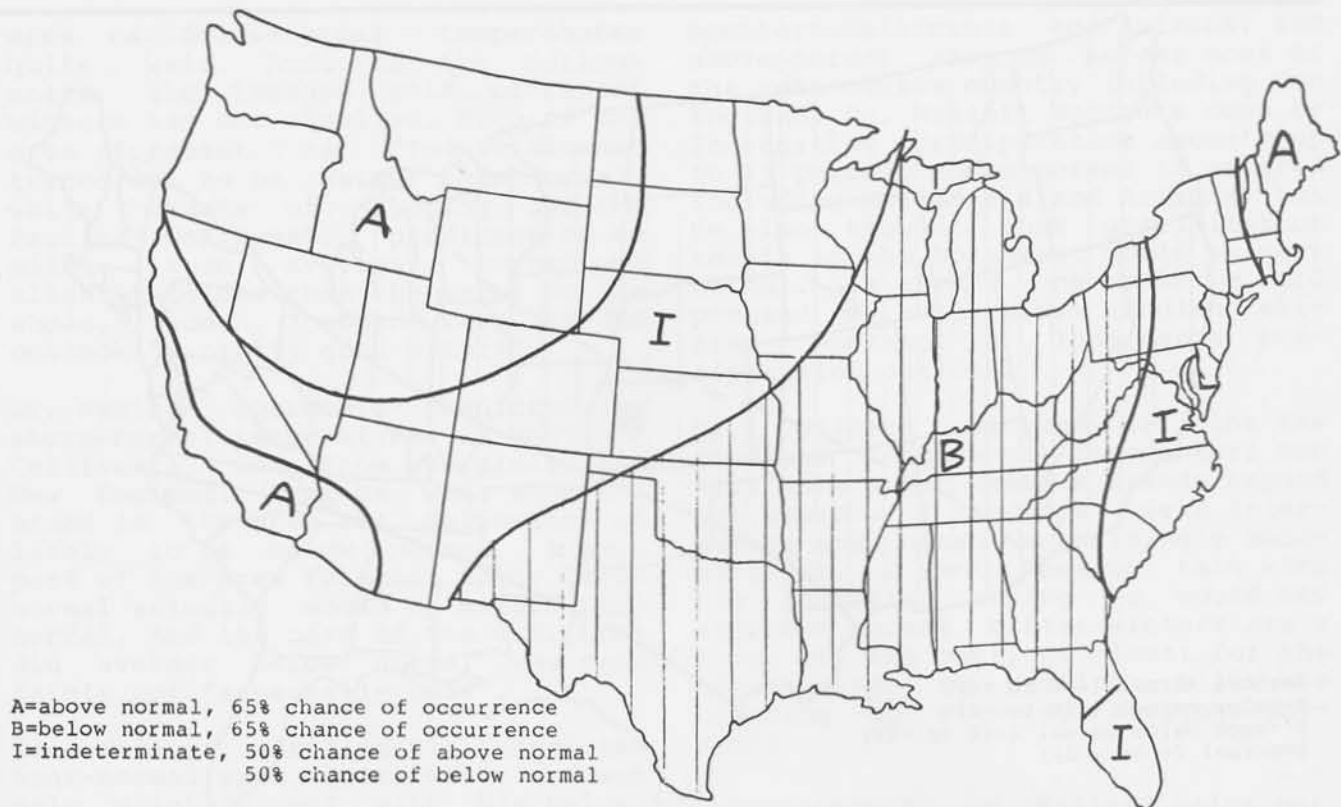


Figure 1. The NWS Climate Analysis Center temperature forecast for the winter (December through February) of 1979-80.

