THE DESTRUCTIVE STORM OF NOVEMBER 25–27, 1950

CLARENCE D. SMITH, JR.
WBAN Analysis Center, U. S. Weather Bureau
Washington, D. C.

The weather over central and eastern United States during November 1950 was notable in several respects. The most outstanding was the rapid intensification of a small Low into one of the most destructive storms ever recorded in northeast United States. This report describes the life history, contributions to deepening, and effects of this storm.

LIFE HISTORY OF THE STORM

The storm of November 25–27 was first noted on the surface weather map of 1230 GMT, November 24 as a small Low developing over North Carolina and western Virginia (fig. 1). The cold front on which the Low formed had moved rapidly southward and eastward from a position on November 22 through Montana and North Dakota. The old occluded Low in the Great Lakes region, which had been one of the major factors in the weather situation, was filling rapidly. By 0030 GMT, November 25 (fig. 2), it was obvious that the deepening Low over North Carolina had completely captured a place of prominence over the Low in the Lakes region.

Some factors contributing to that change can be seen in the 500-mb. charts. Figure 3, the 500-mb. chart for 0300 GMT, November 24, shows the well-developed upper level Low associated with the filling surface storm over the Lakes region. Prior to that time the 500-mb. contours and isotherms had been nearly concentric indicating a cold-core Low with but little temperature advection. The past positions in figure 3 show that the movement of the Low had been quite regular. By 0300 GMT, November 24 (fig. 3), however, the isotherms showed the coldest air over Iowa southwest of the center. The 500-mb. chart for 0300 GMT, November 25 (fig. 4) shows that the cold air was swept rapidly around the Low and was associated with a sudden southward elongation of the center. During the period 0300 GMT, November 24 to 0300 GMT, November 25, the 500-mb. height at Nashville, Tenn., fell 1,140 feet and at Atlanta, Ga., 1,110 feet, while the temperature fell 10° C. and 9.3° C. respectively. Rapid warming aloft also occurred over Minnesota to the northwest of the Low. The 500-mb. temperature at St. Cloud, Minn., for example, rose from −37.6° C. at 0300

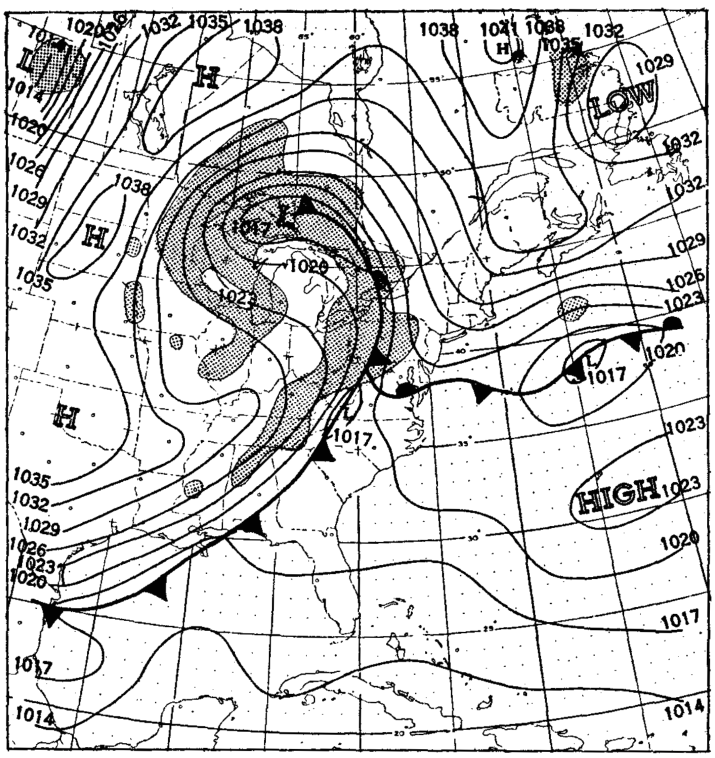

FIGURE 1.—Surface weather chart for 1230 GMT, November 24, 1950. Shading indicates areas of active precipitation.

