UDC 551.515.8(74)"1969.02.05-06"

WEATHER NOTE

A MESOSCALE COLD FRONT IN NEW ENGLAND

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When polar air overlies coastal New England with northwesterly flow aloft and at the surface, the weather is usually innocuous. Consequently the sequence of meteorological events at Boston's Logan Airport during the night of Feb. 5–6, 1969, attracted our attention. In the hourly observations in table 1, note the abrupt wind shift to north-northeast between 0500 GMT and 0600 GMT, accompanied by a brief period of snow flurries and a temperature drop much larger than would be expected in the normal diurnal cycle at this location. Despite the clear evidence of a cold-front passage at Boston, no front was shown on the National Meteorological Center (NMC) surface analyses at 0000 GMT or 1200 GMT on the 6th.

This discrepancy prompted a close examination of the data which started with preparation of a sequence of detailed surface analyses at 3-hr intervals, shown in figure 1. At 1800 GMT of the 5th, we see a relatively uncomplicated pattern of northwesterly flow with some suggestion in the winds and pressures of a ridge over the highlands of northwestern New England and a trough to leeward. There is an unusually strong north-south

TABLE 1.—Hourly observations at Boston's Logan Airport, Mass., during Feb. 5–6, 1969

0518*	45 ⓘ 60−◍/−◍	15+	022/23/2/2826G34
0521	40 ⓘ	15+	036/25/4/2821G33
0600	50 ⓘ / ◍	15+	061/25/7/2818G27
0603	○	15+	078/24/6/2816G22 FEW SC
0604	○	15+	085/24/6/2616G26
0605	60 ⓘ	15+	090/24/7/2716G26
0606	38 ⊕	15+	102/20/10/0214
0607	18 ⊕	4 SW−	114/15/6/3615 SB15
0608	5 ⓘ 18◍ 45◍	4 SW−	115/14/4/3408
0609	○	15+	114/13/4/0206 FEW SC SE45
0610	○	12	114/15/5/2006
0611	○	12	115/19/5/2611
0612	○	12	117/20/5/2416
0615	○	12	129/25/9/2418G22
0618	○	12	110/31/11/2718G24 FEW CU

* In this column, first two digits are date and last two are Greenwich hour.