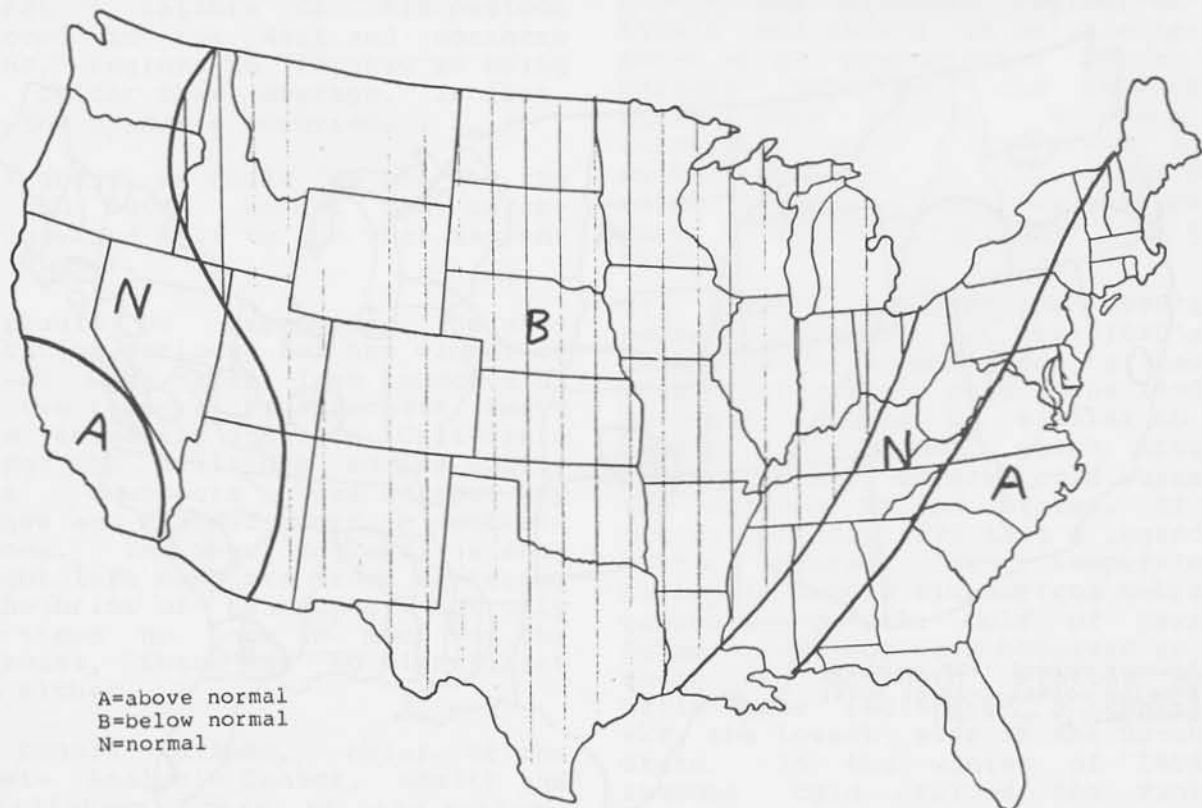


Figure 2. Dr. Jerome Namias' temperature forecast for the winter (December through February) of 1979-80.

