

COLD WAVE PATTERNS OF LEXINGTON, KENTUCKY AND ORLANDO, FLORIDA

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The unprecedented severity of the cold waves of the winter of 1962-63 has prompted this study of the cold wave patterns of Lexington, Kentucky and Orlando, Florida. During the 1962-1963 winter wave after wave of frigid polar air swept southward over the Eastern Cold Wave Track of North America bringing new minimum records to many stations, (Figs. 1, 5, 6). Newspapers headlined the damaging effects of these cold waves on such important and cold sensitive economies as the orange and vegetable industries of Florida.

This study of cold waves through the minimum temperature records of Lexington and Orlando has been undertaken as a pilot project in the appraisal of cold waves and accompanying minimum temperatures as weather and climate phenomena with unusual geographic effects. The major objective is an attempt to reveal distribution and frequency patterns of minimum temperatures as are associated with cold waves since in the United States all unusual minimum temperatures are associated with cold waves, (Figs. 1, 5, 6). A study of figures one and six suggests the definition of a cold wave as an invasion of cold air of 10 degrees F and lower or 20 degrees F below the mean minimum temperature. The 10 degrees F may moderate as the cold air moves southward but the 20 degrees below the normal mean minimum holds even in Florida.

In addition to this major objective, however, this study reveals that certain inferences are warranted relative to cold waves and that these inferences can be the topics for additional study. For instance banner newspaper reporting while true for the moment may exaggerate the damaging effects of the cold wave. In the Florida orange industry what was headlined as an almost total loss for the 1962-1963 crop due to the Dec. 11-14 cold wave turned out to be a relatively low percentage loss with an overall beneficial rather than detrimental effect on the orange industry. An AP press release from Lakeland, Florida of Dec. 14, 1962 reported that the cold Arctic air caused ice to form in from 75 to 100 per cent of the fruit regardless of smudge pots and windmills. The report explained that the damage was greater than in the 1957-58 cold wave when 30 million boxes of fruit were lost and 30,000 fruit trees killed. Harvest hands were reported to have abandoned the totally devastated vegetable farms and to have turned to save the iced oranges for juice. These reports were correct but the

30,000,00 boxes would not be a great percentage of the 163,000,000 box crop which Florida expected and the 30,000 trees would be a very minor percentage of the 600,000 acres of fruit orchards in Florida. Of course the vegetable crop was regrown in six weeks and the prices for citrus fruit had sharply increased. While in Florida, recovery and the resumption of a flourishing landscape obscures the damage of the cold wave and protective devices are the only evidence, elsewhere, the devastating aspect may prevail. In Kentucky the peach crop for the entire state for 1963 was a total loss and many orchards and trees entirely destroyed. North of Laredo Texas the entire citrus industry was destroyed in the cold wave of 1949 and is only now beginning to show recovery.

Geographically such a study as this may be useful in providing protection against widespread damage caused by the cold wave, especially south of the Ohio River where cold waves more frequently fall into the category of "Unusual Weather" and therefore inadequate provisions are made for them. A study of the Lexington cold wave pattern in Figure 1 shows that the cold wave of January 23-24, 1963 brought cold air 47 degree F colder than the normal minimum temperature of 26F. Failure to provide for this departure from normal weather resulted in the total destruction of the peach crop to mention only one item. Also a study of figure one reveals that the temperature fell to 20F below zero in 1899. A Study of Figure 6 shows that Kentucky is always exposed to the cold air masses of Canada where temperatures as low as 70 F below zero occur.

It is difficult to surmise what forethought would have saved Kentucky's peach crop. But afterthought reveals that the margin of protection may not be too wide. Figure 2, plates A, B, C, show that the tree kill of peach orchards was closely related to elevation and slope and that the crest orchards have survived. Estimates are that these crest orchards will produce close to a normal crop in Kentucky in 1964.

In Orlando, Florida care is taken to protect the valuable orchards against cold waves. Smudge pots elevate the radiating surface and heating devices and windmills are about as numerous as the fruit trees. With such protection this district has weathered the cold waves of the past, and a study of the minimum temperature patterns (Figs. 3, 4) of Orlando provides strong evidence that the future of this district is secure with the provisions now at hand. Table One and the graphs of Figs. 3 and 4 show that the Florida industry has weathered a tremendous amount of freezing weather since 1892. At no time, however, has the temperature fallen below 18 F in the Orlando district.