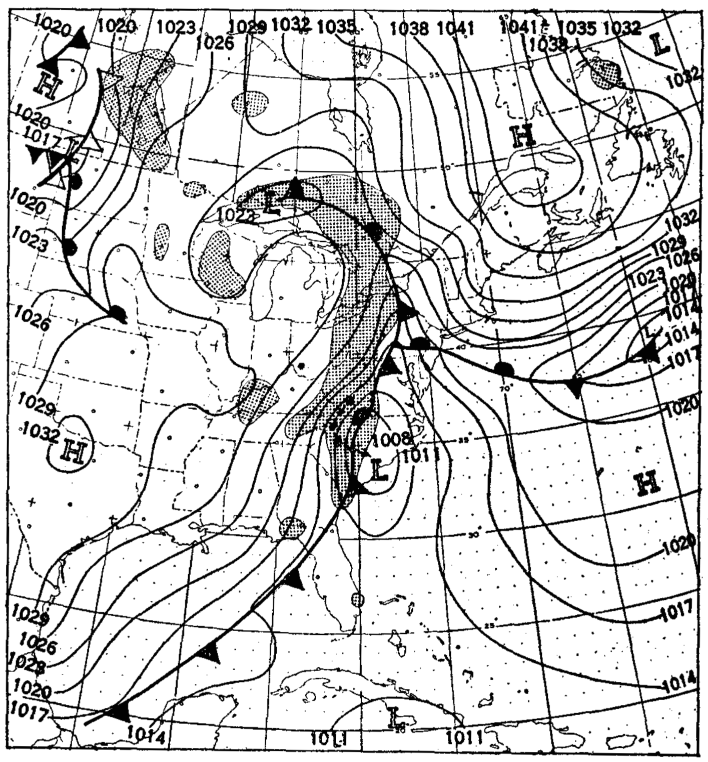

FIGURE 2.—Surface weather chart for 0030 GMT, November 25, 1950. Small squares connected by arrows indicate past positions of main Low at 12-hour intervals.

GMT, November 24 to −19.5° C. at 0300 GMT November 25. Strong warm advection similiar to this is often associated with rapidly moving Lows because they tend to have an intensifying warm ridge following them.

A close examination of the 500-mb. wind field at 1500 GMT, November 24 (not shown) revealed north winds of 80–85 knots on the west side of the Low. The contour gradient downstream on the south side of the Low was not sufficiently strong to cause air at those speeds to follow the curve of the contours. Consequently the air passing into the southern side of the Low crossed contours toward greater contour heights, contributing to the production of northerly winds over Illinois, western Kentucky, and western Tennessee, and consequently to the elongation of the Low [1].

By these means the Low was enabled to re-form quickly over North Carolina by 1500 GMT, November 25 (not illustrated, see figure 7 for 0300 GMT of the 26th), further reinforcing the surface Low in that vicinity in preference to the old Low in the Lakes region.

By 1230 GMT, November 25 (fig. 5) the surface Low had deepened 26 mb. Surface winds behind the former occlusion through Pennsylvania and New York were changed to northerly with some easterly component, the occlusion becoming a warm front. Close examination of a large scale surface map for 1530 GMT, November 25 (not reproduced) revealed signs of a new Low forming near Erie, Pa. By 0030 GMT, November 26 (fig. 6), the new center was the main center and was located near Cleveland, Ohio. The central pressure was 983 mb., 8.4 mb. lower than the original center 12 hours earlier.

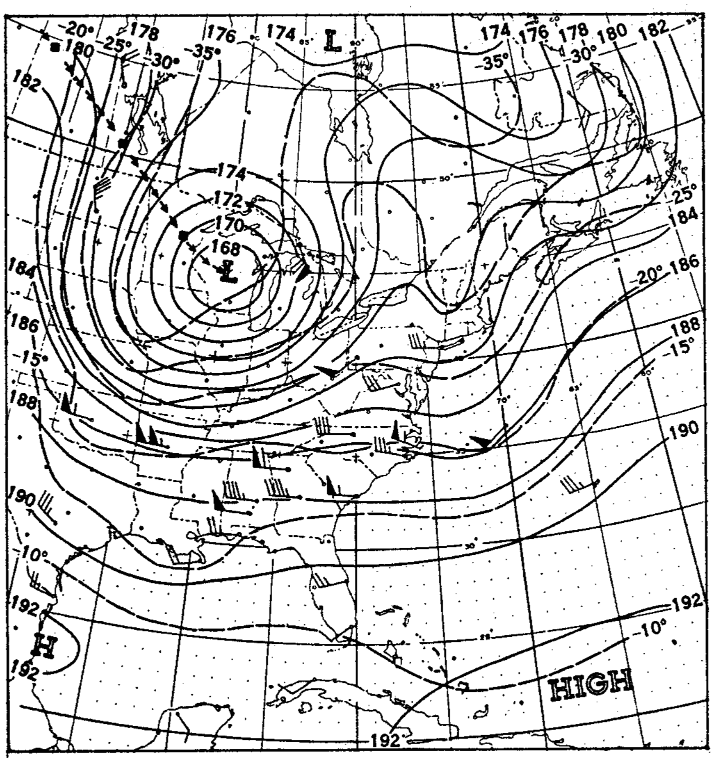

Figure 3.—500-mb. chart for 0300 GMT, November 24, 1950. Contours (solid lines) at 200-foot intervals are labeled in hundreds of geopotential feet. Isotherms (dashed lines) are at intervals of 5° C. Barbs on wind shafts are for speeds in knots (pennant=50 knots, full barb=10 knots and half barb=5 knots). Past positions of the main Low are at 12-hour intervals.