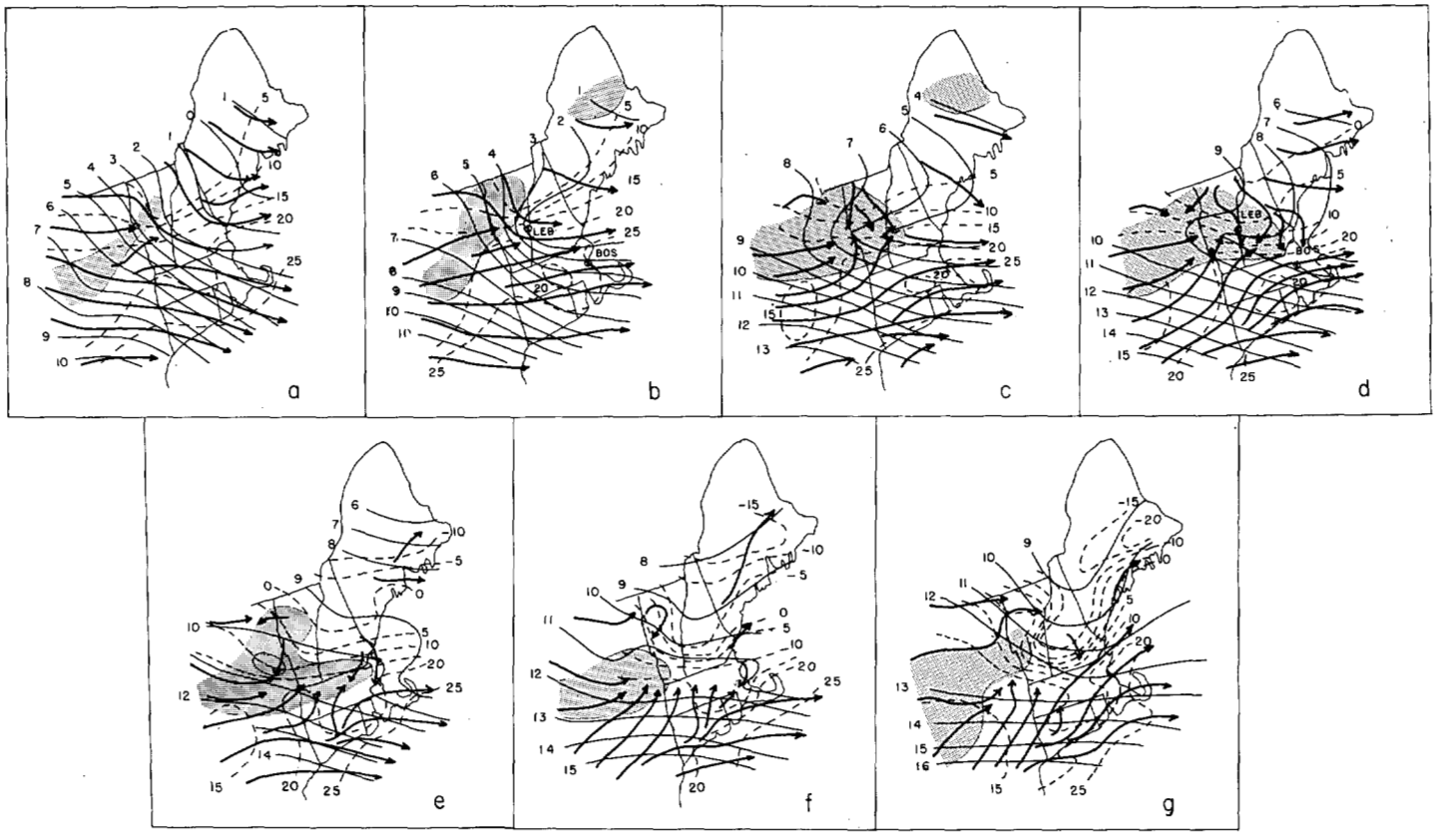

FIGURE 1.—Surface analyses for Feb. 5–6, 1969: (a) 1800 GMT, (b) 2100 GMT, (c) 0000 GMT, (d) 0300 GMT, (e) 0600 GMT, (f) 0900 GMT, (g) 1200 GMT. The solid lines are isobars at intervals of 1 mb, labeled with the excess over 1000 mb. Heavy solid lines with arrowheads are streamlines of the surface wind flow. The dashed lines are isotherms at intervals of 5°F. The stippling covers the area of snow at the time of observation. The positions of Lebanon (LEB) and Boston (BOS) are shown in (b) and (d).

temperature gradient over the entire region, while snow, always found downwind from the Great Lakes in situations of this sort, is restricted largely to the region west of the highest elevations.

Three hours later, there is a gross distortion of the lee trough near Lebanon, N.H., together with the beginning of a sharp wind-shift line separating westerlies from northerlies. Relevant hourlies from Lebanon are in table 2. Note the wind shift and the onset of snow flurries between 2300 GMT of the 5th and 0000 GMT of the 6th, similar to events at Boston 6 hr later. The rapid temperature fall from 0500 GMT to 1200 GMT is mainly the nocturnal cooling to be expected here with the dissipation of low clouds.

In the subsequent maps we see the rapid growth of the wind-shift line toward the east-southeast, accompanied by an extrusion of the snow flurry activity from the west and displaying all the attributes of a cold front as it moves southward. The extent of the pressure perturbation and of the region of northerly wind are very limited, however, and the life history of the phenomenon is short, since virtually all traces of it have disappeared by 1200 GMT of the 6th.

The question arises whether this was a purely orographic phenomenon, produced solely by conditions in the air flow near the surface, or whether it was related to a detectable perturbation in the flow aloft. The analysis at three upper constant-pressure levels at 0000 GMT of the 6th is shown in figure 2, and an appropriate vertical cross-section is displayed in figure 3. Little of interest appears at 850 mb or 500 mb. At 700 mb, however, there is evidence of a west-northwesterly jet over the region where the disturbance first became prominent, with a sharp trough over northern Maine. The jet near Portland, Maine, together with its associated temperature structure, is a striking feature of the cross section. This structural complex, entirely similar to that normally found with jet cores near the tropopause, occurs here at a much lower level and is entirely detached from the main tropospheric jet, a portion of which is seen in the upper left corner of the cross section. The sounding for Portland, shown in figure 4, indicates near-adiabatic conditions from the surface to 755 mb, capped by a layer of strong stability which could be regarded as a surrogate tropopause. The strong vertical wind shear appears just below the base of the layer, suggesting (though not conclusively in the light of observational uncertainty) that the layer itself is not a strongly baroclinic region. This view is supported by other soundings used in the cross-section analysis. The relative humidity in the Portland sounding, neither saturated nor extremely dry above the stable layer, suggests that the vertical motions associated with the disturbance do not extend with appreciable intensity above the 700-mb level.