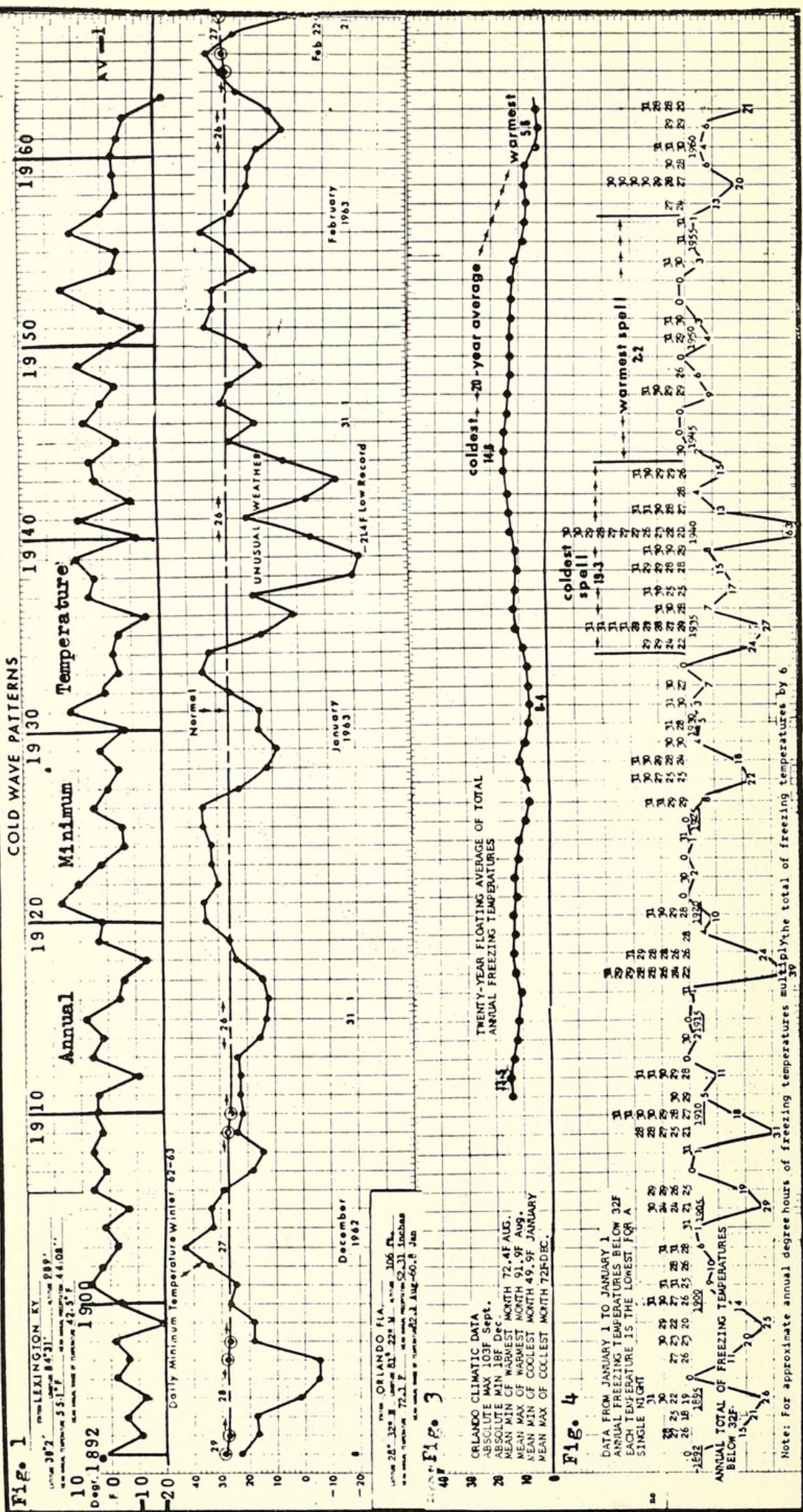


Fig. 1, 3, and 4. — Cold wave patterns of Lexington Kentucky, and Orlando, Florida.