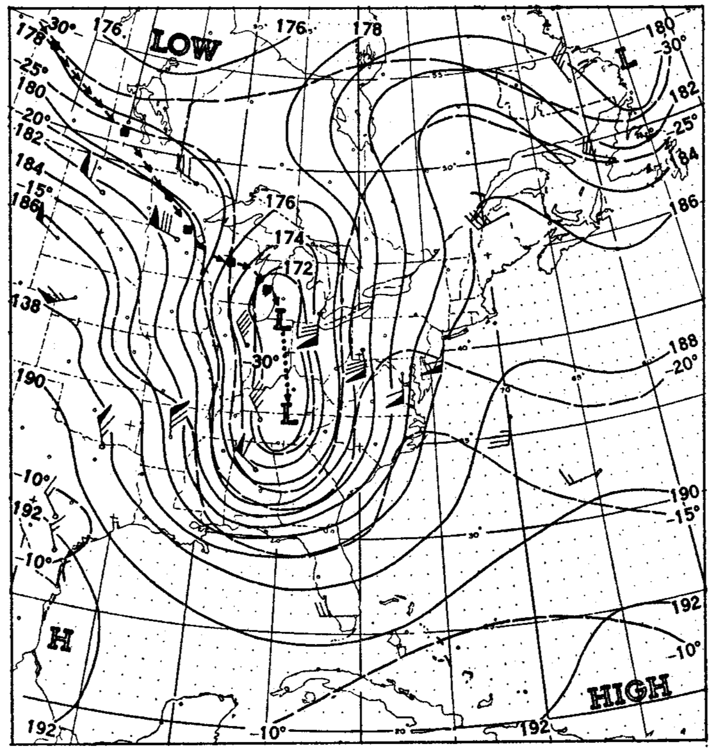

Figure 4.—500-mb. chart for 0300 GMT, November 25, 1950. Dotted portion of the Low track represents reforming of low center.

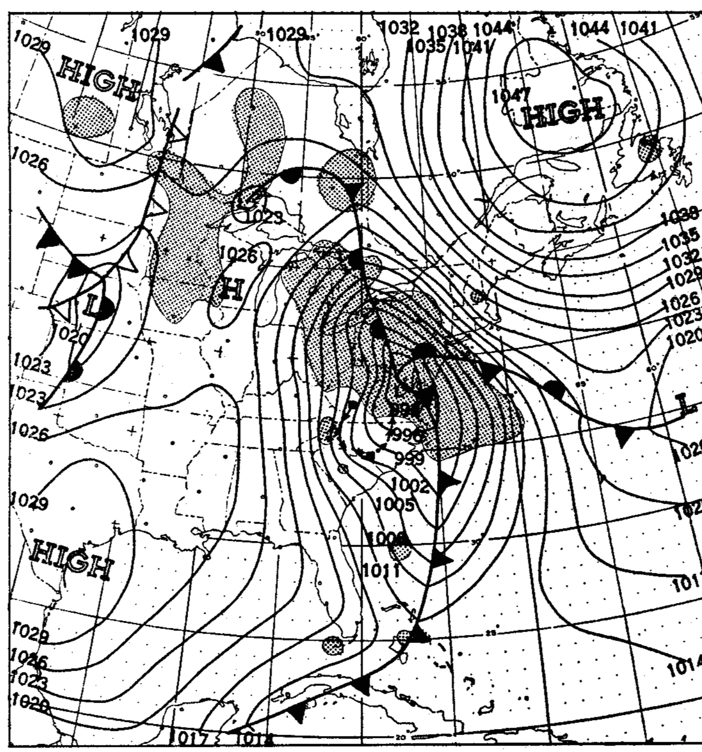

Figure 5.—Surface weather chart for 1230 GMT, November 25, 1950.