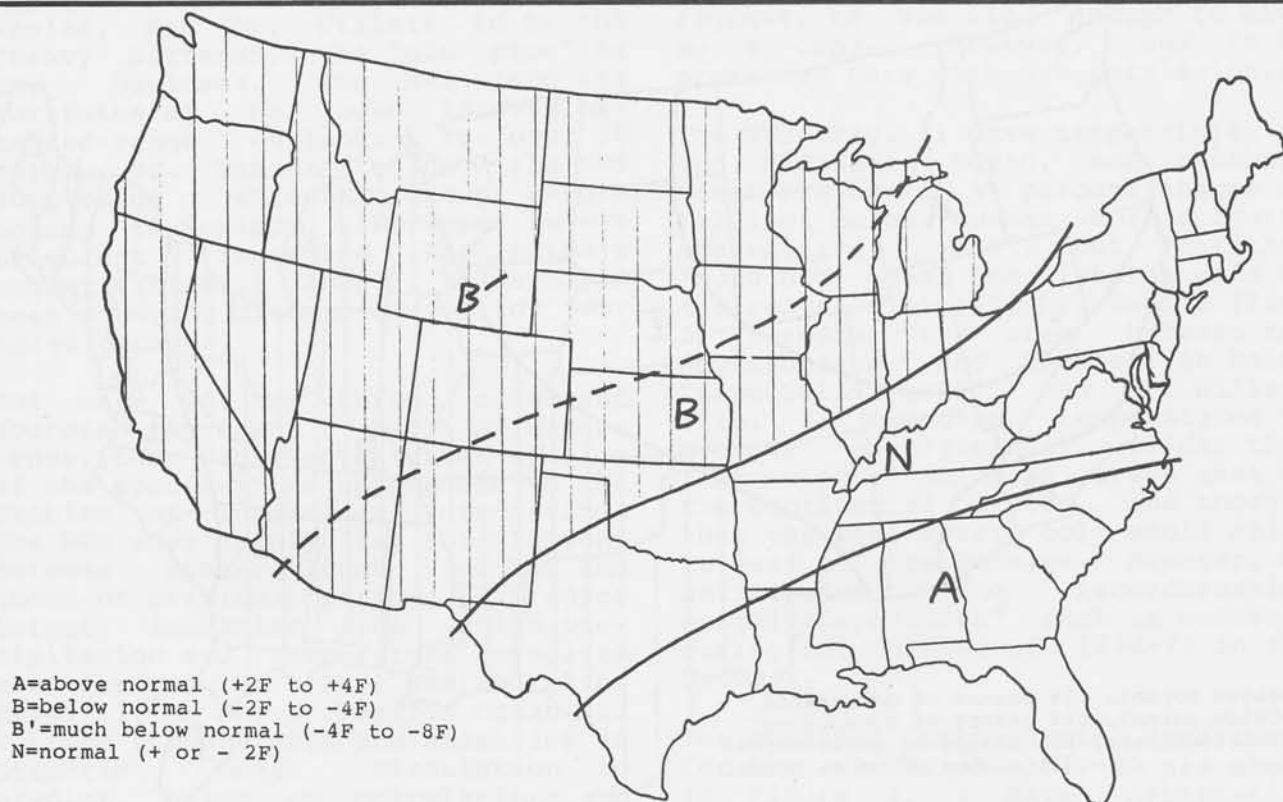


Figure 3. Dr. Hurd Willett's temperature forecast for the winter (December through February) of 1979-80.