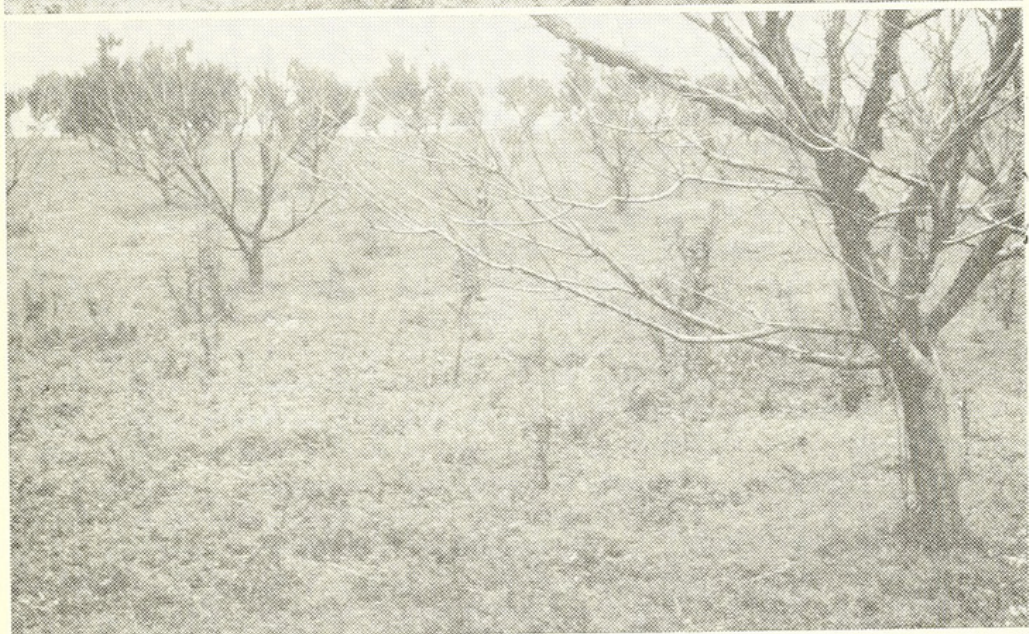


Fig. 2.— Peach orchard damage in the Blue Grass caused by the cold wave of Jan. 23-24, 1963. The upper photograph was taken in an orchard which occupied a dip or trough. The middle photograph was taken in an orchard which occupied a slope from crest to trough. It is significant that the trees on the crest survived. The lower photograph is of a peach orchard which survived the cold wave. It did not bear in 1963—the summer following the cold wave, but it did bear in the summer of 1964.

Table 1. Cold Days at Orlando, Florida. Temperatures in Degrees Fahrenheit. Data from January 1 to January 1, 1892 to 1962.

Year	30F	25F	20F	18F	Year	30F	25F	20F	18F	Year	30F	25F	20F	18F
1892	0	0	0	0	1916	1	0	0	0	1940	8	2	1	0
1893	3	0	0	0	1917	6	2	0	0	1941	5	0	0	0
1894	0	1	0	1	1918	6	0	0	0	1942	1	0	0	0
1895	2	1	1	0	1919	1	0	0	0	1943	5	0	0	0
1896	0	0	0	0	1920	4	0	0	0	1944	1	0	0	0
1897	2	0	0	0	1921	0	0	0	0	1945	0	0	0	0
1898	1	2	0	0	1922	1	0	0	0	1946	0	0	0	0
1899	1	1	1	0	1923	0	0	0	0	1947	4	0	0	0
1900	4	0	0	0	1924	1	0	0	0	1948	1	0	0	0
1901	2	1	0	0	1925	0	0	0	0	1949	0	0	0	0
1902	2	0	0	0	1926	4	0	0	0	1950	2	0	0	0
1903	3	0	0	0	1927	3	2	0	0	1951	2	0	0	0
1904	1	0	0	0	1928	4	1	0	0	1952	0	0	0	0
1905	1	3	0	0	1929	2	0	0	0	1953	0	0	0	0
1906	3	1	0	0	1930	2	0	0	0	1954	2	0	0	0
1907	0	0	0	0	1931	2	0	0	0	1955	1	0	0	0
1908	1	0	0	0	1932	2	0	0	0	1956	1	0	0	0
1909	3	2	0	0	1933	0	0	0	0	1957	1	1	0	0
1910	7	0	0	0	1934	2	2	0	0	1958	7	0	0	0
1911	2	0	0	0	1935	8	1	0	0	1959	2	0	0	0
1912	5	0	0	0	1936	3	0	0	0	1960	3	0	0	0
1913	0	0	0	0	1937	2	2	0	0	1961	2	0	0	0
1914	1	0	0	0	1938	4	0	0	0	1962	3	0	1	0
1915	0	0	0	0	1939	4	0	0	0					