Some explanation of the redevelopment of the center to the west is seen by studying the High which existed at low levels over the Labrador region. During the period 1230 GMT, November 24 to 1230 GMT, November 25 when the storm was forming, the sea level pressure at the center of the High increased to 1,049 mb. (fig. 5). As the storm moved northward the Labrador High moved only slightly eastward. The presence of this blocking High was an important influence in causing the storm to move westward into Ohio and to remain in that vicinity for more than a day.

The increasing pressure gradient between the storm center and the blocking High contributed to the very high winds observed over the northeastern United States. The sea level pressure at Caribou, Maine, reached 1,042 mb. at 0930 GMT, November 25, 3.1 mb. higher than the previous November record (length of record 5 years), while at Dayton, Ohio, at 0630 GMT, November 26, it fell to 983.7 mb., a new November record for that station. Although these pressure records did not occur simultaneously they indicate the extreme pressure gradient that existed over the northeast United States.

Associated with the strong circulation around the Low at 500 mb., significant warming at that level occurred to the east and north of the Low center. The temperature at Goose, Labrador, rose more than 8° C. from 1500 GMT, November 24, to 1500 GMT, November 26, while the height rose almost 850 feet. Since the advection of warm air in the vicinity of 500 mb. would cause the surface pressure to fall (other factors being unchanged) it is necessary to look elsewhere for a cause of the rising surface pressures and 500-mb. heights. A study of the 200-mb. charts shows that associated with the southerly circulation over the east coast, the temperature at that level, over Goose, Labrador, fell almost 15° C. from 1500 GMT, November 24, to 1500 GMT, November 26, while the height rose more than 1,000 feet. Apparently the movement of relatively colder and heavier air in the stratosphere over the Labrador region compensated for the relatively warmer and lighter air brought in around 500 mb. and allowed the surface pressure to remain about the same. Thus the circulation of the Low itself influenced its future movement by contributing to the maintenance of the blocking High.

While the surface Low re-formed and deepened over Ohio, the 500-mb. Low reached its lowest central value, approximately 16,550 feet, at 0300 GMT, November 26 (fig. 7). The past positions, at 12-hour intervals as shown in figure 7, indicate the 500-mb. Low was circling northward. By 0300 GMT, November 27 (fig. 8), it was centered northeast of Toledo, Ohio. Subsequently it moved slowly northward, re-formed over Lake Erie on November 28, moved southward over Washington, D. C., and off toward the northeast. The surface Low reached its maximum depth at 0630 GMT, November 26, over northern Ohio with a central pressure of 978 mb., and by 1230 GMT, November 26, was centered just northeast of Columbus, Ohio (fig. 9). It filled rapidly in the following 24 hours and moved northward over Lake Huron (fig. 10), though snow continued to fall in Indiana, Ohio, and

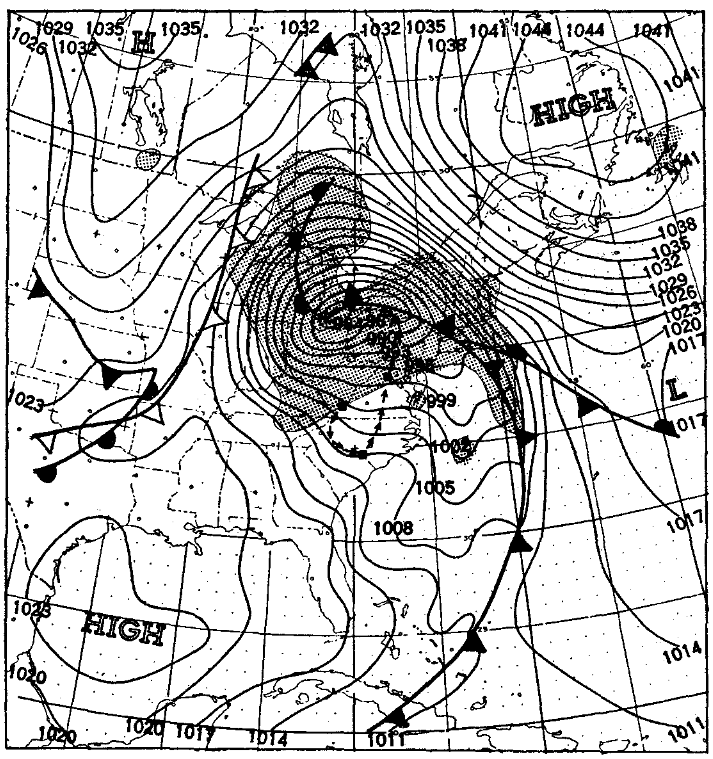

FIGURE 6.—Surface weather chart for 0030 GMT, November 26, 1950.

