

### Weather Note

## REMARKABLE TEMPERATURE FLUCTUATION AT KEENE, N.H., DURING NIGHT OF MARCH 30-31, 1963

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Professor Merton T. Goodrich, Cooperative Weather Observer at Keene, N.H., reported remarkable temperature changes during the night of March 30-31, 1963. Very rapid cooling, from 6 to 9 p.m., EST, dropped the temperature from 46° to 32° F. The temperature then jumped 21° in two hours, to 53° by 11 p.m. Cooling resumed, the temperature dropping 15° in the next two hours to 38° by 1 a.m. A second sharp jump of 7° in the next hour brought the temperature to 45° by 2 a.m. Cooling again resumed, but the morning minimum, 35° at about 7 a.m., lacked 3° of the low mark set at 9 p.m. the previous evening. Figure 1a shows a tracing of the Keene thermograph record. Professor Goodrich indicated that this phenomenon was not entirely local. A motorist had reported to him that the evening had seemed very cold at Hillsboro around 9 p.m. but warm between 10 and 11 p.m. at Deering, N.H.

Observations from surrounding hourly reporting stations did not disclose this pattern of change. Reports from Lebanon FAA and Concord WBAS, just to the north of the affected area, indicated only a very moderate temperature rise concurrent with a secondary cold front passage.

To the south, in Massachusetts, Hanscom Air Force Base at Bedford and the Boston (Logan Airport) WBAS failed to show unusual characteristics. See location map, figure 2.

Interesting thermographic records were obtained from three other locations. That from the Public Service Co. of New Hampshire's Amoskeag Dam, in Manchester, N.H., is shown in figure 1b. There, the early evening temperature drop halted by 7 p.m. After minor fluctuations, a sharp rise brought the temperature up to near the level of the afternoon maximum by about 9:30 p.m. Then two sets of sharp dips and rises occurred between 11 p.m. and 1 a.m. Though these were of less amplitude than the longer duration cycles at Keene, the short period rates of change exceeded Keene's. Unlike Keene's, Manchester's morning minimum was considerably lower than the pre-midnight minimum.

At Dunstable, Mass., just south of the New Hampshire border, 22 mi. south of Manchester and about 45 mi. from Keene, a thermograph is operated by Mr. Edward Hill, USWB Cooperative Observer. His thermograph trace, in figure 1c, shows another pattern. Excepting

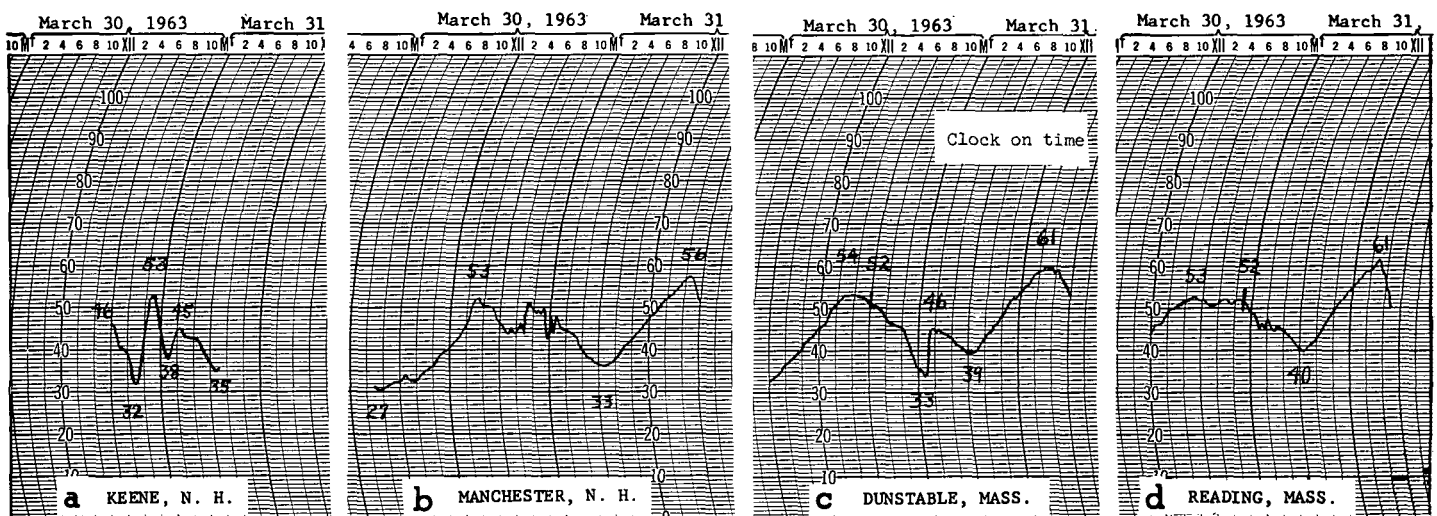


FIGURE 1.—Tracings of thermograph records during the night of March 30-31, 1963 at (a) Keene, N.H., (b) Manchester, N.H., (c) Dunstable, Mass., and (d) Reading, Mass.