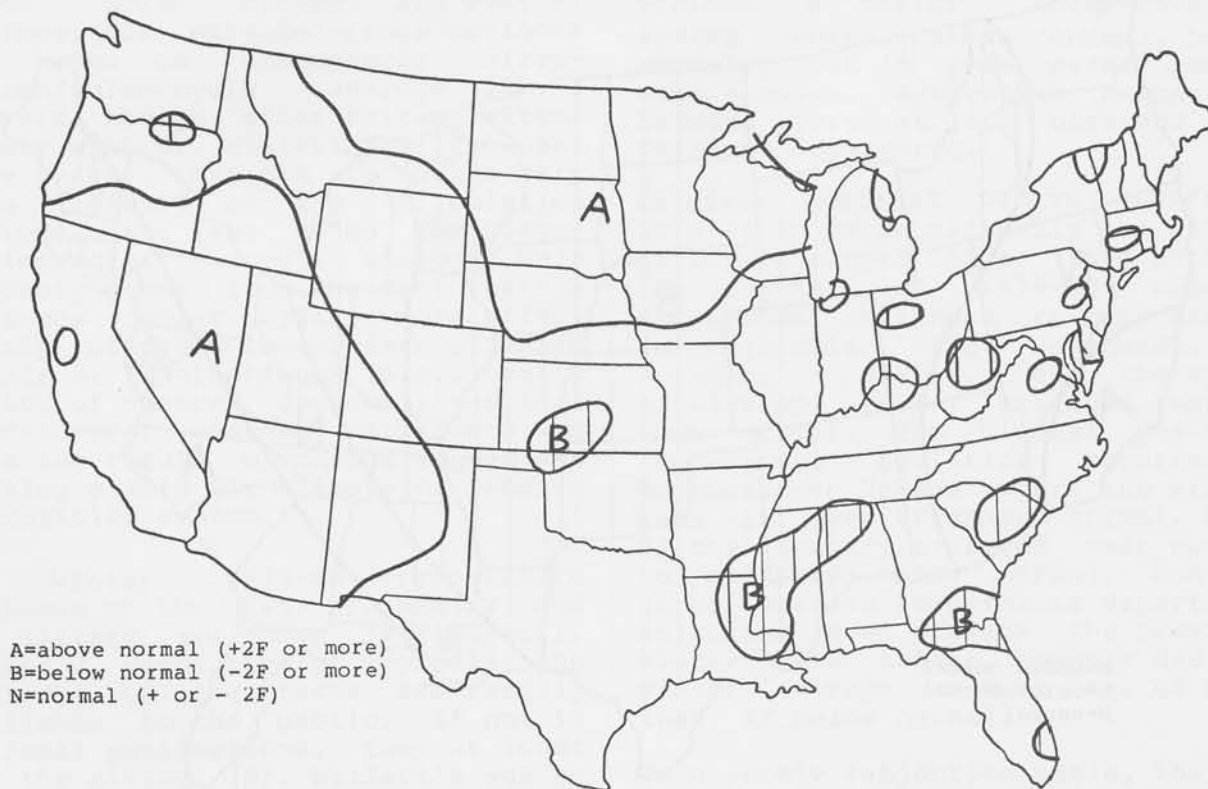


Figure 4. Observed temperature departures for the winter (December through February) 1979-80 (source: NWS).



area of below-normal temperatures quite well. And, as the outlook noted, the intense cold of recent winters was not equalled. Much of the area forecast as "indeterminate" turned out to be warmer than normal, while chunks of Wyoming and the Pacific Northwest, predicted to be milder than average, turned out slightly colder than the mean. On the whole, though, I would term the NWS outlook "a pretty good effort".

Dr. Namias correctly predicted the above-normal temperatures in southern California, and from Virginia into New England, but he was much too broad in the area he delineated as likely to be below normal. A good part of the area forecast to be below normal actually wound up milder than normal. And the part of the U.S. that did average below normal was certainly not "especially cold".

Dr. Willett verified his predicted near-normal area quite well, and was only slightly off with his below-normal region. The area he predicted to be above normal, however, averaged largely colder than normal. But the biggest failure of his outlook occurred in the West and northern Plains, regions he foresaw as being much colder than average. In fact, just the opposite occurred.

So, I guess we chalk up one for the NWS and 700mb height lag correlations, and wait to see what happens next winter.

As should be expected, the precipitation outlooks for the winter of 1979-80 were even less successful than the temperature forecasts. Heavy rains inundated southern California and set the hillsides moving again, while downpours washed out key bridges and flooded homes in southern Arizona. In New England, a snow drought left many ski areas teetering on the brink of bankruptcy. Not only was there no snow in much of the Northeast, there was no significant rain either.

Dr. Donald Gilman, chief of the Climate Analysis Center, admits the precipitation part of the outlook "was poor" (7). Dr. Namias didn't fare any better. He predicted near-to below-normal precipitation in

southern California and Arizona, and above-normal amounts across most of the rest of the country including New England. Dr. Willett scored a coup by forecasting precipitation amounts up to 75 percent above normal in an area including California and Arizona, but he also thought that precipitation totals in the Northeast would be near normal. I'm afraid one would be hard pressed to sell a New England ski-area operator a long-range precipitation outlook.

Dr. Willett is one of the few credible long range forecasters who will talk about weather trends beyond one season. I find his views interesting and often surprisingly accurate (8). I went back to talk with him recently, hoping he would say that our recent bitter winters are a thing of the past, at least for the time being. My heating bills are catching up with my mortgage payments.

Unfortunately, Dr. Willett holds out little hope that we will experience any permanent amelioration in winters over the next couple of decades. He expects the climatic regimes of the 1980's and 1990's to be similar to those which predominated during the periods 1800-1820 and 1880-1900. These were periods, he says, of relatively lower latitudinal zonal westerlies and, in mid-latitudes, colder temperatures. See (9) for a more detailed discussion of this theory.

Dr. Willett foresees the 1980's as being analogous to the 1880's, a decade which he describes as having been "particularly cold." The 1990's, he feels, should be similar to the 1890's, a decade which brought "exceptionally severe" cold waves to the eastern United States. It was during February 1899 that a legendary Arctic outbreak sent temperatures diving to record minimum from Nebraska eastward to the Gulf of Mexico. Subzero readings were observed as far south as northern Florida where Tallahassee registered a remarkable -2F, the lowest ever in the Sunshine State. In the winter of 1894-95 awesome cold ruined the Florida citrus crop. The damage was categorized as "extreme", the only such classification in the past 96 years (10).