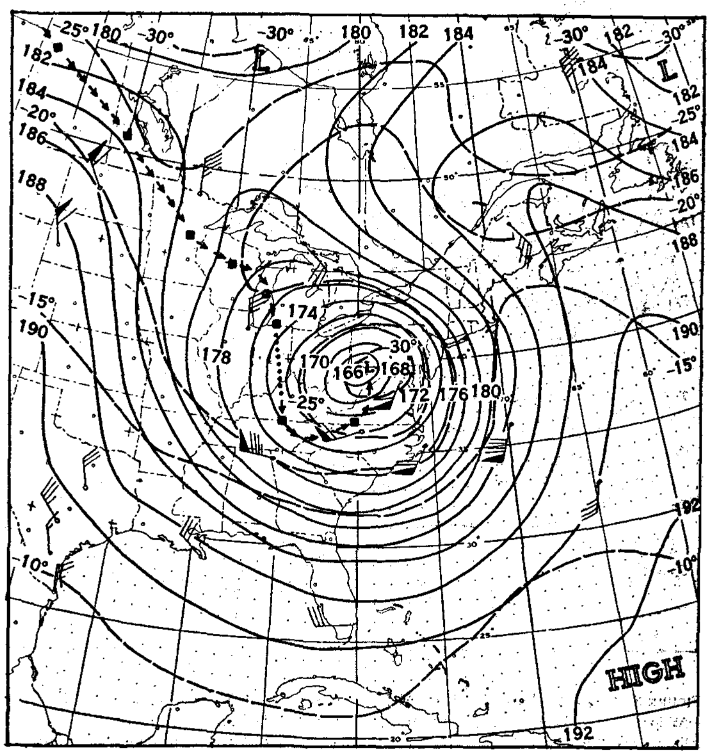

FIGURE 7.—500-mb. chart for 0300 GMT, November 26, 1950.

Pennsylvania. Before completely filling, the Low circled southward again through Ohio, further prolonging the snow showers.

CONTRIBUTIONS TO DEEPENING OF THE STORM

Vederman [2] studied changes in the thickness of the standard layers over the moving centers of rapidly deepening Lows in the eastern United States. His results showed "that the lower two-thirds by weight of the central column becomes thinner (colder and denser) as a storm deepens. The upper one-third of the central column becomes 'thicker' and warmer by an amount sufficient to counteract the action of the lower layers and an additional amount to deepen the Low". A similar analysis of this storm shows that for the 24-hour period ending 1500 GMT, November 25, when the surface Low deepened 24 mb., the entire central column up to 100 mb. became thicker and warmer. This would leave only the portion of the atmosphere above 100 mb. to act in the opposite sense. For the 24-hour period ending 0300 GMT, November 26, when the Low deepened 22 mb., the standard layers below 300 mb. became thinner and colder while the layers above 300 mb. became thicker and warmer. The results for the latter period are entirely compatible with Vederman's average results while those for the former period are perhaps more representative of what might be called an "ideal" case of deepening.

The geographical location of the storm and the distribution of warm and cold air masses probably offer an explanation for the warming in the former period. The Low formed over the Atlantic Coast States not far from the large source of relatively warm, maritime air over the ocean. Also, the existence of a blocking High over Labrador caused the sea level pressure gradient and the contour gradient aloft to become steepest in the northeast

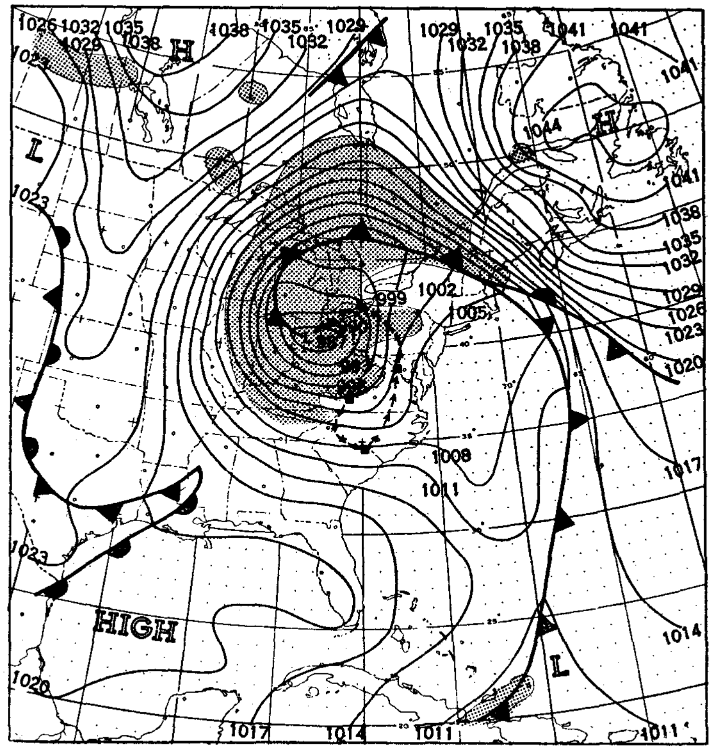

Figure 9.—Surface weather chart for 1230 GMT, November 26, 1950.