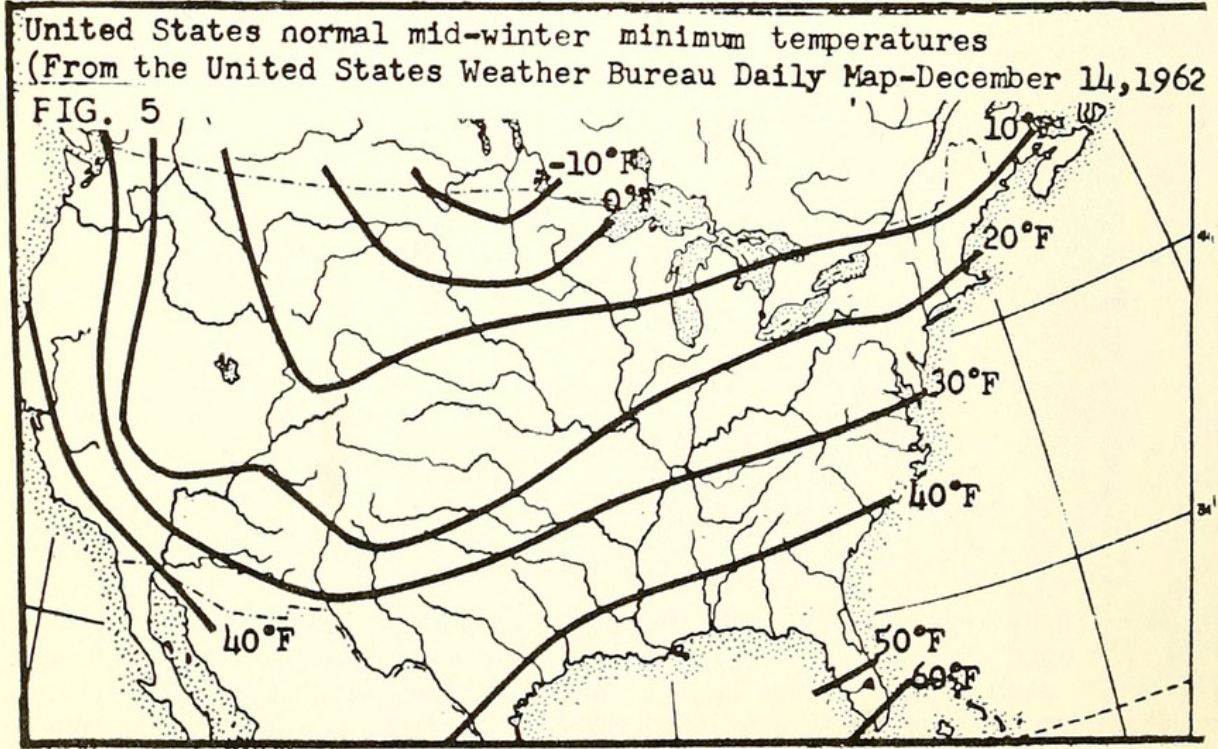


Fig. 5. — United States normal mid-winter minimum temperatures.