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Summers, too, may be somewhat cooler in the near future. Dr. Willett says he "wouldn't be surprised" to see another "Year Without a Summer" within the next 20 years. The infamous "Year Without a Summer" was 1816. Snow whitened parts of New England in June; light frosts struck in July and August, then heavier ones destroyed the corn crop in September. It was the coldest summer ever in New Haven, Connecticut, and Hoheneisenberg, Bavaria (11).

I asked Dr. Willett if he considers sea surface temperature (SST) anomalies in the preparation of his seasonal outlooks. His answer was no. He feels SST anomalies are the result of, not the primary cause of, large scale changes in atmospheric circulation. He admits there may be some feedback effect during stable configurations of the westerlies, but believes that the general circulation pattern shifts -- regardless of the SST anomaly pattern -- "when it's ready."

Dr. Willett and Mr. John Prohaska, who together comprise The Solar Climatic Research Institute, Inc., are currently carrying on research under a grant from NASA. Mr. Prohaska is providing the statistical firepower for Dr. Willett, employing techniques that take the research well beyond the realm of the linear correlations on which Dr. Willett has had to rely in the past. Dr. Willett explains that he is not working on any single, specific hypothesis, but believes that after enough correlation studies are carried out and evaluated he will be able to develop a specific hypothesis. The Russians, Dr. Willett says, are following a similar line of research, but apparently no one else in this country is.

Meanwhile, the great sport of long-range, seasonal forecasting continues. Lag correlations, SST anomalies, and solar-climatic relationships each seem to have provided part of the answer. I predict -- as a meteorologist I can't resist -- that the complete answer is still decades away.

Besides, if the coming winter is going to be mild and snowless, I am not so sure I really want to know

that three months ahead of time. Part of the enzymes that keep operational forecasters going spring from the expectation (hope?) that a monster blizzard is lurking just beyond the latest LFM run.

## REFERENCES AND FOOTNOTES

(1) Harold Bernard is a professional meteorologist and author. His first book, *Weather Watch* (New York: Walker), was published in 1979, and his second, *The Greenhouse Effect* (Cambridge: Ballinger), was released in June of this year.

(2) Diaz, H.F. and R.G. Quayle, 1980. Three Extraordinary Winters. *Weatherwise*, vol. 33, no. 1, pp. 10-11.

(3) Knox, J.B. and W.J. Quirk, 1979. A Consensus of Several Forecasts for the Winter of 1979-80. Lawrence Livermore Laboratory UCID-18328.

(4) Harnack, R.P., 1980. An appraisal of the Circulation and Temperature Pattern for Winter 1978-79 and a Comparison with the Previous Two Winters. *Monthly Weather Review*, vol. 108, no. 1, pp. 37-55.

(5) Namias, J., 1976. Seasonal Forecasting Experiments Using North Pacific Air-Sea Interactions. Preprints, Sixth Conference on Weather Forecasting and Analysis, Albany, American Meteorological Society, pp. 13-16.

(6) Willett, H.C., 1974. Do Recent Climatic Fluctuations Portend an Imminent Ice Age? *Geofisica Internacional*, vol. 14, no. 4, pp. 265-302.

(7) Cooke, R., 1980. A Winter Awry. *The Boston Globe*, March 8, 1980, p. 1.

(8) In one of the first discussions I had with Dr. Willett in late 1976, he mentioned in a rather off-handed way that he expected three abnormally cold winters to occur consecutively in the Northern Hemisphere in the near future. The winters of 1976-77, 1977-78, and 1978-79 brought quick verification of that expectation.

(9) Bernard, H.W., 1979. *Weather Watch*, Walker and Company, New York, New York.

(10) Leavitt, P., 1978. On the Inter-Seasonal Relationships Among Minimum Temperatures and Damaging Freezes in the Central Florida Citrus Belt. *National Weather Digest*, vol. 3, no. 1, pp. 25-29.

(11) Albert, J.M. and H.E. Landsberg, 1974. The Summer of 1816 and Volcanism. *Weatherwise*, vol. 27, no. 2, pp. 63-66.