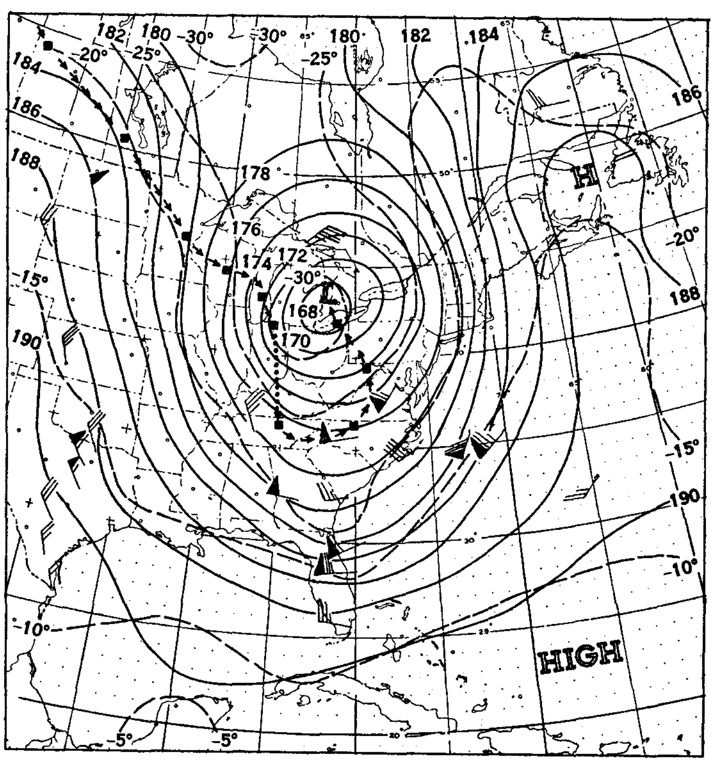

Figure 8.—500-mb. chart for 0300 GMT, November 27, 1950.

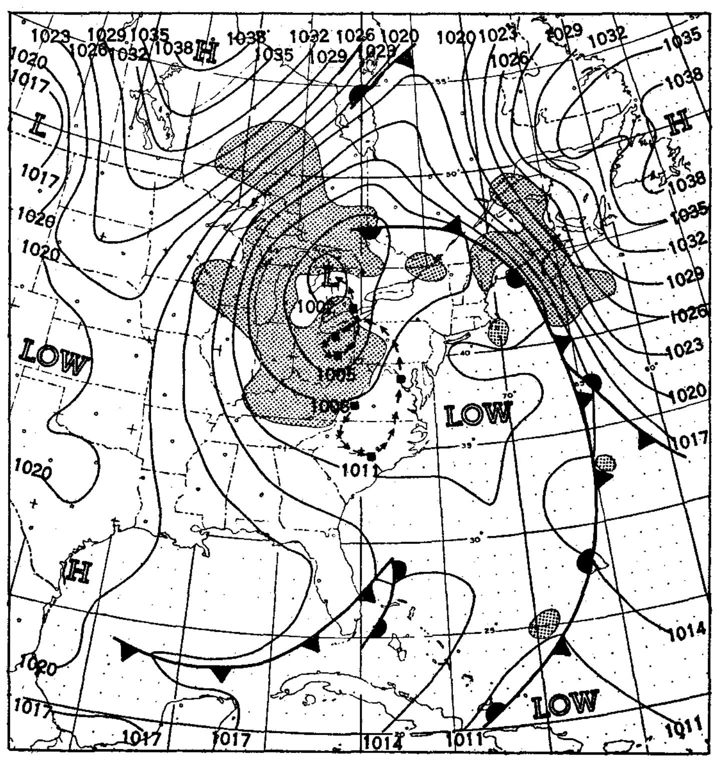

Figure 10.—Surface weather chart for 1230 GMT, November 27, 1950.

quadrant producing rapid influx of the warm air. The advection of colder air in the low levels was generally with winds less strong than those in the warm air and was delayed by the Appalachian Mountain barrier to some extent. It appears that after 12 hours of deepening the vertical mass distribution adjusted to agree with the average conditions found by Vederman.