While the United States Weather Bureau keeps careful records of Track bending and pushing the normal minimal isotherms sharply southward along its main axis. The overall temperature gradient was reduced from the normal of 70 degrees F to 34 degrees F in minimum normal isothermal gradient and the actual recorded temperatures were sharply reduced along the entire track of the cold wave. For example Fargo, North Dakota showed a reduction from its normal minimum of zero degrees F to 14 degrees F below zero, Chicago, Ill from 18

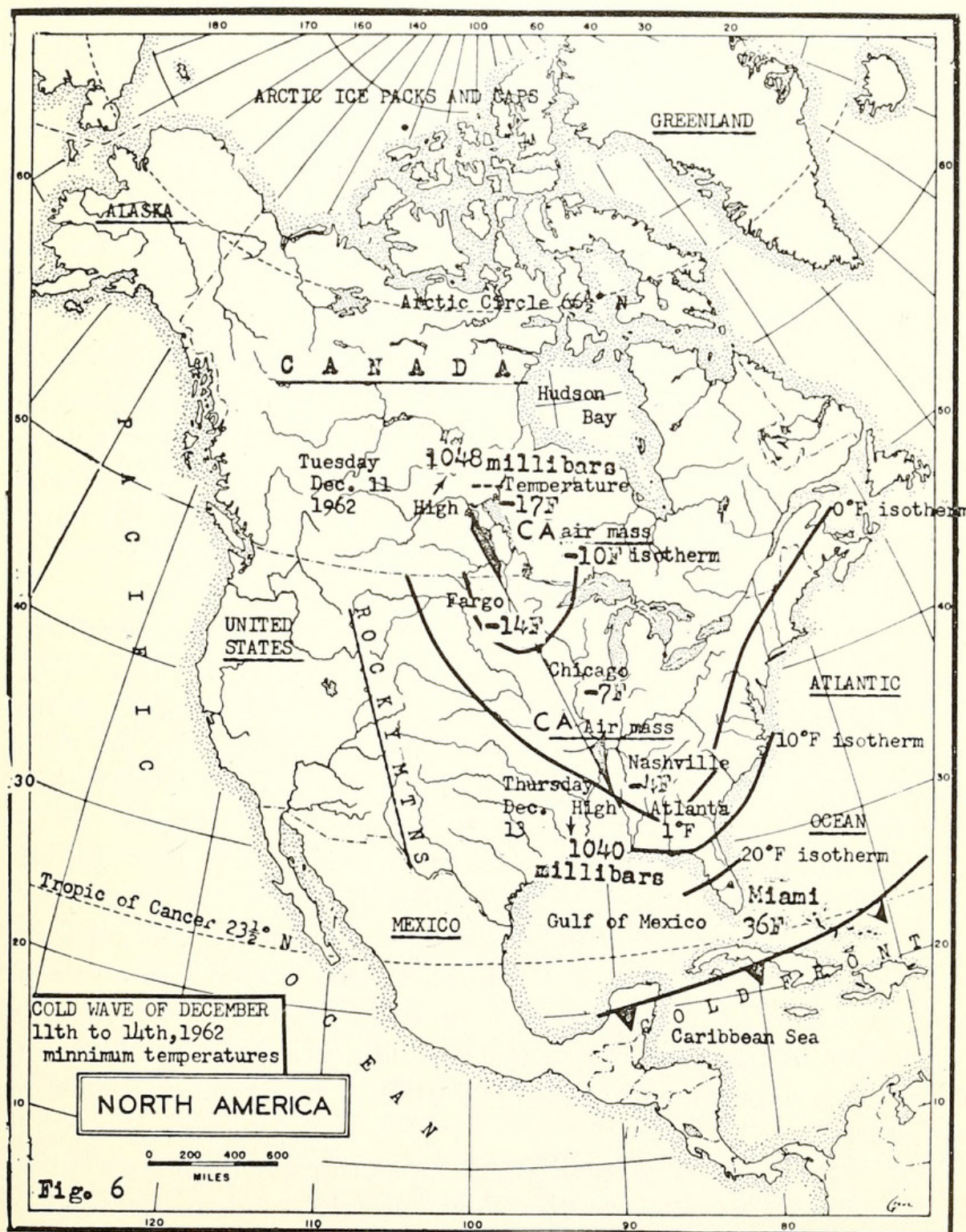


Fig. 6. — Cold wave of December 11 to 14, 1962. Minimum temperatures.

such "Unusual Weather" as the cold wave, much can be done to signalize these data into meaningful maps and charts and to instruct the public as to their significance. For example the United States Weather Bureau map of normal mid-winter minimum temperatures (Fig. 5) shows the roughly parallel isotherms crossing the United States beginning with -10 degrees F in the north central United States and terminating at the tip of Florida with a plus 60 degrees F showing a relatively steep gradient in *minimum* winter temperatures of 70 degrees F for a distance of about 1,800 miles and about 4 degrees F per hundred miles.