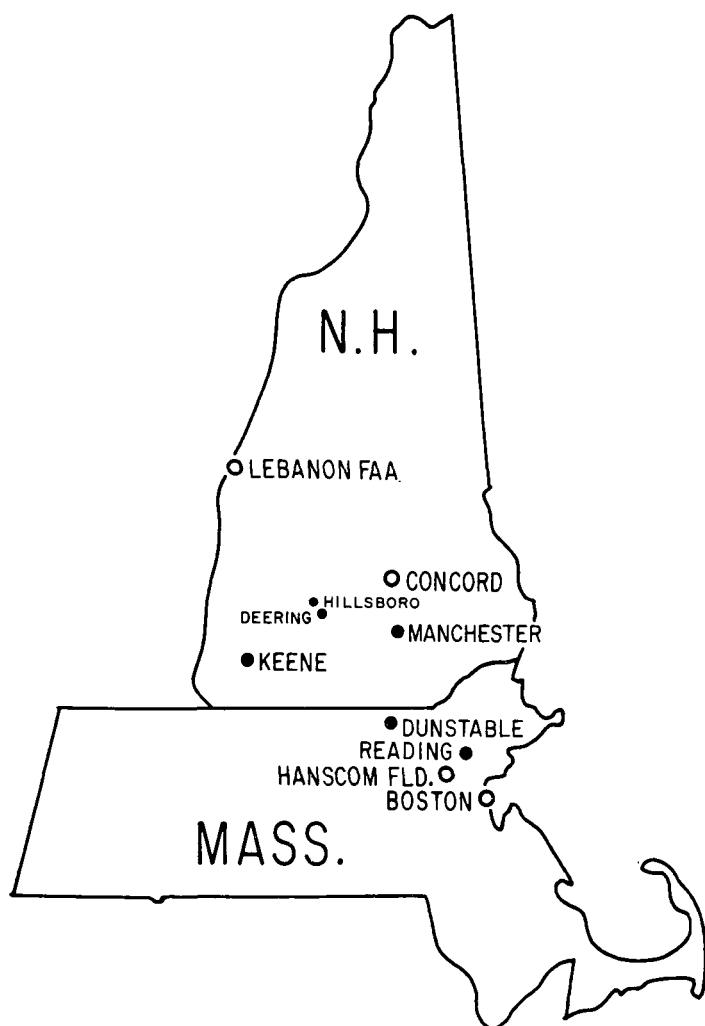


FIGURE 2.—Location map of places mentioned in text.

nearly two hours of only slight cooling from about 8 to 10 p.m., rapid cooling during the evening brought the reading down to a low of  $33^{\circ}$  at about 1 a.m. Then a sudden jump occurred, raising the temperature to  $46^{\circ}$  within a short time. After 2 a.m. gradual cooling gave a morning low of  $39^{\circ}$ ,  $6^{\circ}$  warmer than that at 1 a.m.

The thermographic record at Reading, Mass., 20 mi. east-southeast of Dunstable and about 55 mi. from Keene, N.H., is shown in figure 1d. This trace is still different. The temperature remained fairly near the level of the afternoon maximum until after 10 p.m. A cooling trend dominated during the night, excepting some minor fluctua-

tions during early morning hours. The near-sunrise minimum was therefore much lower than any earlier in the night.

During the evening of March 30 a secondary cold front oriented ENE-WSW moved southeastward through New England. The important features of the front were: (1) it was quite dry with very little associated cloudiness, (2) a narrow tongue of warm air preceded the front at low levels, and (3) the air behind the front was moderately unstable with gusty surface winds. The secondary front was preceded by an occlusion which moved offshore during the late afternoon. As the cloudiness associated with the occlusion dissipated, winds dropped off and radiational cooling was very effective. By 7 p.m. EST, the Albany, N.Y., sounding indicated a  $3^{\circ}\text{C}$ . inversion in the lowest 800-900 ft., with very dry air above.

As the secondary front moved through, the winds strengthened sharply, destroying the inversion and causing a strong temperature rise. The rise amounted to  $9^{\circ}\text{F}$ . in one hour at Albany to the west of Keene, and to  $14^{\circ}\text{F}$ . at Concord, N.H., to the east. The front passed Albany between 10 and 11 p.m., Concord between 11 p.m. and midnight, and Dunstable, Mass., about 50 miles south of Concord, between 1 and 2 a.m.

It is apparent that the front by itself could not have caused the first rise at Keene, and in fact the frontal effects there were delayed one to two hours by the 500-ft. altitude of the station. Since the front was moving at about 20 m.p.h. at the time, the apparent slope of the front was on the order of 1:300, a reasonable figure.

The question now is: What caused the first rapid rise at Keene, which was also observed at Manchester? This was quite a localized phenomenon since it was not observed at Concord and at Dunstable only as an apparent retardation of cooling. Observations, other than temperature, in the area are non-existent but it appears likely that there was some turbulent mixing in the lee of the Green and White Mountains. At 7 p.m., observed winds at Albany were westerly increasing from 27 to 39 kt. between 1000 and 2000 ft. The computed Richardson number in this layer was 0.86, so some instability was present to induce turbulent mixing.

During the spring, cloudiness in the warm air in advance of a cold front often results in maximum temperatures being higher in the cold air than in the warm air. This is shown at Manchester (fig. 1b) and at Dunstable (fig. 1c). However, it is unusual for minimum temperatures to be lower in the warm air than in the cold, as was recorded at Keene and Dunstable.

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