EFFECTS OF THE STORM

The most destructive effects of the storm were heavy snowfall and strong winds, however, several other effects are also equally worthy of note, e. g., crop damage and record minimum temperatures in the Southern States. Table 1 contains the new November minimum temperature records for some of the principal cities. These records occurred during the period 1830 GMT, November 24 through 1830 GMT, November 25. The minimum of 3° F. at Atlanta, Ga., was lower than the previous record by 11° F. while the average lowering of the records at the stations shown was 5.7° F. Stations in the following States also reported new low temperatures for so early in the season: Texas, Ohio, Indiana, Illinois, Wisconsin, and Michigan. The minimum of −23° F. at Pellston, Mich., on November 25 was a new November record low for the State. A number of stations reporting record high temperatures for certain days near the first of the month, reported the coldest average November temperature since 1936.

South Carolina and Georgia suffered the most crop damage. Each had a period of several days that was colder than any November period on record but did not have a snow cover to protect the crops as was the case in northern Alabama and northern Mississippi. The extended freeze destroyed many harmful insects partially offsetting the loss of crops. Contrary to what would be expected, crops in Florida suffered relatively little damage. Low humidity plus a light wind prevented heavy frost formation and prevented damage to most of the citrus crop. Truck crops were killed in northern Florida, but less than 10 percent of those in the main Indian River area were damaged. The first warnings of the November 26 freeze in Florida were issued on November 22 giving ample time for protective measures [3].

The area experiencing damaging winds included New England, New York, New Jersey, and Pennsylvania. Principally on November 25, but also on November 26 at some stations, the fastest mile of wind exceeded 50 m. p. h. from an easterly direction. At coastal stations such as Boston and Newark the fastest mile exceeded 80 m. p. h. Peak gusts as high as 110 m. p. h. were reported at Concord, N. H. The strong on-shore winds caused excessively high tides and flooding in some cities in Connecticut and New Jersey. A comprehensive estimate of monetary damage is not available, but some areas reported more damage than resulted from the 1938 or 1944 hurricanes. According to news reports by insurance companies, payments to policy holders for storm damage aggregated more than for any previous storm in the United States.

The area receiving the largest amount of snow was centered in West Virginia, western Pennsylvania, and

TABLE 1.—*Some November minimum temperature records*

Station	Nov. 1950 minimum	Previous Nov. record minimum	Years of record
	° F.	° F.	
ALABAMA			
Birmingham	5	14	54
Mobile	22	24	78
Montgomery	13	18	79
FLORIDA			
Apalachicola	24	28	29
Jacksonville	23	25	79
Pensacola	22	25	70
GEORGIA			
Atlanta	3	14	72
Augusta	11	21	78
Savannah	15	22	79
KENTUCKY			
Louisville	−1	1	78
NORTH CAROLINA			
Asheville	−5	4	47
Wilmington	16	20	80
SOUTH CAROLINA			
Charleston	17	23	79
Greenville	11	14	65
TENNESSEE			
Chattanooga	4	11	72
Knoxville	5	8	79
Memphis	9	16	78
Nashville	−1	8	78

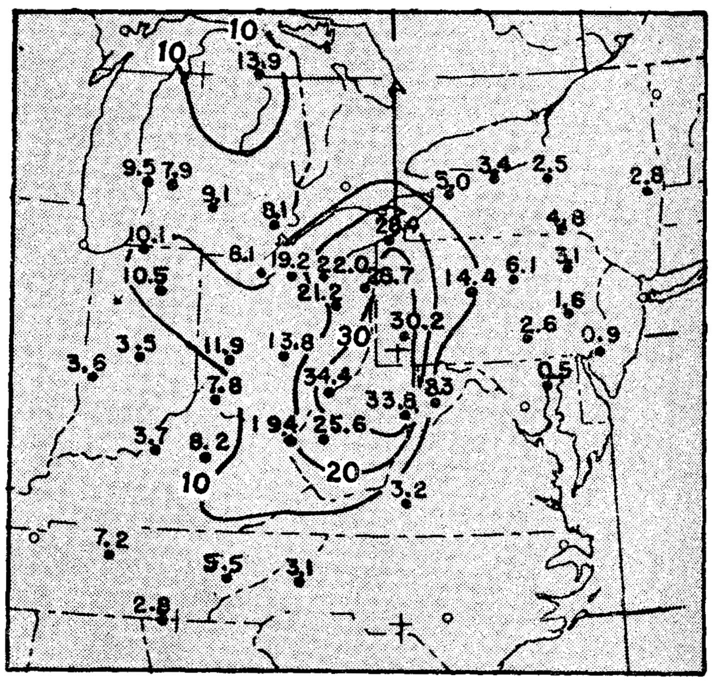

FIGURE 11.—Total snowfall at principal stations for the period November 24 through November 28, 1950. Values plotted in inches and tenths. Lines outline the approximate areas of 10-, 20-, and 30-inch accumulation.