Against this background of normal mid-winter minimum temperatures a composite map from three daily weather maps of the December 11-14 cold wave was arranged and is quite revealing of the elements and operation of a cold wave, (Fig. 6). A Continental Arctic (cA) air mass appears in Canada conditioned to -17 degrees F with a density of 1048 millibars. Within three days this cA air mass has poured southward along the Eastern North American Cold Wave Track bending and pushing the normal minimal isotherms sharply southward along its main axis. The overall temperature gradient was reduced from the normal of 70 degrees F to 34 degrees F in minimum normal isothermal gradient and the actual recorded temperatures were sharply reduced along the entire track of the cold wave. For example Fargo, North Dakota showed a reduction from its normal minimum of zero degrees F to 14 degrees F below zero, Chicago, Ill. from 18 degrees F to minus (-7) degrees F, Nashville, Tennessee from 40 degrees F to -4 degrees F, Atlanta, Georgia from 45 degrees F to 1 degree F, and central Florida from 50 degrees F to 20 degrees F. . The destructive capacity of the cold wave is due to (1) its abruptness, at any one place a matter of a few hours and for the entire United States two to three days, (2) its wide departure from normal, especially in the South in this instance as much as 44 degrees F, (3) its areal coverage with devastation more widespread than for any other natural calamity (4) the fact that it strikes the most highly cultured area in the world in economic development. It is fortunate that the cold wave is of such short duration with its most severe temperatures often passing in a single night. This promotes unusual protective devices. Also the economy of an area will have adjusted to a usual degree of tolerance in the departure of cold temperatures from the average.

For instance the daily minimum temperatures at Lexington for the winter of 1962-'63 discloses the above principles when plotted in a line chart, (Fig. 1). The daily normal minimum temperature for the

winter months is 26 degrees F. The departure from this normal is not great usually above zero F and the average lowest annual temperature is -1 degree F. . On nine occasions in seventy years the temperature fell to -10 degrees F and in two of these instances 1899 and January of 1963 the extremes of twenty below zero were reached. Great damage was inflicted in this last cold wave at Lexington due to the progress in the economy and the absence of preparation for it. Plumbing, even in new homes, burst from freezing, plant nurseries suffered severe winter kill in their field stock and the entire peach crop was destroyed. There is no room for detailed analysis in this article but the statement appears warranted that forethought and simple devices would have prevented most if not all of the damage from the last cold wave.

But at Orlando, Florida, where the sensitive orchards are vulnerable to temperatures from 32 degrees F downward, simple provisions have not sufficed and elaborate and expensive protective devices had to be installed. Also the need for such equipment is evident when the record for the past 70 years at Orlando shows that only 14 of these 70 years were frost free (Fig. 4). During the "Cold Spell of 1934-1944 not a single winter was frost free. The coldest winter of 1939-1940 had 11 nights with frost or below 32 degrees F. On the coldest night of 1940 the temperature fell to 20 degrees F and the protective devices had to overcome at least 72 degree hours of freezing weather. That such elaborate cold protecting devices and conserving equipment had been installed in the Florida orchards proves what astonishing adjustments thoughtful men can and will make when and where necessary and desirable.

The periodicity shown by the graphs of minimum temperatures for Orlando (Figs. 3, 4) raise many questions beyond the scope of this paper but two features deserve remarks. First, figure 3, the floating minimum temperature average, shows fluctation in the freezing temperature totals but no definite trend either toward warmer or colder weather can be positively stated. At present there appears a warming trend since 1944 but to argue that this trend will continue would be to predict startling changes in the not distant future. It appears much safer to assert that a cooling trend will set in but with no more serious effects than in the past. Second, in figure 4, there is evidence that "cold spells" and "warm spells do alternate and follow each other. Since there appears no regularity in this fluctuation any prediction would be questionable excepting to say that judging from the past the Florida fruit districts are prepared for the worst in cold waves.

Notes and References:

The author composed and prepared all illustrations used. Data was obtained from the United States Weather Bureau and from the United States Department of Agriculture.

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