TABLE 2.—*Hourly observations at Lebanon, N.H., during Feb. 5–6, 1969*

0512*	/⊙	15+	005/4/−1/3004
0515	20X	3 SW−	021/9/0/3607 SB38
0518	30 ⊙ /−⊙	10	019/13/−3/3012G20
0521	30 ⊙ U ⊙	12	018/17/1/2906G14
0522	MSG		
0523	30 ⊙ U ⊙	8	040/14/5/2910
0600	30 ⊙ U ⊙	3 SW−	050/13/10/3604 SB25
0601	35 ⊙ U ⊕	3 S−	056/12/7/0203
0602	35 ⊙ U ⊕	2 S−F	070/8/4/0105
0603	−XU ⊕	2 S−F	082/7/3/3603
0604	20X	2 S−F	092/6/3/0000
0605	−X35 ⊙	2 S	095/7/4/0000
0606	40 ⊙	7	095/3/0/0000 SE25
0609	○	7	095/−6/−10/0000
0612	○	15	104/−12/−17/0000 FEW CU

*In this column, first two digits are date and last two are Greenwich hour.

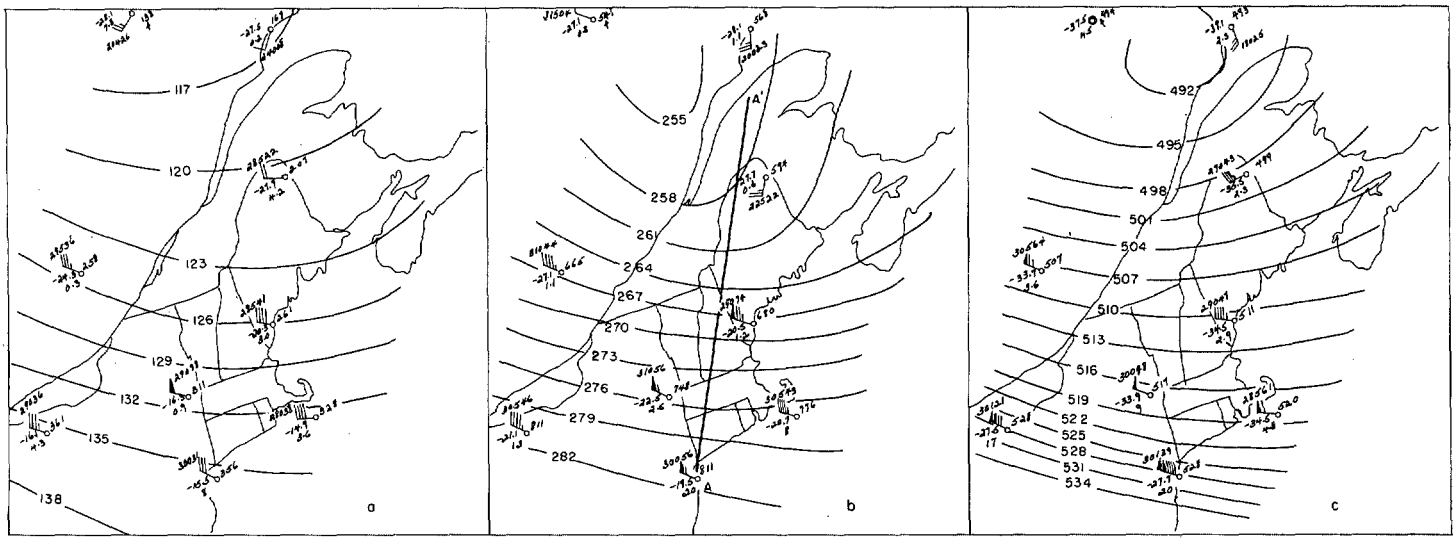

FIGURE 2.—Upper level analyses for 0000 GMT on Feb. 5–6, 1969: (a) 850 mb, (b) 700 mb, (c) 500 mb. The data are plotted in the conventional manner. The solid lines are contours at intervals of three decameters.