eastern Ohio. Figure 11 shows the total amount that fell at certain principal stations during the period November 24–28. Table 2 contains some comparisons with previous snowfall records. The 34.4 inches that fell at Parkersburg, W. Va., during the 5-day period exceeded not only the record November amount but also the record monthly amount by 5.3 inches. The heavy snowfall plus drifting blocked the highways, railroads, and city streets in Ohio, West Virginia, western Pennsylvania, and parts of Indiana. Business and transportation were brought to a standstill. Many of the heavy industries in the Cleveland and Pittsburgh areas were forced to close. According to press reports the storm caused approximately 300 deaths either directly or indirectly. The electric power transmission lines were very severely damaged in the area of heavy snow resulting in more than 1,000,000 homes being without power for many days.

TABLE 2.—*Some snowfall comparisons*

Station	Snowfall November 24–28	Previous record November snowfall	Record monthly snowfall (all months)	Years of record
OHIO	*in.*	*in.*	*in.*	
Cincinnati	7.8	8.9	21.4	65
Cleveland	22.0	22.2	30.5	63
Columbus	13.8	8.2	29.2	65
Sandusky	19.2	8.6	29.8	66
Toledo	8.1	12.0	26.2	65
Youngstown	28.7	12.2	30.1	6
PENNSYLVANIA				
Curwensville	14.4	9.9	41.1	7
Erie	28.4	35.1	53.6	65
Pittsburgh	30.2	14.7	36.3	65
WEST VIRGINIA				
Elkins	33.8	20.5	36.6	51
Huntington	19.4	.4	19.1	9
Parkersburg	34.4	15.9	29.1	62
Petersburg	8.3	3.0	15.6	5

The storm of November 1950 has been compared to the storm of November 9 and 10, 1913. (The latter storm has been discussed by Mook [4].) The 1913 storm exceeded the 1950 storm in damage to Great Lakes shipping. Whereas the 1950 storm caused negligible damage to Lakes ships, the 1913 storm took 200 lives on Lake Huron and caused nearly $2,000,000 damage to Lakes ships [5]. In most sections the amount of snow in the 1950 storm exceeded the amounts in the 1913 storm [6].

The heavy snow of the 1950 storm, remaining on the ground approximately a week, was melted during the first 4 days of December by above-normal temperatures. Moderate flooding resulted in the Ohio River and tributaries. At Pittsburgh, the river stage reached 28.5 feet on December 4, 4½ feet above flood stage, and at Cincinnati, 56 feet on December 11, 4 feet above flood stage.

More complete data from the November 1950 storm are published elsewhere by the Weather Bureau [7]. The problem which the storm presented to the forecaster is discussed by Bristor [8].

REFERENCES

1. H. B. Wobus and L. C. Norton, "Some Synoptic Aspects of a Change in Weather Regime during February 1950", *Monthly Weather Review,* vol. 78, No. 2, February 1950, p. 31–40.
2. J. Vederman, "Changes in Vertical Mass Distribution over Rapidly Deepening Lows", *Bulletin of the American Meteorological Society,* vol. 30, No. 9, November 1949, p. 303–309.
3. U. S. Weather Bureau, *Weekly Weather and Crop Bulletin, National Summary,* for week ending November 28, 1950, vol. 37, No. 48.
4. C. P. Mook, "The Famous Storm of November, 1913", *Weatherwise,* vol. 2, No. 6, December 1949, pp. 126–128.
5. J. H. Armington, "Climatological Data for November, 1913, District No. 4, The Lake Region", *Monthly Weather Review,* vol. 41, No. 11, November 1913, p. 1678–1680.
6. F. J. Walz, "Climatological Data for November, 1913, District No. 3, Ohio Valley", *Monthly Weather Review,* vol. 41, No. 11, November 1913, p. 1666.
7. U. S. Weather Bureau, *Climatological Data, National Summary,* vol. 1, No. 11, November 1950.
8. C. L. Bristor, "The Great Storm of November 1950", *Weatherwise* (in press).

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