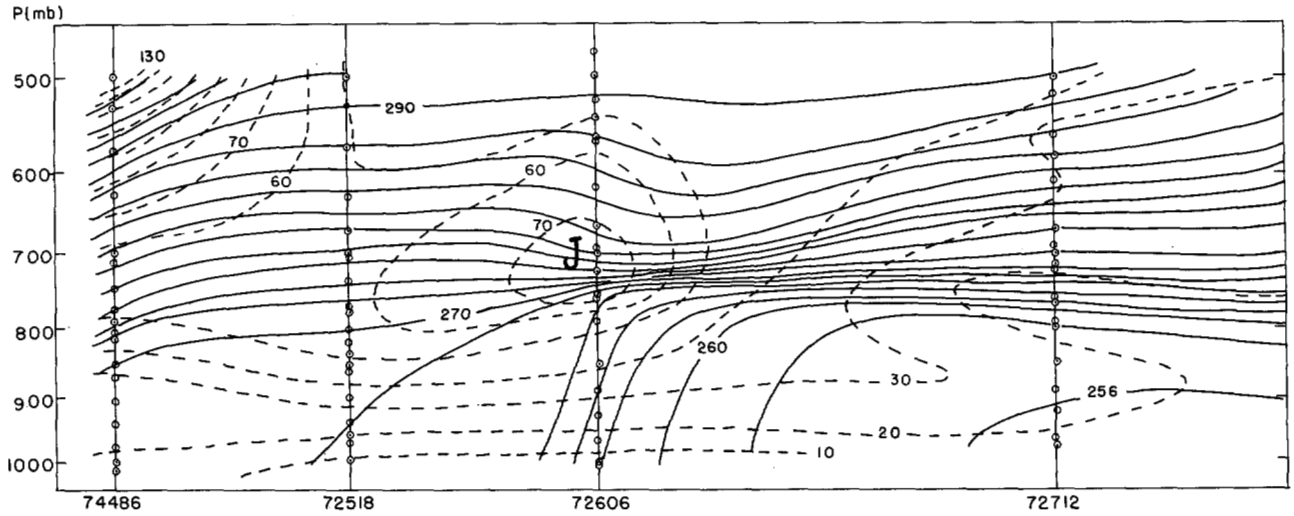

FIGURE 3.—Vertical cross-section along the line A–A′, shown in figure 2b. The soundings are plotted at the intersections of this line and perpendiculars from the station locations to the line. The solid lines are isotherms of potential temperature at intervals of 2°K. The dashed lines are isotachs at intervals of 10 kt.

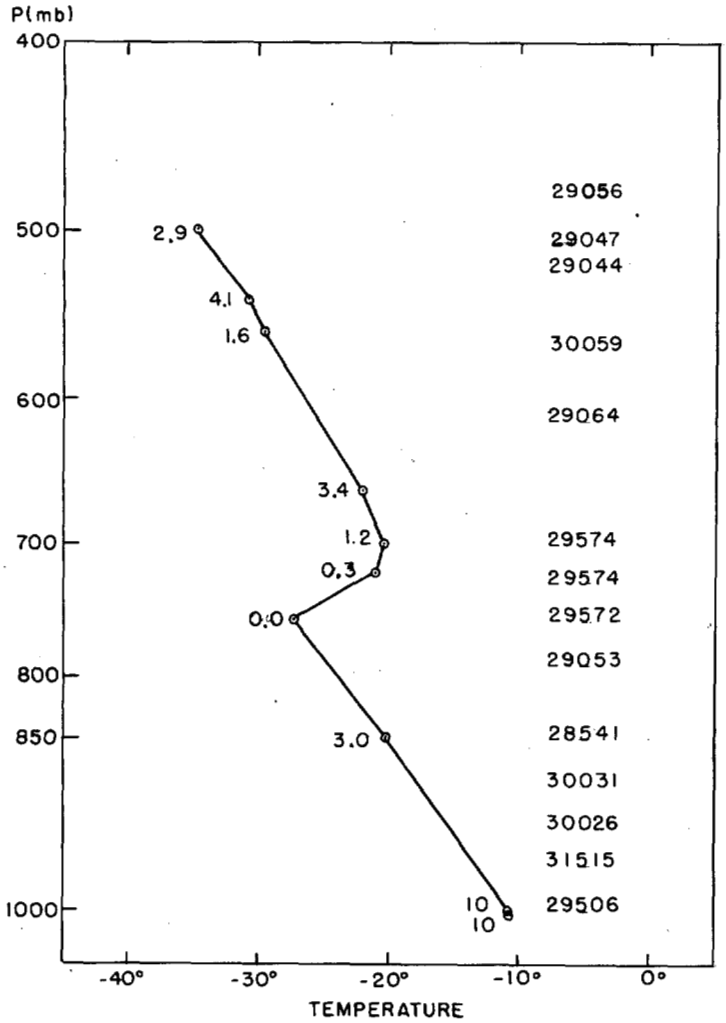

FIGURE 4.—The temperature sounding for Portland, Maine. Dewpoint depression is given to the left of the temperature points. Wind data at the appropriate pressure levels is plotted to the right.

The 700-mb perturbation could not be reliably traced upstream because of sparcity of sounding data in Canada, but there was evidence of a weak center of surface pressure falls over lower Ontario and upper New York State prior to the development on the lee slopes in New England. On the basis of the available evidence, however, the entire phenomenon is seen as confined in the vertical, in the horizontal, and in time, relative to our experience with ordinary baroclinic systems of middle latitudes. We offer no hypothesis beyond the above vague allusion to orographic influence and scaled-down baroclinicity, but we point to this phenomenon as a sample of the rich variety of mesoscale events marginally detectable in the conventional observation network and certainly worthy of study.

[*Received March 26, 1969*]